



Souvenir-Cum-Compendium
of Abstracts for

1st International Conference

Future Strategies for Sustainable
Agriculture and Technology Impact on
Human Health and Environment (FSATIHE-2024)

March 1-3, 2024

*Editors- Dr. Rajan Kamboj
Co- editor- Dr. D R Thakur,
Kunal Narwal and Sunil Kumar*

Organized by Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh-175028, in association with Society for the Advancement of Agricultural, Horticultural and Allied Science, Kurukshetra, Haryana-136118



+91-8006511800
+91-8006521800
+91-8006531800



saahasconference@gmail.com,
publicationsaahas@gmail.com

www.abhilashiuniversity.ac.in
www.saahas.info

Publish by stella internationa publication

Copyright © 2024, *Stella International Publication* TM

All rights reserved. Neither this book/souvenir nor any part may be reproduced or used in any form or by any means, electronic or mechanical, including photocopying, microfilming, recording or information storage and retrieval system, without the written permission of the publisher and author.

Edition: 1st

Publication Year: 2024

ISBN: 978-81-969866-6-7

ISBN 978-81-969866-6-7



Published by:

Stella International Publication

1781-3, U.E., Kurukshetra

Haryana 136118 (India)

Email: stellapublication07@gmail.com

Website: www.stellainternationalpublication.com



Dr. R.K. Abhilashi

Chancellor

Abhilashi University



Dear Esteemed Guests, Participants and Scholars

It is with great pleasure and immense pride that I extend my warmest greetings to all of you on behalf of Abhilashi University. As we gather here for the inaugural "1st International Conference Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024)," it marks a significant milestone in our journey towards academic excellence and societal advancement.

At Abhilashi University, we firmly believe that the true essence of education lies in nurturing the holistic development of every learner. Our mission is not merely to impart knowledge but to foster the mental, spiritual and ethical growth of our students. With the blessings of Nirankar, we have embarked on a relentless pursuit of excellence in the field of education.

The School of Agriculture at Abhilashi University, situated in the serene surroundings of Chail Chowk, Mandi (H.P.), stands as a beacon of academic rigor and innovation. Equipped with state-of-the-art facilities, cutting-edge pedagogical techniques and a dynamic curriculum, our university endeavors to empower our students to become skilled and responsible professionals, capable of addressing the challenges of the modern world.

I extend my heartfelt congratulations to the honorable Vice Chancellor, President and Secretary of the Society for the Advancement of Agricultural, Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana, as well as the members of the organizing committee, faculty and students, for their tireless efforts in organizing this prestigious conference.

As we embark on this intellectual journey together, I am confident that the deliberations and insights shared during this conference will prove to be invaluable to farmers, academicians, scholars and policymakers in the field of agriculture. May this gathering be a fertile ground for collaboration, innovation and transformative ideas that will shape the future of sustainable agriculture and its impact on human health and the environment.

I extend my best wishes for the success of the conference and look forward to the fruitful exchange of knowledge and ideas.

Warm regards,

Dr. R.K. Abhilashi

Chancellor

Abhilashi University

Dr. L.K. Abhilashi
Pro Chancellor
Abhilashi University



Dear Esteemed Guests, Faculty and Students

It is with immense pleasure and a sense of deep commitment that I extend my warmest greetings to each one of you on behalf of Abhilashi University. As we gather here for the auspicious occasion of the "1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024)," it is a moment of great significance in our journey towards academic excellence and societal welfare.

In today's ever-evolving world, educational institutions bear the responsibility of not only nurturing intellectual and technical skills but also fostering a culture of responsibility and citizenship among students. At Abhilashi University, we are steadfast in our commitment to providing a platform for innovative ideas and nurturing an environment where students can emerge not only as proficient professionals but also as compassionate and conscientious citizens.

Our vision is to empower our students to become agents of positive change, dedicated to the upliftment of mankind and the betterment of society. We are dedicated to excellence in teaching and research, striving to match the best standards in the country. To achieve this noble goal, we are committed to channeling more resources and creating conducive atmospheres for our faculty, staff and students to realize their full potential.

At Abhilashi University, we embrace a multi-stakeholder approach, wherein students, parents, farmers, teachers, staff members and alumni all play a pivotal role in shaping the future of higher education. Together, we envision a harmonious and progressive environment where learning flourishes and all stakeholders thrive.

I extend my heartfelt gratitude to the honorable Vice Chancellor for their invaluable guidance and support, as well as to the dedicated team of the School of Agriculture and the Society for the Advancement of Agricultural, Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana, for their contributions towards organizing this grand conference.

As we embark on this journey of knowledge and collaboration, I invite each one of you to join us in making Abhilashi University a beacon of learning, innovation and social responsibility. Together, let us strive to promote a healthy and harmonious atmosphere on our campus and beyond.

I extend my best wishes for the success of the conference and look forward to the fruitful exchange of ideas and insights.

Warm regards,

Dr. L.K. Abhilashi
Pro Chancellor
Abhilashi University

Dr. Vijay Paul Sharma



Chairman, Commission for Agricultural Costs and Prices (CACP)
Ministry of Agriculture and Farmers Welfare, Government of India



Dear Esteemed Colleagues and Participants,

It is with great pleasure and a sense of honor that I extend my warmest greetings to all of you. As we gather here for the momentous occasion of the 1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024), organized by the School of Agriculture, Abhilashi University, in collaboration with the Society for the Advancement of Agricultural, Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana, I am filled with optimism for the future of agriculture and environmental conservation.

I would like to express my heartfelt gratitude to Dr. D.R. Thakur, Dean of the School of Agriculture, for his unwavering dedication and tireless efforts in organizing this conference. His leadership and commitment to the advancement of agricultural sciences are truly commendable.

I also extend my sincere thanks to Dr. Rajan Kamboj, President of SAAHAS, whose visionary leadership has been instrumental in bringing together researchers, scientists and policymakers from around the world to discuss pressing issues in agriculture and environmental sustainability. His passion and dedication to the cause are an inspiration to us all.

I would also like to extend my gratitude to the honorable Chancellor, Dr. R.K. Abhilashi ji, Pro Chancellor L.K. Abhilashi ji, Prof. H.S. Banyal ji and respected Registrar Dr. Kapil Kapoor ji, for their invaluable support and guidance in making this conference a reality. Their vision and commitment to education and research are truly commendable.

To all the chairpersons, members of various committees, faculty, staff and students involved in organizing and participating in this conference, I offer my sincere appreciation for your hard work and dedication. Your contributions are vital to the success of this event.

As we embark on this journey of knowledge-sharing and collaboration, I am confident that the discussions and insights gained during this conference will pave the way for sustainable solutions in agriculture and environmental conservation.

Warm regards,

Dr. Vijay Paul Sharma

Chairman, Commission for Agricultural Costs and Prices (CACP)
Ministry of Agriculture and Farmers Welfare, Government of India

Prof. H.S. Banyal
Vice Chancellor
Abhilashi University



Dear Esteemed Guests, Researchers and Participants,

With the blessings of the almighty, we embark on a journey that harks back 12,000 years, to the dawn of agriculture. It is a journey that began in the face of adversity, as our ancestors, faced with drought and dwindling resources, turned to cultivating their own sustenance. The story of agriculture is one of resilience, ingenuity and continuous adaptation—a testament to humanity's ability to thrive in the face of challenges.

Today, as we stand at the crossroads of progress and sustainability, the importance of agriculture cannot be overstated. It is both a source of livelihood for millions and a custodian of our planet's health. However, the path to sustainable agriculture is fraught with obstacles, from inadequate policies to the misuse of resources. It is imperative that we heed the call of the Sustainable Development Goals, working towards a future where poverty and inequality are eradicated, the environment is protected and all people enjoy health, justice and prosperity.

In this spirit, the School of Agriculture, in collaboration with the Society for the Advancement of Agricultural, Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana, is proud to organize the 1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024) from March 1st to 3rd, 2024. This conference serves as a platform for scholars, researchers and practitioners from around the world to share insights, exchange ideas and collaborate towards a more sustainable future.

I am confident that the deliberations and discussions that ensue during this conference will pave the way for transformative advancements in the field of sustainable agriculture. The insights gleaned from scientific research will undoubtedly benefit humanity, offering solutions to the challenges that lie ahead.

I extend my heartfelt appreciation to the Dean of the School of Agriculture, Dr. D.R. Thakur, President Dr. Rajan Kamboj, Secretary Kunal, the organizing committee, faculty, staff members and students for their commendable efforts in bringing this conference to fruition. Your dedication and hard work are truly commendable.

As we embark on this collective endeavor, I offer my best wishes for the success of the conference. May it be a beacon of knowledge, innovation and collaboration, guiding us towards a more sustainable and prosperous future.

Warm regards,

Prof. H.S. Banyal
Vice Chancellor
Abhilashi University

Dr Hari C Sharma FNAAS, FESA, FESI



Former: Vice Chancellor – YS Parmar University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh, India.



Principal Scientist, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Telangana, India.



Message

It is heartening to note that the Abhilashi University is organizing the “**1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment**”, under the auspices of Society for the Advancement of Agricultural and Horticultural and Allied Science, between 1 - 3 March 2024, to address the major issues concerning food security, malnutrition and the environment.

Agriculture growth is the key for sustainable development to reduce poverty by raising farm incomes. There is an urgent need to promote precision agriculture based on modern techniques of crop production encompassing biotechnology, nanotechnology and information technology for a sustainable increase in crop productivity and conservation of the environment. The green, white and blue revolutions are the key to promote economic growth and reduce poverty.

However, equally important is the need to link the future strategies with their impact on environment. The major challenge before us is to identify ways to enhance crop productivity while reducing their impact on the environment. The future strategies require a major emphasis on climate change impacts and adoption of sustainable farming systems to enhance farm incomes.

I take this opportunity to congratulate organizers for a timely initiative to discuss the important issues concerning food and nutritional security, and conservation of the environment, and I wish you a great success in organizing this conference.

Hari C Sharma

Honorary Fellow, ICRISAT, Patancheru 502324, Telangana, India

Adjunct Professor, IARI, 110,012, New Delhi

Address for Correspondence: MVC 236, Silverbirch, Pocket 5, Omaxe New Chandigarh 140901, Mohali, Punjab, India. Email: hchsh19@gmail.com. Cell: 7807803661.

Dr. H.K. Chaudhary
Former Vice-Chancellor
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya,
Palampur, Himachal Pradesh



Dear Esteemed Participants and Colleagues,

I am delighted to learn that Abhilashi University, Chail Chowk, is hosting a three-day International Conference on 'Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024) in collaboration with the Society for the Advancement of Agricultural, Horticultural, and Allied Science (SAAHAS), Kurukshetra, Haryana.

Sustainable Agriculture plays a pivotal role in feeding the growing population and mitigating climate change. The challenge lies in increasing food production while urban areas expand into agricultural land. To ensure agricultural sustainability, we must safeguard, maintain, and enhance the fertility of our receding agricultural lands.

The indiscriminate use of chemical pesticides and fertilizers contributes to air and water pollution, posing hazards to human health and the environment. Practices like reducing the use of pesticides, crop diversification, and maintaining pasture land are vital for sustainable agriculture.

Recognizing agriculture's crucial role in ensuring food security and nutrition, it's imperative to stay updated on technological advancements in the field. Integrating scientific interventions with technological innovations can significantly impact human health and the environment positively.

The chosen conference topics promise to enhance participants' scientific knowledge, fostering discussions on pressing issues. My appreciation and congratulations to Abhilashi University and SAAHAS for organizing this essential event, benefiting scientists, researchers, scholars, farmers, and stakeholders.

Prof. Harinder K. Chaudhary
Former Vice-Chancellor
CSK HP Agricultural University Palampur

Dr. D.R. Thakur

Chief Convener

Dean, School of Agriculture

Abhilashi University



It is my pleasure to extend warm welcome and invite you all on “1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024)” to be held on 1st to 3rd March, 2024 organized by School of Agriculture, Abhilashi University with the association of Society for the Advancement of Agricultural Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana. After Independence with the Introduction of high yielding Varieties and the improved quality of fertilizer and irrigation techniques led to the increase in the production to make the country Self-Sufficient in food grains, The Problem of Poverty, hunger/ malnutrition, health and environment still persists in India and the real income of the farmer has declined. It needs sustainable agriculture for conserving the environment and preventing pollution for human health. So, it is timely remedy to reconnoiter many Concealed Concepts and share with the looming scholars and researchers for the amelioration of the humanity. There is unquestionably an exigency to understand to the existing Problems in Agricultural Sustainable and Technology. Their impact on Human Health and environment.

The invited illustrious Talented and guest speakers are well known in their forte and consented to Join this event off and online mode from different parts of the globe. I extend my distinctive thanks to our Hon’ble Chancellor, Dr.R.K Abhilashi, Pro- Chancellor, Dr. L.K Abhilashi, Vice- Chancellor, Prof H.S Banyal and Respected Registrar, Dr. Kapil Kapoor and President, SAAHAS Society, Dr. Rajan Kamboj for their valuable suggestions, vision, mission and guidance in the stage of conference. I am thankful to chairpersons, members of different committees, staff and students for their energetic collaboration. I hope deliberation of this conference will help the policy makers and scholars in comprehension and magnify the cognition of the theme. I and on behalf of my institute, I am thankful to all those, who have ahead to assist us and organize this conference.

Prof D.R Thakur

Dr. Kapil Kapoor
Registrar
Abhilashi University



Dear Participants, Researchers and Esteemed Guests

Indian agriculture, the backbone of our nation's economy and the livelihood for a significant portion of our population, stands at a crucial juncture. It is beset by a multitude of challenges that threaten its sustainability and growth. As we convene for the 1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024) from March 1st to 3rd, 2024, at Abhilashi University, the School of Agriculture, in collaboration with the Society for the Advancement of Agricultural, Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana, aims to delve deep into these challenges and chart a course towards sustainable solutions.

The theme of this conference is not merely a reflection of the current state of Indian agriculture but also a testament to our commitment to address the pressing issues facing our agricultural sector. Over the course of three days, we will engage in insightful discussions, exploring the underlying causes of these challenges and identifying potential solutions that align with the principles of sustainability and environmental stewardship.

I am confident that the deliberations and discussions that ensue during this conference will serve as a catalyst for positive change. By enlightening our students and participants, we pave the way for informed decision-making and transformative action in the field of agriculture.

I extend my heartfelt congratulations and best wishes to the Dean of the School of Agriculture, the President and Secretary of SAAHAS, the members of the organizing committee, faculty, staff members and students involved in making this conference a reality. Your dedication and hard work are commendable and I am certain that your efforts will bear fruit in advancing the cause of sustainable agriculture.

As we embark on this journey of knowledge-sharing and collaboration, I am optimistic that this conference will not only be successful but also contribute significantly to the welfare of our farmers, academicians, scholars and researchers in the field of agriculture.

Warm regards,

Dr. Kapil Kapoor
Registrar
Abhilashi University

Dr. Rajan Kamboj
Assistant Professor cum President (SAAHAS),
Department of Entomology, School of Agriculture, Abhilashi University



Dear Colleagues, Researchers and Esteemed Guests,

It is with great pleasure and a profound sense of purpose that I extend my warmest greetings to all of you. The Society for the Advancement of Agricultural, Horticultural and Allied Science (SAAHAS), Kurukshetra, Haryana, has long been dedicated to advancing scientific and educational endeavors in agriculture, environmental stewardship and the welfare of farmers. As the elected President of SAAHAS, it has been my heartfelt desire to spearhead an international-level event that would benefit farmers, scientists, academicians, researchers and policymakers alike.

With the unwavering support and collaboration of Abhilashi University, Chail Chowk, Mandi (H.P.), this vision has come to fruition in the form of the upcoming 1st International Conference on Future Strategies for Sustainable Agriculture and Technology Impact on Human Health and Environment (FSATIHE-2024), scheduled from March 1st to 3rd, 2024. This conference promises to be a unique platform for scientists and researchers from across the globe to convene, exchange ideas and explore various aspects of sustainable agriculture and environmental conservation.

I am deeply grateful to Dr. Kunal Narwal, Secretary, Dr. Sunil Kumar, Treasurer of SAAHAS and all the enthusiastic members who have tirelessly contributed to realizing this mission. Their dedication and commitment have been instrumental in bringing this conference to fruition.

I extend my heartfelt thanks to the honorable Chancellor, Dr. R.K. Abhilashi ji, Pro Chancellor L.K. Abhilashi ji, Prof. H.S. Banyal ji and respected Registrar Dr. Kapil Kapoor ji, for their invaluable support and relevant suggestions. I also extend my gratitude to Dr. D.R Thakur, Dean of the School of Agriculture, for his guidance and cooperation throughout this endeavor.

I would be remiss if I did not acknowledge the contributions of the chairpersons, members of various committees, staff and students, whose active cooperation has been pivotal in making this conference a reality.

I am confident that the exchange of knowledge and expertise during the conference will have a lasting impact on all participants and society at large. Together, let us strive towards a future where sustainable agriculture and environmental conservation are not just ideals but tangible realities.

Warm regards,

Dr. Rajan Kamboj
Assistant Professor, School of Agriculture
Abhilashi University

ORGANIZING COMMITTEE

CHIEF PATRON



Dr. R.K. Abhilashi

Chairman's / Chancellor's
Abhilashi Group of Institutions/Abhilashi University

CO-CHIEF PATRON



Dr. L.K. Abhilashi

Managing Director / Pro-Chancellor's
Abhilashi Group of Institutions/
Abhilashi University

PATRON



Dr. V.P. Sharma

Chairman
Commission for Agricultural Costs and Prices (CACP),
Ministry of Agriculture and Farmers Welfare, Government of India



Dr. H.S. Banyal

Vice-Chancellor
Abhilashi University, Chail Chowk,
Mandi, Himachal Pradesh



Dr. H.C. Sharma

Ex Vice-Chancellor
Dr. YS Parmar University of Horticulture and Forestry, Nauni,
Solun, Himachal Pradesh



Dr. H.K. Chaudhary

Ex Vice-Chancellor
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya,
Palampur, Himachal Pradesh

Chief Convener



Dr. D.R. Thakur

Ex-Pr. Scientist (Agriculture Economics) CSK HPKV / **Dean**,
Agriculture, Abhilashi University, Mandi



Dr. Kapil Kapoor

Registrar
Abhilashi University, Mandi, Himachal Pradesh



Dr. Rajan Kamboj

President, SAAHAS Society, Kurukshetra,
Assistant Professor, Entomology, Mandi,
Abhilashi University

Co-Chief Convener

- **Dr. Narbada Devi**, Chairperson, Genius Education Society (GES), Ner Chowk, Mandi, Himachal Pradesh
- **Dr. Promila Abhilashi**, Vice-Chairperson, Abhilashi Education Society (AES), Chail Chowk, Mandi, Himachal Pradesh
- **Dr. Aakash Kamboj**, BAMS, Physician, M.D., Shree Shyam Hospital, Rohtak & Founder Member, SAAHAS Society, Kurukshetra
- **Dr. Ravinder Kumar**, Assistant Professor, Department of Soil Science, Abhilashi University, Member, SAAHAS Society, Kurukshetra
- **Dr. Priyanka Narwal**, Assistant Professor, Jaat Educational College, Rohtak, Founder, Member, SAAHAS Society, Kurukshetra

International Advisory Board

- **Dr. H.C. Sharma**, Former Principal Scientist - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Telangana & Former Vice-Chancellor, Dr YS Parmar University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh
- **Dr. Uttam**, Senior Scientist, CIMMYT-Borlaug Institute for South Asia, BISA, Ludhiana
- **Dr. Navtej Singh Bains**, Director Research, Punjab Agricultural University, Ludhiana & Senior Scientist, Borlaug Institute for South Asia, BISA, Ludhiana
- **Dr. Abhishek Singh** Senior Researcher (Scientist) Faculty of Biology, Yerevan State University Armenia
- **Dr. Dinesh Kumar Saini**, Post-Doctoral Research Associate Texas Tech University, Department of Plant & Soil Science
- **Dr. Shanta**, Ex. Assistant Professor, Dilla University, Ethiopia & Associate Professor, Department of Economics, ACECM, Eternal University, Baru Sahib, Himachal Pradesh
- **Mrs. Ankita Datta**, Research Assistant, School of Natural Resources and Environment, IFAS | University of Florida, Gainesville
- **Mr. Ayush Kachrulal Sharma**, Research Assistant, Soil, Water, and Ecosystem Sciences Department, IFAS | University of Florida, Gainesville, Florida, USA
- **Ms. Ankita Datta**, Research Assistant, School of Natural Resources and Environment, IFAS | University of Florida, Gainesville

ORGANIZING COMMITTEE

National Advisory Board

- **Dr. Rajbir Singh, Assistant Director General** (Agronomy, Agroforestry & Climate Change), NRM Division of ICAR, Pusa, New Delhi
- **Dr. P.D. Sharma, Former Assistant Director General**, (Soil Science) ICAR, Pusa, New Delhi
- **Dr. D.K. Vatsa**, Head, Department of Agricultural Engineering & **Vice-Chancellor**, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Kartar Singh Verma**, Former Director Research & Dean, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh & **Former Vice Chancellor**, Carrier Point, Hamirpur
- **Dr. J.K. Sharma**, Former Principal Scientist cum Head, Department of seed Science & **Vice-Chancellor**, Baddi University of Emerging Science and Technology, Baddi, Himachal Pradesh
- **Dr. Ravinder Sharma**, Former Director Research, **Former Vice-Chancellor**, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh
- **Dr. Ashok Kumar**, Former Professor and Head, Department of Agricultural Economics, Extension Education and Rural Sociology, COA, CSK HPKV, Palampur & **Former Vice-Chancellor**, Apex Professional University, Arunachal Pradesh
- **Dr. Hemant Dadhich**, Director Research, Dean, College of Dairy Science and Technology & **Pro-Vice Chancellor**, Rajasthan University of Veterinary Science, Bikaner
- **Dr. R.K. Sharma**, Former Dean, P.G. cum **Registrar**, CSK HPKV, Palampur
- **Dr. Chander Parkash**, Head, IARI, Regional Research Station, Katrain, Kullu, Himachal Pradesh
- **Dr. Satish Chander Sharma**, Former Director Research & Former Dean, COA, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. R.P. Kaushik**, Former Dean & Former Director Research, Incharge of Rice and Wheat Research Station, Malan, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Ses Ram Thakur**, Director Research, Biotechnology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. S.K. Upadhya**, Director Research & Head, Department of Horticulture, Director Research, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. R.P. Narwal**, Former Director Research, CCS Haryana Agricultural University, Hisar, Haryana
- **Dr. D.S. Mehla**, Former Regional Director, Regional Research Station, CCS HAU, Uchaani, Karnal
- **Dr. Dalel Singh**, Ex. Director Rice Research Station CCS HAU, Kaul, Kaithal
- **Dr. S.S. Yadav**, Assistant Director (Plant Protection), Directorate of Research, CCS Haryana Agricultural University, Hisar, Haryana
- **Dr. Vinod Kumar Sharma**, Associate Director, CSK HPKV, Regional Research Station, Bajaura, Kullu, Himachal Pradesh
- **Dr. S.K. Upadhya**, Director Research, Head, Department of Horticulture, CSKHPKV, Palampur
- **Dr. B.S. Deor**, Former Associate Director, Regional Research Station, Bajaura, Kullu, CSK HPKV, Palampur
- **Dr. S.P. Sharma**, Former Director Research, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. R.C. Thakur**, Former Director Research, CSK HPKV, Palampur & Former Dean, School of Agriculture, Abhilashi University, Chail Chowk, Mandi
- **Dr. R.K. Singh**, Former Professor & Dean, College of Veterinary and Animal Science, Bikaner
- **Dr. S.P. Sharma**, Former Director Research, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. R.S. Prashar**, Former Dean, College of Neri, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan
- **Dr. R.S. Parsher**, Former Dean, College of Neri, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh
- **Dr. Pankaj Sood**, Principal Extension Specialist cum KVK InCharge, CSK HPKV, KVK, Sunder Nagar, Himachal Pradesh
- **Dr. Shakuntla Rahi**, Principal Extension Specialist, Department of Vegetable Science, CSK HPKV, KVK, Sunder Nagar, Himachal Pradesh
- **Dr. Maha Singh Jaglan**, Coordinator, Krishi Vigyan Kendra, CCS Haryana Agricultural University, Uchani, Karnal
- **Dr. Chander Kanta**, Programme Coordinator, CSK HPKV, KVK, Bajaura, Kullu, Himachal Pradesh
- **Dr. R.S. Choudhary**, Senior Scientist & Head, Krishi Vigyan Kendra, Sirohi, (Agriculture University, Jodhpur), Rajasthan
- **Dr. B.S. Thakur**, Principal Extension Specialist, Regional Horticultural Research and Training Station, Bajaura, Kullu (HP) Associate Director, Regional Research Station, Bajaura
- **Dr. H.R. Meena**, Head & Professor, Division of Extension Education, ICAR, IVRI, Izatnagar
- **Dr. R.S. Chandel**, SWO & Head, Department of Entomology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. T.S. Chahal**, Former Dean, Agriculture Guru Nanak Dev University (GNDU), Amritsar & Member InCharge, CKD Institute of Management and Technology, Amritsar, Punjab
- **Dr. Naveen Thakur**, Professor cum Head, Department of Agronomy and Director Extension, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Sunita Yadav**, Professor cum Head, Department of Entomology, CCS Haryana Agricultural University, Hisar, Haryana
- **Dr. Y.S. Paul**, Former Head, Department of Pathology, Former Dean, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. N.K. Sankhyan**, Professor cum Head, Department of Soil Science, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. D.K. Banyal**, Professor cum Head, Department of Pathology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Kapila**, Professor cum Head, Department of Seed Science, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Parkash Mehta**, Professor & Head, Department of Agricultural Economics, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Tek Chand Bhalla**, Former Head of Biosciences, Former Dean, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Surender Kumar**, Principal Scientist, InCharge, Bee Research Station, Nagrota Bagwan, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Anoop Kumar Katoch**, Professor cum Head, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. K.R. Dabur**, Professor & Head, Department of Nematology, Former Dean, SGT University, Gurugram

ORGANIZING COMMITTEE

- **Dr. J.P. Saini**, Former Head, Department of Organic Farming, CSK HPKV, Palampur
- **Dr. Joginder Sharma**, Former Head, Department of Entomology, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh
- **Dr. S.K. Chauhan**, Former Head, Department of Agricultural Economics, Extension Education and Rural Sociology, COA, CSK HPKV, Palampur, Dean, Social Science, Eternal University, Sirmaur, Himachal Pradesh
- **Dr. Ajay Kumar Sood**, Professor, Department of Entomology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Virender Kumar**, Principal Scientist, Head, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. S.K. Rana**, Principal Scientist, Department of Agronomy, CSK HPKV, Palampur
- **Dr. B.S. Chandel**, Principal Scientist, Dairy Engineering, NDRI, Karnal
- **Dr. Dharam Pal Singh**, Subject Matter Specialist, Centre for Subtropical Fruits (Indo-Israel Centre of Excellence), Department of Horticulture, Kurukshetra, Haryana
- **Dr. Shivendu Pratap Singh Solanki**, Subject Matter Specialist, Centre for Subtropical Fruits (Indo-Israel Centre of Excellence), Department of Horticulture, Kurukshetra, Haryana
- **Dr. Surender Kumar**, Principal Scientist, CSK HPKV, Regional Research Station, Bajaura
- **Dr. Brij Bala**, Professor, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. S.S. Rana**, Principal Scientist, Department of Agronomy, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Shivali Sharma**, Senior Specialist-PGR & Pre-breeding at the Global Crop Diversity Trust, ICRISAT, Hyderabad
- **Dr. G.D. Sharma**, Principal Scientist, Department of Agronomy, CSK HPKV, Palampur
- **Dr. S.S. Masand**, Former Professor, Department of Soil Science, CSK HPKV, Palampur & Former Dean, School of Agriculture, Abhilashi University, Chail Chowk, Mandi
- **Dr. S.K. Sharma**, Former Professor, Department of Vegetable Science, CSK HPKV Palampur & Dean, Agriculture, Eternal University, Sirmaur, Himachal Pradesh
- **Dr. Gopal Krishan Kumar**, Former Professor, Department of Forestry, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan
- **Dr. Y.S. Negi**, Former Professor cum HOD, M.B.A., Dr. Y.S. Parmar UHF, Solan, Dean, Shoolini University
- **Dr. Sandeep Manuja**, Professor, Department of Agrometeorology, CSK HPKV, Palampur
- **Dr. B. Savita**, Professor, Agricultural Extension, College of Agriculture, Rajinder Nagar, Hyderabad
- **Dr. D.K. Parmar**, Former Principal Scientist, CSK HPKV, Regional Research Station, Bajaura
- **Dr. K. Bhanu Rekha**, Professor, Department of Agronomy, Agricultural College Adilabad. Professor Jayashankar Telangana State Agricultural University, Hyderabad
- **Dr. B. Savitha**, Professor, Department of Agricultural Extension, College of Agriculture Rajendranagar Hyderabad
- **Dr. Rakesh Thakur**, Professor, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Harbans Lal**, Principal Scientist, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. M.S. Pathania**, Principal Scientist, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. K.D. Sharma**, Former Principal Scientist, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, Palampur, Himachal Pradesh
- **Dr. Sanwal Singh Meena**, Associate Professor, Principal Investigator (FIM Project) & Head Dept. of Farm Machinery and Power Engg., College of Technology & Engineering, Maharana Pratap University of Agriculture & Technology, Udaipur
- **Dr. Saurabh Sharma**, Associate Professor, Nagaland University, School of Agricultural Science, Nagaland
- **Dr. Karan Singh**, Associate Professor, Indira Gandhi University, Meerpur, Rewari, Haryana
- **Dr. Sanwal Singh Meena**, Associate Professor and Head, Department of FMPE, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan
- **Dr. Keshav Ram Sharma**, Associate Professor, Department of Economics CSK HPKV, Palampur, Himachal Pradesh & Senior Manager in UCO Bank

Local Advisory Board

1. **Dr. Vivek Vyas**, Nodal Officer, Swami Keshwanand Rajasthan Agricultural University (SKRAU), Bikaner
2. **Dr. Vijay Prakash Arya**, Zonal Director Research, Dean, Principal Scientist, College of Agriculture, Sri GangaNagar
3. **Dr. D.K. Mishra**, Dean, BAMS, Abhilashi University, Chail Chowk, Mandi
4. **Dr. D.P. Dhaiya**, Dean, Pharmacy, Abhilashi University, Chail Chowk, Mandi
5. **Dr. Vivek Chauhan**, Director Research, Abhilashi University, Chail Chowk, Mandi
6. **Prof. Devender Sharma**, Dean Students Welfare, Abhilashi University, Chail Chowk, Mandi
7. **Dr. Shampy Duggal Director**, Admission & Placement, Abhilashi University, Chail Chowk, Mandi
8. **Dr. Farhan**, Assistant Professor, Department of Food Technology, Community Science, CSKHPKV, Palampur
9. **Dr. Ankaj**, Assistant Professor, GC Negi college of Veterinary and Animal Sciences, CSKHPKV, Palampur
10. **Dr. Brij Vanita**, Subject Matter Specialist (Veterinary & Animal Husbandry Science), Krishi Vigyan Kendra, CSK HPKV Mandi
11. **Dr. Sandeep Kumar**, Assistant Professor, Department of Horticulture (Vegetable Science), Abhilashi University
12. **Dr. Naveen Kamboj**, Assistant Professor, Regional Research Station, CCS Haryana Agricultural University, Karnal
13. **Dr. Mandeep Rathee**, Training Assistant, Krishi Vigyan Kendra, Kaithal, CCS Haryana Agricultural University, Hisar, Haryana
14. **Dr. Pankaj Bodla**, Department of Plant Pathology, Maharana Pratap Horticultural University, Karnal, Haryana
15. **Dr. Vinod Kumar**, Department of Vegetable Science, Maharana Pratap Horticultural University, Karnal, Haryana
16. **Dr. Gaurav Singh**, Department of Entomology, Maharana Pratap Horticultural University, Karnal, Haryana

ORGANIZING COMMITTEE

Organising Convener

- **Dr. Bheeru Lal Kumar**, Professor in Agronomy department, Agriculture University Jodhpur, Rajasthan
- **Prof. Pundlik K Waghmare**, Assistant Professor, Vasantnao Naik Marathwada Krishi Vidyapeeth, General Secretary of Agronomy Society, Maharashtra
- **Dr. C.P. Doshi**, Retd. Professor (Dept. Of Farm Power & Machinery) Maharana Pratap University of Agricultural and Technology, Udaipur, Rajasthan
- **Dr. Mayur Kumar Meshram**, Department of Agronomy SMS, ICAR-CICR, Krishi Vigyan Kendra, Nagpur
- **Dr. G.D. Sahu**, Associate Professor and Principal Investigator PFDC, IGKV Raipur Chhattisgarh
- **Dr. Dharam Pal Singh**, SMS, Centre for Subtropical Fruits (Indo-Israel Centre of Excellence), Department of Horticulture, Kurukshetra, Hr.
- **Dr. Shivendu Pratap Singh Solanki**, SMS, Centre for Subtropical Fruits (Indo-Israel Centre of Excellence), Department of Horticulture, Kurukshetra, Haryana
- **Dr. Arun Alfred David**, Associate Professor, (Department of Soil Science and Agricultural chemistry) NAI, SHHUATS, Prayagraj, U.P
- **Dr. Abhilasa A LaL**, Associate Professor Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, U.P.
- **Dr. A.M. Nadaf**, Associate Professor, Head, Department of Entomology Kittur Rani Channamma, College of Horticulture, Karnataka
- **Dr. Sunil Kumar Dadhich**, Associate Professor, SKN Agriculture University (SKNAU), Jobner

Organising Secretaries

- **Dr. Sharanabasappa Deshmukh**, Associate Professor, Department of Entomology, University of Agricultural and Horticultural Sciences, Shivamoga, Karnataka
- **Dr. Ram Bharose**, Associate Professor, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, U.P. (SHUATS)
- **Dr. Prakash Chand Ghasal**, Assistant Scientist (ARS), Agronomy, Indian Institute of Farming Systems Research (IIFSR), Modipuram, Meerut U.P.
- **Dr Dileepkumar Masuthi**, HOD, BCI, Department KRCCH, Arabhavi (UHS Bagalkot)
- **Dr. Sanjay Arora**, Assistant Scientist (Soil Science), I.A.R.I., New Delhi
- **Dr. Ravinder Kumar**, Department of Soil Science, School of Agriculture, Assistant Professor, Abhilashi University
- **Dr. Sandeep Kumar**, Assistant Professor, Department of Horticulture (Vegetable Science), Abhilashi University
- **Dr. Rashid Khan**, Assistant Scientist (Horticulture) Swami Keshwanand Rajasthan Agricultural University (SKRAU), Bikaner, Rajasthan
- **Dr. Ashok Kumar Meena**, Assistant Professor & Incharge AICRP on Groundnut, Rajasthan Agricultural Research Institute, Durgapura (SKNAU, Jobner) Jaipur
- **Dr. Neha Joshi**, Assistant Professor, (Faculty of Agriculture and Agroforestry), Kumaun University, Nainital
- **Dr. Geetika Bhatia**, Assistant Professor, Department of Plant Pathology, Mata Gujri College, Fatehgarh Sahib, Punjab

Co-Organising Secretaries

Invitation Committee

- Dr. Ravinder Kumar, AU
- Dr. Khub Ram Thakur, AU

Reception/Certificate Committee

- Mrs. Shivani Kaundal, AU
- Mrs. Aishwarya, AU

Registration Committee

- Dr. Aakash Kamboj, Founder Member, SAAHAS
- Dr. Manish Chauhan, AU
- Dr. Priyanka Kumari, AU
- Mrs. Aditi, AU
- Mrs. Tamana, Founder Member, SAAHAS
- Dr. Priyanka Narwal,
- Mr. Novil, Member, SAAHAS

Accommodation Committee

- Dr. D.R. Thakur, Dean, AU
- Mr. Khub Ram Thakur, AU
- Dr. Rajan Kamboj, AU

Meal and Refreshment Committee

- Dr. Jay Nath Patel, AU
- Dr. Aakash Kamboj, , Founder Member, SAAHAS
- Mr. Akshay, AU
- Mr. Kunal, Founder Member, SAAHAS

Technical Committee

- Dr. Anupam Kumar, AU
- Dr. Sandeep Kumar, AU
- Dr. Komal Sharma, AU
- Dr. Ritika Singh, AU
- Dr. Ankit Gill, Member, SAAHAS
- Dr. Anil Kumar, Member, SAAHAS
- Dr. Nirmal Singh, Member, SAAHAS
- Mrs. Bhushna, AU

Stall Management Committee

- Dr. Rajan Kamboj, AU
- Dr. Ravinder Kumar, AU
- Dr. Sunil Kumar, AU
- Mr. Karan Kamboj, Member, SAAHAS

Media Committee

- Dr. Alok Kumar, AU
- Dr. Mohd Shah Alam, AU
- Mr. Vasu Mehta, member, SAAHAS

Discipline Committee

- Dr. Jay Nath Patel, AU
- Dr. Ravi Sharma, AU
- Mr. Akshay, AU
- Mrs. Aishwarya, AU

Promotional committee

- (Eco Fast Agri Solution)
- Shivendra Pratap Rathore
- Anshul Gaur
- Pawan yadav
- Nidhi Kumari
- Raj Thakur
- Ankit Kumar Rai
- Vijendra Pratap Rathore

Hall Management Committee

(Decoration, Banner, Stage)

- Dr. Nandita Sharma, AU
- Dr. Komal Sharma, AU

Seating Arrangement Committee

- Mr. Yograj, AU
- Mr. Karan Kamboj, Member, SAAHAS
- Dr. Mohit Sharma, Member, SAAHAS

Saraswati Puja Committee

- Dr. Sonia Rani, AU
- Mrs. Shivani Kaundal, AU
- Mrs. Tamana, Founder Member, SAAHAS
- Mrs. Aditi, AU

Transport Committee

- Dr. Ravi Sharma, AU
- Mr. Vijay Sharma, AU
- Dr. Manish Kumar, Member, SAAHAS

Power Supply Committee

- Mr. Manoj Verma, AU
- Mr. Dimple, AU

Contents

Crop Diversification: A Catalyst for Income Generation in Agricultural Economies <i>Hanumantappa Jamanal¹ and Bheemanagouda²</i>	1
Dynamics of Cropping Pattern of Gird agro-climatic zone of Madhya Pradesh, India <i>¹Aditya Singh, ²Dr. Sarita Sharma and ³Dr. Poonam Chaturvedi</i>	1-2
Economic analysis of cost components of rice cultivation in major producing states in India <i>Sarita Sharma, Aditya Singh and R.M. Sahu</i>	2
Diversified cropping sequence's influence on yield, resource use efficiencies and carbon footprints <i>Pooja¹ and S.S Rana²</i>	2-3
Stepwise Regression Analysis on Paddy Production in Manipur <i>Soibam Loidang Devi</i>	3
Effect of Plant Growth Retardants on Production of Potato var. Kufri Jyoti <i>*Rajeev Kumar, Reena Kumari, Kumari Shiwani and Neha Thakur</i>	3-4
Edible Vaccine: A new technique for enhancing quality of vegetables <i>Heena¹* and Sandeep Kumar¹</i>	4
Estimation of Rice Production in Manipur <i>* Taibangjam Loidang Chanu¹, * Dr. S. Loidang Devi²</i>	4
Enhancing ecological sustainability: the role of agroforestry in environmental conservation <i>Garima, Yourmila Kumari, Manoj Kumar Thakur and Kashish Walia</i>	5
Effect of sowing dates and nutrient levels on physiological parameters of Finger millet varieties under <i>kandi</i> belt of Jammu region <i>¹Vijay Kumar, ²Vijay Bharti, ³Anil Kumar and ⁴Vikas Sharma</i>	5-6
Breeding Strategies for Climate Smart Crops <i>Hima bindu.P¹, Bsawaraj PS², K.Divya³</i>	6
Impact of climate change on agriculture <i>Punit Kumar¹, Dr. Jay Nath Patel² and Abhishek Sanspal¹</i>	6-7
Climate Change Resilience through Forest <i>Yourmila Kumari, Garima, Manoj Kumar Thakur and Kashish walia</i>	7
Enhancing Climate Resilience in Agriculture through National Innovations in Climate Resilient Agriculture (NICRA) project <i>Aparna Jayan R.¹* and Parvathi Sankar P²</i>	8
Problems and Prospects of Vegetable Production in Himachal Pradesh <i>Manjeet Singh*, Manish Chauhan, Sandeep Kumar, Shivani Kumari</i>	8-9
Climate Change: Impact of climate change on vegetable production <i>Latesh Narval*, Sandeep Kumar, Manish Chauhan, Ajay Kumar</i>	9
Arsenic metal tolerance potential of endophytic fungi isolated from plants of arsenic contaminated sites <i>Abhinandana, K. R¹*, Sowmya, N. R¹., Lohith Kumar, N¹. and Krishna Naik, L¹.</i>	10

Energy conservation agriculture: Role of Renewable Energy <i>Shivam Yadav¹, Prof (Dr.) Biswarup Mehra², Prateek Kumar³</i>	10-11
Sustainable Agriculture strategies against climate change: Its Recommendations <i>Dr. Puri M. G,¹ Dr. Kadam J. R.² Miss. Dahiphle T. P³</i>	11
Screening of rhizobacterial strains for drought stress tolerance under <i>in vitro</i> condition <i>Sowmya, N. R^{1*}, Abhinandana, K. R¹. Lohith Kumar, N¹. and Krishna Naik, L¹</i>	11-12
The Impact of Climate Change on Pulse Production and Productivity in India: An Analysis of Causes, Effects, and Mitigation Measures <i>Dr. Mohd Shah Alam¹, Dr. Jay Nath Patel¹, Dr. Anupam² and Yograj¹</i>	12
Climate Resilient Agri food System <i>Khushboo Shekhawat^{1*}, Ankita Singh², Kedar Mahadev Gheware³ and Vijay Kumar⁴</i>	13
Impact of drip fertigation on GHG emission and crop productivity of tomato <i>Keerthana Maveril M*, Manoj Khanna</i>	13-14
Assessment of Spring Water Quality: Towards Effective Water Resource Management <i>Vijeta Thakur¹ and Dr SK Bhardwaj²</i>	14
Potential evapotranspiration spatio-temporal trend analysis at different agro-climatic zones of Haryana, India <i>Rahul Punia^{a*}, Anurag^a, Pardeep Kumar^b</i>	15
Economic Resilience of Farm Households Towards Climate Change: A Scenario Analysis of Coastal Plains of Kerala <i>Pooja Krishna J¹, Jayalekshmi, G²</i>	15-16
Millet's cultivation: an approach towards climate resilient agriculture for North Western Himalayas <i>Reena Kumari, Rajeev Kumar, Shikha Bhagta and Kumari Shiwani</i>	16
Use of Mycorrhizal fungi as a Biofertilizer: Benefit from Past Success <i>*¹Shivani, ²Dr. Hem Chander and ³Dr. Ritika Singh</i>	17
Alkaline Protease Production from Agrowastes by Solid State Fermentation <i>Nity Sharma^{1*}, Harmanjit Kaur Goindi²</i>	17-18
ARIMA Model Forecasting of Area, Production, and Productivity of Total Rice in Jalpaiguri District of West Bengal <i>¹Nishtha Pradarshika Rai* and ²Satyananda Basak</i>	18
Constraints faced by farmers practicing natural farming in Himachal Pradesh <i>Komal Sharma¹, Manoj Gupta² and Nandita Sharma³</i>	18-19
Conservation agriculture for resource use management <i>M.P. Priyadharshini¹, S. Naveenkumar²</i>	19
Nurturing Sustainability: Exploring Seed Priming using Zinc Sulphate Nanoparticle for Enhancement of Growth and Antioxidant Status in <i>Solanum lycopersicum</i> L <i>Sheetal Chand*, Sandeep Arora, Rahul Anand, Himanshu Singh</i>	19-20
Effect of different levels of nitrogen on wheat crop <i>Simran¹, Dr. Mohd Shah Alam² and Rakhi¹</i>	20
Integrated Nutrient Management (INM) <i>Ritika Gupta¹ and Jay Nath Patel²</i>	21

Integrated Weed Management in Oat crop <i>Komal¹, Dr. Mohd Shah Alam² and Rakhi¹</i>	21-22
Integrated Nutrient Management in Oat crop <i>Rakhi¹, Dr. Mohd Shah Alam² and Komal¹</i>	22
Effect of integrated nutrient management in mung bean <i>Sahil Chauhan¹, Jay Nath Patel², Vishal Chaudhary¹</i>	22-23
Intercomparison of organic and inorganic fertilizer in Wheat crop <i>Akshay Kumar¹, Dr. Mohd Shah Alam² and Sandeep¹</i>	23
Integrated Farming System: Model and scope in Himachal Pradesh <i>Sandeep¹, Dr. Mohd Shah Alam² and Rakhi¹</i>	23-24
Tillage based weed management practices in maize crop <i>¹Vivek Kaushal and ²Priyanka Kumari</i>	24
Nutraceutical value of Vegetables <i>Ankita*, Sandeep Kumar, Manish Chauhan</i>	24-25
Extraction of bioactive compounds from kinnow flavedo by ultrasonication assisted natural deep eutectic solvent <i>*Taru Negi¹, Anil Kumar¹, Satish Kumar Sharma¹, Archana Gangwar¹</i>	25
Bioremediation: An Iconic Method for Vegetable Waste Management <i>Akankshi Sharma*, Sandeep Kumar, Manish Chauhan, Yasmin</i>	25-26
Qualitative Screening of Microbial Isolates for Gluconic Acid Production <i>D. Vijaysri¹, Livleen Shukla¹, S. T. M. Aravindharajan¹, S. H. Manoj¹</i>	26
Characterization of Cassava Starch/Pine Needle Fiber Blend Films for Packaging Applications <i>*Shreejaya Sivadas¹, P. K. Omre², N. C. Shahi³</i>	26-27
The Hormone of Darkness “Melatonin” <i>Indu Rana¹, Dr. Neetu Sharma², Ms. Harshlata³, Mrs. Vijay Bharti⁴</i>	27
Silicosis –NOT A new disease, but the neglected one <i>Diksha Motalyal¹, Dr. Neetu Sharma², Ms. Harshlata³, Mrs. Vijay Bharti⁴</i>	27-28
Leveraging Precision Farming Technologies for Sustainable Agricultural Development <i>Sabhaya Nirali Bharatbhai</i>	28
Variable Rate Technology in Vegetable Crops <i>K Rajendar sagar¹*, B Ramesh Babu², M Ravindra Babu³ and M Paratpara Rao⁴</i>	28-29
The Role of Precision Farming in Vegetable Production <i>Nikita Sharma¹ and Sandeep Kumar²</i>	29
Drone agriculture: Use of drone technology for better farming <i>¹Divya Chaudhary, Dr. Mohd. Shah Alam² and Kamini Thakur¹</i>	29-30
Precision Farming: The Future of Indian Agriculture <i>Yasmin*, Manish Chauhan, Sandeep Kumar, Akankshi Sharma</i>	30
Precision Agriculture: A modern approach to smart farming <i>Ranjna Kumari¹, Dr. Mohd Shah Alam² and Kamini Thakur¹</i>	30-31
Strategic Water Resource Management for Maize: Integrating Remote Sensing and GIS <i>Sanjay H. Parmar, Daksh D. Vadalia, G. V. Prajapati and P. A. Pandya</i>	31
Sustainable agricultural land use practices in Western Rajasthan: A Review <i>Supriya Kumari Sharma¹ and Afroz Alam*</i>	32

Morphometric analysis on different species of honeybees in Tarai region of Uttrakhand <i>Mamta Joshi^{1*}, Pramod Mall²</i>	32
Insect Visitors of Bottle Gourd Flowers <i>Elika Pavan Venkata Kumar¹ Dr. Kumaranag K. M¹</i>	33
Insect Biodiversity in Chachyot Valley <i>Gunjan¹, Ms. Harshlata², Dr. Neetu Sharma³, Mrs. Vijay Bharti⁴</i>	33-34
Vertical farming technology and its benefits <i>Vivek Kumar¹, Dr. Jay Nath Patel² and Sahil Sethi¹</i>	34
Application of Internet of Things in Agriculture <i>Neha Yadav¹, Dr. Beena Yadav²</i>	34-35
Technological Advancements in Precision Agriculture: A Comprehensive Overview <i>Nayan Deep and Dr Devinder Kumar Mehta</i>	35-36
Agricultural information utilization behaviour of farmers using smartphone <i>Kungumaselvan T¹ and Ravi Kumar Theodore²</i>	36
Screening of different genotypes of chickpea against gram pod borer <i>Helicoverpa armigera</i> (Hubner) <i>Amogha^{1*}, Usha², V.K. Mishra³ and M. Soniya Devi³</i>	36-37
Biological control of weed <i>Vikrant</i>	37
Population dynamics of cabbage butterfly (<i>Pieris brassicae</i> L.) in Balh valley of Himachal Pradesh <i>Om Prakash^{1*}, Ritika Singh² Alok kumar³</i>	38
Antagonistic potential of native isolates of Trichoderma for the management of Anthracnose (<i>Colletotrichum capsici</i>) of chilli <i>Pooja Thakur</i>	38-39
Development and Evaluation of <i>Cleistanthus collinus</i> (Roxb.) Benth ex Hook. f. based Emulsion formulation against <i>Spodoptera frugiperda</i> (J. E. Smith.) <i>^{1*}K. Harikaran and ²Thirunavukkarasu Selvamuthukumar</i>	39
Effect of Inert minerals and Botanicals on Adult emergence of Pulse beetle, <i>Callosobruchus maculatus</i>, in Stored Black gram <i>Maharaj Satwika¹, Tirumalasetty Madhumathi², Bhimineni Ratna Kumari³, V. Prasanna Kumari⁴</i>	39-40
Early blight: A threat to tomato crop <i>Sunit Dogra^{*1} and Anupam Kumar²</i>	40
Pest and Disease Control Methods <i>Sandhya Thakur</i>	40-41
Population dynamics of leaf eating caterpillar, <i>Diaphania indica</i> on watermelon in Coimbatore district <i>T. P. Chandana^{1*}, M. Muthuswami², A. Suganthi³</i>	41
Bio-herbicides: A sustainable way to control weeds <i>Jay Nath Patel¹, Mohd Shah Alam¹, Anupam Kumar² and Sushant Kumar³</i>	41-42
<i>In-vitro</i> efficacy of fungicides at different concentrations against <i>Ustilagoidea virens</i> <i>Ashwani Kumar¹ and Anupam Kumar²</i>	42

In-vitro Screening of <i>Trichoderma</i> isolates through dual culture plate technique against Sheath blight (<i>R. solani</i>) disease of rice <i>Ashish¹ and Anupam kumar²</i>	42-43
Studies on Generative potential and Virulence efficacy of an isolate of <i>Steinernema pakistanense</i> (Nematoda: Steinernematidae) against Lepidopteran and Coleopteran Pests <i>Parul Chauhan*, Ayushi Chaudhary and Istkhar</i>	43
First Survey and Authentic report of Entomopathogenic Nematode from District Tonk, Rajasthan, for biocontrol agent against <i>Galleria mellonella</i> and <i>Tenebrio molitor</i> <i>Ayushi Chaudhary*, Parul Chauhan, and Istkhar</i>	43-44
To study the Anthracnose Disease of Chilli <i>Preeti Thakur*, Dr. Anupam Kumar, Dr. Rajan Kamboj, Prabhat kumar</i>	44
Seed health status of farmers' saved wheat seed in Punjab <i>Rubleen Kaur, Parminder Singh Tak and Rajnish Verma</i>	44-45
Insect Pest Fauna of Carrot and their Management <i>Ramesha N M^{1*}, Rafee C M², Hegde M G³, Hiremath S M⁴</i>	45
Use of Bio-Agents and Phyto Extracts for Management of Yardlong Bean Seed Mycoflora <i>S. A. Rathod¹ and V. P. Prajapati²</i>	46
Fusarium wilt resistance characterization in the nuclear male sterile (NMS) backcross population of muskmelon <i>Vishal Choudhary^{1*}, Navraj Kaur Sarao¹, Sat Pal Sharma², Jaideep Kaur Deol¹</i>	46
Role of Grafting in Vegetables <i>Ajay Kumar*, Sandeep Kumar, Manish Chauhan, Latesh Narval</i>	47
Nano Boost: Elevating Crop Productivity with Advanced Nano Fertilizers <i>Dharmvir¹, Dr. Jay Nath Patel² and Sahil Sethi¹</i>	47-48
Differential Responses of Integrated Nutrient Management practices on performance of garlic in North Western Himalayas <i>Manish Chauhan^{a*}, Hem Raj Sharma^b</i>	48
Effects of sowing methods and nitrogen management on wheat crop <i>Sushma¹, Dr. Mohd. Shah Alam² and Rakhi¹</i>	48-49
Impact of Nano Fertilizers on the Yield and Growth of Indian Mustard (<i>Brassica juncea</i> L.) <i>Manish Sharma¹, Dr. Mohd Shah Alam²</i>	49
Importance of Nitrogen in Fodder Crops <i>Shivansh Thakur¹ and Jay Nath Patel²</i>	49-50
Effect of organic and inorganic sources of nutrients on soil properties and wheat yield <i>Harshit Gupta¹ and Priyanka Kumari²</i>	50
Effect of natural farming, organic and inorganic systems of nutrition on soil chemical properties and yield of wheat <i>Tejender Singh¹ and Priyanka Kumari²</i>	51
Nutrient management practices in wheat crop <i>Priya Thakur¹ and Priyanka Kumari²</i>	51
Effect of integrated nutrient management on growth and biomass production of ashwagandha (<i>Withania somnifera</i>) in mid hill region of Himachal Pradesh. <i>Anjly Kumari</i>	52

Management Practices Impacts on Soil Nutrient Status of Apple Orchards in Kullu District Of Himachal Pradesh <i>Priyanka Sharma, Mohinder Singh* and S K Bhardwaj</i>	52
Nutrient management-Enhancing soil health and crop yield <i>Bhaskar Anand¹ and Sandeep Kumar¹</i>	53
Evaluating Genetic Diversity in Rabi Sorghum Genotypes for Drought Tolerance Through SSR Marker Analysis <i>Navyashree R^{1*}, Mummigatti UV², Nethra P³ and Basavaraj B⁴</i>	53-54
Plant growth promoting and biocontrol activities of <i>Pseudomonas fluorescens</i> for Pea (<i>Pisum sativum</i> L.). <i>Aishwarya*, Manjula¹, Ajay Kumar Gautam²</i>	54
CRISPR/Cas9: Genome editing technology and it's applications <i>Riddhi Rathore</i>	54-55
Sustainable Practices for Soil and Nutrient Management in Horticulture <i>D. K. Vasoya¹, V. M. Gohil², Pratik Chaudhary and Janika Bhadarka</i>	55
Zero Budget Natural Farming (ZBNF) <i>Nikhil Sharma¹, Dr. Jay Nath Patel² and Vishal¹</i>	55-56
Organic Farming- Enhancing soil health and production <i>Shubham Chauhan¹ and Sandeep Kumar¹</i>	56
Assessing the Impact of Various Organic Sources on Yield and Quality of Rabi Sorghum in Organic Farming <i>D. J. Patel^{1*} and R. H. Kotadiya²</i>	56-57
Natural Farming: Cultivating Healthier Ecosystem for Human Well-being <i>*Geetanjali and Shanta Kumari *Dr. Khem Singh Gill</i>	57
Organic Farming: A New Uprising in Agriculture <i>Vishal Chaudhary¹, Dr. Jay Nath Patel², Sahil Chauhan¹</i>	57-58
Role of Organic Farming in Agriculture <i>Vishal¹, Dr. Jay Nath Patel² and Nikhil Sharma¹</i>	58
Organic farming: Its impact on soil health and food grain <i>Kamini Thakur¹, Dr. Mohd. Shah Alam² and Divya Chaudhary¹</i>	58-59
Effect of natural farming and organic farming systems of nutrition on yield and economics of maize <i>¹Pankaj and ²Priyanka Kumari</i>	59-60
Effect of different nutrient management practices on soil chemical properties and yield of transplanted rice <i>Harish Kumar¹ and Priyanka Kumari²</i>	60
Effect of natural farming and organic nutrient management on yield and economics of soybean <i>¹Naman Kumar and ²Priyanka Kumari</i>	60-61
Scope and Importance of Organic Farming in Vegetable Crops <i>Shubham Verma*, Manish Chauhan, Sandeep Kumar, Himanshu Sharma</i>	61
Millets and Indigenous Food Systems in Indian Subcontinent: Revitalization, Resilience, and Sovereignty <i>Vicky Yadav¹ and Saloni Kumari²</i>	61-62
Effect of Nutrient Management on Growth, Yield and Economics of Rabi Sorghum Under Organic Farming <i>R. H. Kotadiya^a and D. J. Patel^b</i>	62

Impact of organic farming on soil fertility and biodiversity for sustainable agriculture <i>Prachi Baliyan¹ and Afroz Alam*</i>	62-63
To study the different pulse flour on the growth of oyster mushroom (<i>Pleurotus ostreatus</i>) <i>Sahil Chaudhary*, Dr. Anupam Kumar, Prabhat Kumar, Preeti thakur</i>	63
Organic Farming- Enhancing soil health and farming practices <i>Disha¹ and Sandeep Kumar¹</i>	63-64
Growth and productivity of adzuki bean (<i>Vigna angularis</i> L.) as influenced by natural and organic farming practices <i>Rimzim¹ and Janardan Singh²</i>	64
Organic Farming and Sustainable Agriculture <i>Dhirendra Kumar</i>	65
Effect of integrated nutrient management on grain yield and quality of black aromatic rice under black aromatic rice-broadbean cropping sequence <i>Thoudam Anupama Devi and Edwin Luikham</i>	65
Perception of Beneficiaries about PDS Ration in District Sirmour of Himachal Pradesh <i>Ritu Verma*¹ and Shanta Kumari²</i>	66
Transforming Marketing Potentials: Elevating Rural Livelihood through e-NAM <i>Vartika Srivastava*, Dr. Manju Dahiya**</i>	66
Enhancing yield, water and energy productivity, and profitability of cucumber through drip fertigation with organic and inorganic sources under protected environment <i>Bhawna Babal¹*, Sanjeev K. Sandal¹, and Narender K. Sankhyan¹</i>	67
Advancing Sustainable Agriculture through Innovative Approaches in Soil Health Management and Organic Farming Practices <i>Yadav Shivani Indrajiet</i>	67-68
Natural formulation and chemical as pre-sowing seed treatment affecting seed quality of finger millet (<i>Eleusine coracana</i> L. Gaertn) <i>*Neha Thakur¹, Priyanka Thakur², Rajeev Kumar¹ and Sarita Devi¹</i>	68
Effect of seed treatments on seed quality of field pea (<i>Pisum sativum</i> L.) <i>Alok kumar¹*, Ritika Singh² Om Prakash³</i>	68-69
Soil and Water Conservation for Modern Aspects of Crop Production Technologies <i>Ram Swaroop Choudhary</i>	69
Response of Humic Acid and Inorganic Fertilizers on Vegetative Growth of Dahlia (<i>Dahlia variabilis</i> L.) <i>Kedar Mahadev Gheware¹*, Nomita Laishram² and Arvinder Singh³</i>	69-70
Dynamic Trends and Significance of Indian mackerel (<i>Rastrelliger kanagurta</i>) Fishery: A Comprehensive Analysis (2009-10 to 2021-22) <i>Anzil Rikesh. B¹* and N. Karthik²</i>	70
Future Strategies for sustainable agriculture and Technology Impact on human health and environment <i>Dr. Sandeep Kumar, M.D Kayachikitsa (First Year)</i>	70-71
Activation of biochar for adsorption and its environmental application <i>Phalphale Ketan Bibhishan *, Raj Narayan Pateriya</i>	71

Soil Health and Soil Management Strategies for Sustainable Hill Agriculture Ravinder Kumar ¹ , Priyanka Kumari ² and Sukhdev Singh Paliyal ³	71-72
Promoting Ecosystem Health through Innovative Land Use Practices Surender Kumar ¹ , Sheikh Amjid ² , N. P Thakur ¹ , Haleema Bano ³	72-73
Sustainable Agriculture and Resource Management Saniya Syed ¹ , Abhinav Yadav ² , Nikita Mourya ¹	73
Cover crops and green manures: Enhancing soil health and moisture retention Nishant Thakur ¹ and Sandeep Kumar ²	73-74
Appraisal of groundwater quality and its correlation with soil properties in Haryana Kavita Boora ^{1*} , Kautilya Chaudhary ¹ and Ram Prakash ¹	74
Soil and Water Conservation for a Sustainable Agricultural System A.V. Barad ¹	74-75
Water harvesting on amphi-phobic biomimetic material inspired by beetle Prikkxit ^{1*} , N.K. Sankhyan ² , S.K. Sandal ³ and Divya Jyoti ⁴	75
Nano Fertilizers – A Novel Approach to Increase Nutrient Use Efficiency Shivani Kumari [*] , Manish Chauhan, Sandeep Kumar, Manjeet Singh	75-76
Efficacy of nano- vis-à-vis prilled urea on plant growth attributes, nitrogen uptake, and apparent soil nitrogen balance in rice crop. Suman ¹ , Debashis Chakraborty ^{1*} , Achchhelal Yadav ¹ , P.K. Upadhyay ²	76
Effect of natural farming, organic, inorganic and integrated nutrient management on quality of fodder oat (<i>Avena sativa</i> L.) Shobit ¹ and Priyanka Kumari ²	77
Effect of nitrogen levels and cutting management on quality of fodder oat (<i>Avena sativa</i> L.) Ayush Prasher ¹ , Priyanka Kumari ² , Ravinder ³	77
Effect of sowing methods and row spacing on yield of fodder sorghum and pearl millet hybrids ¹ Arun Verma and ² Priyanka Kumari	78
Effect of sowing dates and varying seed rates on yield of wheat Pallvi ¹ and Priyanka Kumari ²	78
Citrus limonoid glucosyltransferase (CrLGT) gene characterization from kinnow mandarin and its overexpression Ekta Patel ¹ , Piyali Das ¹ , Somak Hazra ¹ , Prashant Mohanpuria ¹	78-79
Role of artificial seed in crop improvement Priyanka ¹ , Ravi Sharma ^{2*} , Ritika Singh ² , Priyanka Uppal ¹	79
Crop diversification for enhancing farmers income in Himachal Pradesh Priyanka Kumari ¹ and Ravinder Kumar ²	80
Impact of green synthesis nanoparticles on crop production ¹ Anuj Chaudhary, ² Navdeep Sharma	80-81
Influence of Sowing Techniques and Herbicidal Treatments on the Morpho-physiological Parameters: Plant Height and Dry Matter Accumulation in Maize (<i>Zea mays</i> L.) Sahil Chauhan ¹ , Mohit Naik ² and US Walia ³	81
Organic farming versus conventional Farming impact on environment, yield, soil property and human health Bavita Kumari	81-82

Correlation and path coefficient analysis for fruit yield and component traits in bacterial wilt tolerant genotypes of bell pepper (<i>Capsicum annuum</i> L. var. <i>grossum</i> Sendt.) <i>Anuradha^{1*} and Sonia Sood²</i>	82
Assessing the Impact of Cadmium and Lead Toxicity on Germination Percentage, Plant Height and Internodal Spacing in Chickpea (<i>Cicer arietinum</i>) <i>Mohit Naik¹, Sahil Chauhan² and M.C. Rana³</i>	83
Carotenoids: Nature's Vibrant Pigments and Health Guardians <i>Raveena Rani, Priyanka and Veenu Sangwan</i>	83-84
To study on biology of Oleander hawk moth (<i>Daphnis nerii</i>) under ambient condition <i>Vinod Kumar</i>	84
Efficacy of essential oils and plant extracts in controlling <i>Varroa destructor</i> in <i>Apis mellifera</i> Linnaeus colonies in Tarai regions <i>Akanksha Ruhela¹ and Pramod mall²</i>	84-85
Genetic variability analysis in stone and kernel traits of wild apricot (<i>Prunus armeniaca</i> L.) trees in Himachal Pradesh, India <i>Anchal* and Anita Kumari</i>	85
Performance of half sib progenies for morphometric and fodder traits of <i>Grewia optiva</i> Drummond <i>Shikha Bhagta, Jai Pal Sharma, Reena Kumari and Sarita Devi</i>	85
Development and Evaluation of Climate - Resilient Clones of Willows (<i>Salix</i> species) <i>JP Sharma¹, Tusha², Shikha Bhagta¹, Sapna Thakur³</i>	86
Nitrogen Management in Agriculture: A Comparative Analysis of Organic and Inorganic Sources <i>Sahil Sethi¹, Dr. Jay Nath Patel² and Dharmvir¹</i>	86-87
Integrated weed management in Wheat crop <i>¹Adarsh, Dr. Mohd. Shah Alam² and Sandeep¹</i>	87
Impact of weed management methods on yield and economics of transplanted rice <i>Manish Kumar¹ and Priyanka Kumari²</i>	87-88
Effect of integrated nutrient management on yield and economics of soybean <i>¹Ashish Kapoor¹ and ²Priyanka Kumari</i>	88
Effect of weed management practices on yield and economics of maize (<i>Zea mays</i> L.) <i>Hemlata¹ and Priyanka Kumari²</i>	88-89
Weed management practices in wheat crop <i>Aditya¹ and Priyanka Kumari²</i>	89
Effect of nitrogen levels, organic manure and biofertilizers inoculation on yield and economics of sorghum and pearl millet hybrids <i>Ankita Walia¹ and Priyanka Kumari²</i>	89
Effect of weed management practices on yield and economics of wheat (<i>Triticum aestivum</i> L.) <i>Priyanka Bhardwaj¹ and Priyanka Kumari²</i>	90
Influence of weed control methods on yield and economics of wheat (<i>Triticum aestivum</i> L.) <i>Abhishek¹ and Priyanka Kumari²</i>	90

<i>In-vitro</i> Evaluation of Fungicides against Brown Spot (<i>Bipolaris oryzae</i>) Disease of Rice <i>¹Neeraj Bhardwaj and ²Anupam Kumar</i>	91
To study the isolation and purification of sheath blight (<i>Rhizoctonia solani</i>) disease of rice <i>Prabhat Kumar¹, Anupam Kumar², Sahil Chaudhary¹ and Preeti Thakur¹</i>	91-92
Research Trends on Animal Health in the Era of Artificial Intelligence <i>¹Dr. Ajay Patial, ¹Dr. Peer Rayees Aziz, ¹Dr. Kirti Jamwal, ¹Dr. Ananya Sharma</i>	92
Livelihoods and Livestock: An Analysis of Mandi district's Animal Husbandry <i>Brij Vanita¹, Ankaj Thakur², Pankaj Sood¹ and Rajesh Rajput²</i>	92-93
Morphological basis for identification of <i>Swertia chirata</i>: A traditional herb Aruna Mehta*, Ravinder Raina, Neena Kumari and Kumari Bandna	93
The Local Medicinal Plant Knowledge in Temperate Regions of Himachal Pradesh <i>Neena Kumari, Aruna Mehta and Kashish Walia</i>	93-94
Isolation and purification of proteins from <i>Tinospora cordifolia</i> against <i>Pseudomonas aeruginosa</i> <i>Parul¹, Dr. Sneh Sharma¹ and Dr. Vivek Sharma²</i>	94
Impact of Agricultural Practices on Environment <i>Richa Thakur</i>	94
Influence of Agriculture on Child Nutrition through Child Feeding Practices in India <i>Sukriti Awasthi</i>	95
Contribution of Non-Timber Forest Products (NTFPs) in tribal economy of Kinnaur district of Himachal Pradesh <i>Akanksha Klate^{1*}, Shilpa², Ajit Sharma³ and Sandeep Kumari⁴</i>	95
Artificial Intelligence (AI) in Fish Nutrition: The Future of Aquaculture <i>Patekar Prakash ^{1*}, Jebarson Solomon ¹, Swapnil Narsale ¹, and K.N. Mohanta ^{*2}</i>	96
Integrated Farming System (IFS) <i>Abhishek Sanspal¹, Jay Nath Patel², Punit¹</i>	96-97
Legal and Judicial Perspective of Contractual Employment in India with Special Reference to Teachers: An In-depth Analysis <i>¹Sujata Lather and ²Lt. Col. Dr. Anil Balhera</i>	97
Time Span in Adjudication of Anti-Defection Petition By Speaker: A Need To Revisit <i>¹Vanika and ²Lt. Col. Dr. Anil Balhera</i>	97-98
Development of Protein and Energy Rich Ready-To-Eat Snack: A Sustainable and Scientific Approach to Healthier Snacking <i>Shrishti Singh and Dr. Neetu Dobhal</i>	98
Survival Dynamics of <i>Xanthomonas axonopodis</i> pv. <i>phaseoli</i> in Infected Seed and Plant Debris in Himachal Pradesh <i>¹Sakshi Suchita and ²Sandeep Kansal</i>	98-99
<i>In-vitro</i> evaluation of natural products against <i>Colletotrichum gloeosporioides</i> causing anthracnose in Citrus <i>Deepika¹, Kumud Jarial¹ and R.S. Jarial²</i>	99
Enhancing Agricultural Productivity Through Technology Transfer in Rural Farming Communities <i>Meenu and Dr. Manju Dahiya</i>	99-100

Dynamics of India's Seafood Exports Business and Their Contribution to the Blue Economy: A Quantitative Analysis <i>N. Karthik*¹, P. Seenivasan² and Anzil Rikesh³</i>	100
Organic farming: Its impact on soil health and food grain <i>Kamini Thakur¹, Dr. Mohd. Shah Alam² and Divya Chaudhary¹</i>	100-101
Nutraceuticals and health benefits of cereal grains and pulses <i>Priyanka Uppal¹, Alok Kumar^{2*}, Ritika Singh², Priyanka¹</i>	101-102
Strategies for Agricultural Extension to Enhance the Farmers' Knowledge <i>Mahiwal Singh Sisodiya & Aditya Vikram Nirala</i>	102
Factor affecting the possession of soil health card by the beneficiary and non-beneficiary farmers in district mandi of Himachal Pradesh <i>Lalit kumar¹ and Sonia Rani²</i>	102-103
Impact of Kisan Credit Card Scheme in District Mandi of Himachal Pradesh <i>Meenakshi Devi¹ and Sonia Rani²</i>	103
Protected cultivation of vegetable crop <i>Himanshu Sharma*, Sandeep Kumar, Manish Chauhan, Shubham Verma</i>	103-104
Examining the Knowledge Level of Rural Women on Post-Harvest Technologies and Value-Added Products <i>Bharti*, Dr. Rajesh Dahiya**</i>	104
Effect of Ultrasonication on coating properties and shelf life of fresh cut onion <i>* Neha Rawat¹, Satish Kumar Sharma² and Charu Bisht³</i>	104-105
Hydroponics farming in Vegetable Production <i>Priyanka Devi*, Manish Chauhan, Sandeep Kumar, Neha</i>	105
Vertical farming: The future of agriculture <i>Neha*, Sandeep Kumar, Manish Chauhan, Abhishek</i>	105-106
Assessing the Feasibility and Benefits of Self-Propelled Paddy Harvesters in Hilly regions of India <i>Sheikh Aadil Mushtaq*, Sanjay Khar, Sushil Sharma and J.P. Singh</i>	106
Agrotourism - The Rural Retreats <i>Jayasudha J^{1*}, R. M. Naik², K. L. Chaudhary³</i>	106-107
Factors that Influence Farmer's Behaviour Towards Risk Taking: An Empirical Study in Himachal Pradesh <i>Nandita Sharma*, Aman Sharma, Komal Sharma, Kapil Kathuria</i>	107
An Exploratory Study for Conceptualization of Rural Entrepreneurship: Major Challenges and Opportunities in India <i>Taruna*, Nandita Sharma, Komal Sharma, Ankita</i>	108
Sustainable Initiatives in Agribusiness Entrepreneurship <i>Aparna Gogoi</i>	108-109
Post-Harvest Management of Vegetable <i>Mohit Sharma¹ and Sandeep Kumar²</i>	109
A study on socio-economic status of farmers practicing natural farming in Himachal Pradesh <i>Ankita*, Komal Sharma, Nandita Sharma, Taruna</i>	109-110
Integrated crop management practices for offseason garden Pea in high hill wet temperate region of north-western Himalaya <i>Shakuntla Rahi¹, Pankaj Sood², Akhilesh Sharma³, Desh Raj Chaudhary⁴, Ranjana Thakur⁵ Brij Vanita⁶ and Arti Mahajan⁷</i>	111-112

Determining the genetic parameters of grain protein content and yield traits in rice (<i>Oryza sativa</i> L.) Grains G. Kiruba ¹ , S. Geetha ^{1*} , R. Saraswathi ¹ , R. Santhi ² , D. Uma ³ and R. Pushpa ⁴	112-115
Adapting Floriculture to Urban India: Navigating Climate and Pollution Changes Akhil Rana ^a , Sukhjinder Singh ^{a*} , Deepika Sharma ^a and Bhavya Bhargav ^b	116-126
Organic farming: Concept and Importance in Indian Agriculture Dr. Mohd Shah Alam ¹ , Yograj ¹ , Suraj Singh ² , Dr. Roop Kishor Pachauri ³	126-137
Sustainable Practices for Soil and Nutrient Management in Horticulture D. K. Vasoya ¹ , V. M. Gohil ² , Pratik Chaudhary and Janika Bhadarka	137-145
Microbial Biosurfactants: Efficient Tools in Bioremediation of Hydrocarbons Abhinandana, K. R ¹ , Krishna Naik, L ¹ . And Monisha, K. R ²	145-151
Drone agriculture: Drone technology applied to improve farming ¹ Divya Chaudhary, Dr. Mohd Shah Alam ² , Rakhi ¹ , Simran ¹	151-159
Black Soldier Fly: A Sustainable Solution for Environment-Friendly Waste Management Maharaj Satwika ¹ , Chava Asritha ² , N. M. Ramesha ³ , Burjikindi Madhuri ⁴	156-167
Irrigation Regimes and Soil Amendments Response on Yield and Uptake of Basmati-370 Sheikh Amjid ¹ , Vikas Abrol ¹ , Vikas Sharma ¹ , A.P Singh ² .	168
Low Tunnel Production of Muskmelon: Technological Advancement and Economic Analysis Aakashdeep Yadav ^{1*} , Dr. Parminder Singh ² , Dr. JS Papang ¹	168-169
Harnessing the Circular Economy Paradigm for Sustainable Agriculture Bheemanagouda ¹ and Hanumantappa Jamanal ²	169-170
Assessment of soil available nutrients and micronutrients under different tea (<i>Camellia sinensis</i>) gardens of Himachal Pradesh, India Ankit Gill ¹ and Praveen Thakur ²	170
Incorporation of enriched city compost for improving soil health, yield and quality of wheat under system of wheat intensification Ravindra M. Muchhadiya [*] , R. B. Thanki, H. L. Sakarvadia and P. D. Kumawat	170-171
Utilizing the potential of buffalo as a meat animal for augmenting farmer's income. Yashwant Singh ¹ and Shwetambri Jamwal ²	171-177

Theme 1: Enhancing Agricultural Income, Diversification, and Addressing Agricultural Growth Challenges

Crop Diversification: A Catalyst for Income Generation in Agricultural Economies

Hanumantappa Jamanal¹ and Bheemanagouda²

Teaching Assistant¹ Kousali Institute of Management Studies KUD, Karnataka and Ph.D. Scholar² Department of Food Science and Nutrition UAS, Dharwad

Crop diversification is the practice of cultivating a variety of crops within a same agricultural system. This method is increasingly recognized as vital for attaining sustainable agricultural development and generating income in rural communities. Increased biodiversity, better soil quality, less risks of disease and pests and fewer exposure to the effects of climate change are only a few advantages of variety. However, this strategy's ability to boost farmers' financial gains is one of its most notable benefits. By diversifying the crops they plant, farmers may lower risk and boost profitability by reaching a larger range of customers. Growers that cultivate a diverse range of crops, each with distinct growth cycles and market demands, may ensure a consistent income stream throughout the year. To ensure a steady flow of income, for example, a crop may do well during the rainy season while another may perform well during the dry season. Moreover, crop diversification can lead to value addition by incorporating high-value crops or specialty products. This enables farmers to capture niche markets and demand premium prices, thereby enhancing their overall income. Additionally, diversified farming systems often integrate agroforestry practices or livestock rearing, further diversifying sources of revenue and promoting sustainable land management. Crop diversification also contributes to food security by broadening the range of foods available in the community. This not only improves nutrition but also reduces dependence on single crops, enhancing resilience to market fluctuations and external shocks. To sum up, crop diversification is a complex tactic with enormous potential for generating revenue in agricultural economies. By embracing diversity in their farming practices, farmers can mitigate risks, enhance resilience and discover new opportunities for profitability. Policymakers and stakeholders must prioritize initiatives that support and incentivize crop diversification to promote sustainable rural development and equitable economic growth.

Keywords: Crop diversification, income generation, agricultural economies, sustainable development

Dynamics of Cropping Pattern of Gird agro-climatic zone of Madhya Pradesh, India

¹Aditya Singh, ²Dr. Sarita Sharma and ³Dr. Poonam Chaturvedi

¹Ph.D. Scholar, Department of Agricultural Economics and Farm Management, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh

²Assistant Professor (Contractual), Indira Gandhi Krishi VishwaVidyalaya (IGKV), Raipur, Chhattisgarh

³Assistant Professor (Contractual), Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur, Madhya Pradesh

Corresponding author email: adidig4338@gmail.com

Abstract

The study analysed the dynamics of Cropping Pattern of Gird agro-climatic zone of Madhya Pradesh. The dynamics of Cropping Pattern of Gird agro-climatic zone has been analysed district wise for the districts of Ashoknagar, Bhind, Guna, Gwalior, Morena, Sheopur and Shivpuri. For the 10 selected crops namely Paddy, Wheat, Jowar, Bajra, Maize, Gram, Barley, Groundnut, Soyabean and Mustard absolute and relative changes in area in current year over the base year during the study period have been examined. For the purpose of study, secondary time series data has been collected from the official website of Directorate of Land Records, Madhya Pradesh for the period of 10 years from 2007-08 to 2016-17. There was an overall shift of crops in the Gird agro-climatic region from which Paddy had the highest shift of 157.39 per cent followed by Wheat which had

the shift of 54.72 per cent in the region. Jowar and Maize were found to have the lowest shift in their cropping area in the region with -68.55 per cent and -36.57 per cent respectively. Mainly oilseeds had the major contribution in the cropping pattern in the region. Overall, it can be observed that the pattern of farming is shifting towards cereals and oilseeds and thus farmers should ultimately focus on exploring potential of land according to this shift in cropping pattern and creating a better marketing channel for generating better profits and income.

Keywords: Dynamics, Cropping Pattern, Absolute change, Relative Change

Economic analysis of cost components of rice cultivation in major producing states in India

Sarita Sharma, Aditya Singh and R.M. Sahu

Department of Agricultural Economics and Farm Management

Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur – 482004 (M.P.), India

Corresponding author email: sarita90677@gmail.com

Abstract

In India rice is grown in almost all the states and it is one of the major food crop. The study analyzed the growth rate of different cost components used for rice cultivation. The growth rate was observed for the states of West Bengal, Uttar Pradesh, Punjab, Odisha, Bihar, Chhattisgarh, Andhra Pradesh, Assam, Haryana, and Madhya Pradesh for 15 years from 2002-03 to 2016-17. Orissa contributed maximum share (55.16%) on human labour cost in the total cost of cultivation as compared to other states whereas, the human labour contributed maximum share as compared to other inputs in the states. All the states showed increasing and significant trend in total cost whereas, Madhya Pradesh had maximum positive and significant growth (12.81%) per annum for the total cost of cultivation. The state of Madhya Pradesh showed higher positive annual growth in insecticide (50.61%) and fertilizer (16.49%) cost as compared to all selected states and inputs.

Keywords: Rice, trend, annual growth rate, cost components

Diversified cropping sequence’s influence on yield, resource use efficiencies and carbon footprints

Pooja¹ and S.S Rana²

¹M.Sc. Agriculture, ² Principal Scientist (Agronomy),

¹Department of Agronomy, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, H.P., India, 176062

¹Corresponding author email: chandelpooja1792@gmail.com

Abstract

The field experimental work was undertaken at Bhadiarkhar farm of the CSKHPKV, Palampur during 2022-2023. Ten cropping sequences *viz.* maize-wheat, maize-gobhi sarson+toria, dhaincha-early cabbage-frenchbean, sunhemp-vegetable pea-frenchbean, maize+soybean- chickpea+linseed, rice-wheat+gram, hybrid sorghum+hybrid bajra-oats+sarson (hybrid), hybrid sorghum+hybrid bajra-ryegrass+berseem, babycorn-broccoli-frenchbean and okra-turnip-tomato, were compared for production, resource use efficiency and carbon footprints with three replications in Randomized Block Design. Okra-turnip-tomato gave highest maize grain equivalent yield. It was followed by babycorn-broccoli-frenchbean, hybrid sorghum+hybrid bajra-oats+sarson and hybrid sorghum+hybrid bajra-ryegrass+berseem crop sequences. Maize + soybean-chickpea+linseed occupied the land for longer duration and therefore had higher land utilization index. It was followed by maize-gobhi sarson+toria, hybrid sorghum+hybrid bajra-ryegrass+berseem. Dhaincha-early cabbage-frenchbean had the minimum land use index. The more fallow period between harvest and sowing of the successive crop require

incorporation of some leafy vegetable or some other crop. Hybrid sorghum+hybrid bajra-ryegrass+berseem had the highest apparent nutrient use productivity followed by sunhemp- vegetable pea-frenchbean and hybrid sorghum+hybrid bajra-ryegrass+berseem. Okra-turnip-tomato had the highest irrigation water use efficiency and labour use efficiency. Sunhemp-vegetable pea-frenchbean resulted in significantly highest carbon efficiency and highest carbon sustainability index and lowest carbon footprints.

Keywords: Cropping sequence, yield, resource use efficiency, carbon footprints

Stepwise Regression Analysis on Paddy Production in Manipur

Soibam Loidang Devi

Department of Statistics, D.M College of Science

Dhanamanjuri University, Imphal

Corresponding author email: drsoibamloidangdevi@gmail.com

Abstract

Manipur is in north eastern part of India and internationally bordering state with Myanmar. Rice is staple food. The economy coming from rice crop production generates income of the people for their livelihood mainly and has a major contribution to NSDP. Hence, the contributing factors, for enhancing in the rice production, have to be identified so as to gear up the sustainable development in the state. The aim is to identify the factors of rice crop with reference to various agro-climatic, socio-economic, and topographical conditions of Manipur. Under a stratified two- stage sampling design, cross-sectional primary data is collected and stepwise regression analysis was followed by proposing a statistical model. The model fits the data well and diagnostic checks confirmed that the data do not contradict the general underlying assumptions about the model. By the value of $R=0.907$ (before) and $R=0.925$ (after) application of stepwise regression process respectively indicates that 90.7 percent (before) and 92.5 percent (after) of variation in the yield is explained by the independent variable under consideration.

Key words: step-wise regression, Manipur, cross sectional data, statistical model

Effect of Plant Growth Retardants on Production of Potato var. Kufri Jyoti

***Rajeev Kumar, Reena Kumari, Kumari Shiwani and Neha Thakur**

Dr YS Parmar University of Horticulture and Forestry, College of Horticulture and Forestry, Thunag, Mandi, H.P.-175048

Abstract

A field experiment was conducted at farmer's field in village Thunag of district Mandi, Himachal Pradesh falling under wet-temperate region during summer season of year 2023 in randomized block design with three replications to study the effect of plant growth retardants on potato (*Solanum tuberosum* L) var Kufri Jyoti production. Two growth retardants Cycocel (at 250ppm, 500ppm & 750ppm) and 2,3,5, Triiodobenzoic Acid (50ppm, 100ppm & 200ppm) along with control were tested in different concentration to study its effect on plant height (cm), number of shoots/plant, number of compound leaves/ plant, haulms weight/ plant (g), number of tubers/ plant, Average tuber weight (g), tuber yield/ m² (kg) and tuber yield/ ha (q). There was significant difference among treatments for all the parameters except number of tubers per plant. Plant height (cm), number of shoots/plant, number of compound leaves/ plant and haulms weight/ plant (g) were decreased with increase in the concentration of growth retardants. However, average tuber weight (g), tuber yield/ m² (kg) and average tuber yield/ ha (t) were increased with the increase in the concentration of plant retardants and maximum average tuber weight (82.83 g), tuber yield/m² (17.37 kg) and tuber yield /ha (34.73 t/ha) were recorded in T3 treatment CCC750ppm.

Keywords: Potato, Plant Growth Retardants, Wet Temperate Region

Edible Vaccine: A new technique for enhancing quality of vegetables

Heena^{1*} and Sandeep Kumar¹

¹Department of horticulture, Abhilashi University Chail Chowk, Mandi

Corresponding author email: hinathakurrajput44@gmail.com

Abstract

Edible vaccine is a plant derived vaccines that can be eaten is a new approach in the field of vaccination. Vaccines have been major for the prevention of infectious diseases. Edible Vaccine are prepared by introducing selected desired genes into plants and inducing these genetically modified plants (GMP) to manufacture the encoded proteins. This process is known as “Transformation” and the altered plants are called “Transgenic plants”. Methods used for the production of edible vaccines are direct gene insertion methods and indirect gene insertion methods. Advantages of edible vaccines are administration by means of feeding and sterile environment for injections is no more mandatory. Vegetable for edible vaccine such as transgenic potato with Enterotoxigenic *E. coli* LT-B gene which effective against the diarrhoea. Spinach based edible vaccine developed by inserted the gene rabies virus Glycoprotein gene which effective against the rabies. University of Agriculture Sciences, New Delhi developed muskmelon based edible vaccine and inserted gene was against the Rabies. Vaccines play a vital function in the case of diseases. Revolution of edible vaccine is a great development in the area of biotechnology and its achievement requires awareness. Edible vaccine is easy to manufacture, they do not any storage conditions. Limitations of edible vaccines are stability of vaccine are not known and Consistency of dosage is not analogous.

Keywords: Biotechnology, Edible Vaccine, Transgenic, Vegetables

Estimation of Rice Production in Manipur

*** Taibangjam Loidang Chanu¹, * Dr. S. Loidang Devi²**

¹Department of Statistics, D.M College of Science, Dhanamanjuri University, Imphal,

Department of Statistics, D.M College of Science, Dhanamanjuri University, Imphal

Corresponding author email: loidangtt@gmail.com

Abstract

Manipur is situated in the north eastern part of India. Rice is principal food and income from its production as major livelihood of the people of this region. The objective of this study is to forecast the rice production of Manipur through fitting of univariate Auto Regressive Integrated Moving Average (ARIMA) model. The time series secondary data was utilized for the analysis. ARIMA (2, 1, 1) model is found suitable for rice production. It was found that the value of $r^2 = 0.523$ for the ARIMA model of rice production, it means that out of the total variation 52.3% was explained by the independent variable (past values), on the rice production of Manipur. The forecasted values of rice production for the year 2021, 2023, 2024 & 2025 were 498.02,475.67,480.71,493.67 &499.00 respectively base on the fitted ARIMA (2,1,1) model.

Keywords: Forecast_Modelling _Rice yield -ARIMA model

Theme 2: Adapting to Climate Change, Ensuring Resilience, and Implementing Sustainable Agricultural Practices and Policies

Enhancing ecological sustainability: the role of agroforestry in environmental conservation

Garima, Yourmila Kumari, Manoj Kumar Thakur and Kashish Walia

Dr YS Parmar University of Horticulture and Forestry, College of Horticulture and Forestry Thunag Mandi HP 175048, India

Corresponding author email: garimasharma446@gmail.com

Abstract

Ensuring the sustainability of our ecosystems is crucial for securing resources for future generations and maintaining the delicate balance of the natural world. Agroforestry emerges as a vital player in advancing environmental sustainability through the strategic integration of agricultural and forestry practices. By harmonizing trees with crops or livestock, agroforestry fosters diverse ecosystems that support biodiversity, providing habitats for a wide array of plant and animal species. The inclusion of trees in these systems serves as a potent tool for carbon sequestration, acting as crucial carbon sinks that absorb and store atmospheric carbon dioxide. This not only aids in reducing greenhouse gas concentrations but also contributes significantly to mitigating the impacts of climate change. Moreover, agroforestry systems play a key role in local climate moderation by offering shade, windbreaks, and regulating moisture levels. Beyond environmental benefits, these practices enhance economic viability and livelihoods in rural communities by diversifying farm income streams. The positive impact extends to water resources, with agroforestry reducing runoff and replenishing groundwater, thereby improving both the quality and quantity of water available. The creation of vegetation corridors in agroforestry systems also promotes habitat connectivity, supporting wildlife conservation efforts and fostering genetic diversity. Additionally, sustainable biomass production and effective erosion control further underscore the multifaceted advantages of integrating agroforestry into land-use planning and agricultural systems. Ultimately, such integrated approaches stand as potent contributors to the achievement of sustainable development goals.

Key words: Sustainability, agroforestry, climate change, biodiversity conservation and carbon sequestration

Effect of sowing dates and nutrient levels on physiological parameters of Finger millet varieties under *kandi* belt of Jammu region

¹Vijay Kumar, ²Vijay Bharti, ³Anil Kumar and ⁴Vikas Sharma

¹Ph.D. Scholar, Division of Agronomy, ²Professor (Agronomy), Water Management Research Centre, ³Dean, Faculty of Agriculture and ⁴Professor & Head, Division of Soil Science & Agricultural Chemistry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

¹ Corresponding author email: vkr90707@gmail.com

Abstract

A field experiment was conducted at Advance Centre for Rainfed Agriculture, Dhiansar, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu during *kharif*, 2023 to study the agronomic interventions on growth and productivity of Finger millet (*Eleusine indica* L. Gaertn.) under *kandi* belt of Jammu region. The experiment was laid out in factorial randomized block design with three replications. There were 24 treatment combinations comprising three sowing dates (20th June, 30th June and 10th July), two varieties (VL Mandua 382, VL Mandua 379) and four nutrient levels (0, 20:10:10, 40:20:20 and 60:30:30 kg of N:P₂O₅:K₂O/ha).

On the basis of one year study, the results on physiological parameters revealed that among different sowing dates, crop sown on 30th June recorded significantly lesser number of days to complete emergence while, sowing of finger millet on 10th July takes lesser number of days for 50% flowering and maturity as compared to other sowing dates. Among varieties, VL Mandua 382 takes lesser number of days to complete emergence and maturity and VL Mandua 379 takes lesser number of days to 50% flowering. Likewise, among nutrient levels, 60:30:30 takes lesser number of days to complete emergence and 20:10:10 takes lesser number of days to 50% flowering and maturity. From this one year study, it can be concluded that sowing of finger millet variety VL Mandua 382 on 10th July with nutrient level 20:10:10 kg of N:P₂O₅:K₂O/ha will help the farmers in getting finger millet crop well in time. The study also is of immense importance as this shall help to develop package and practice for cultivation of Finger millet in Jammu region.

Keywords: *Finger Millet; sowing date; varieties; nutrient levels; physiological parameters.*

Breeding Strategies for Climate Smart Crops

Hima bindu. P¹, Bsawaraj PS², K.Divya³

^{1,3}*Ph.D. Genetics and Plant Breeding, PJTSAU*

²*Scientist, Plant Breeding ICAR-National institute of Abiotic Stress Management, Baramati-413115*

Corresponding author email: himabindu4agri@gmail.com

Abstract

Agriculture and climate change are internally correlated with each other in various aspects. Climate change affects agriculture in different ways, e.g., variations in annual rainfall, average temperature, heat waves, modifications in weeds, pests or microbes, global change of atmospheric CO₂ or ozone level, and fluctuations in sea level. Climate change threatens farmers ability to produce quality crops. The threat of varying global climate has greatly driven the attention of scientists, as these variations are imparting negative impact on global crop production and compromising food security worldwide. Climate resilience is the capacity of an ecosystem to respond to a disturbance by resisting damage and recovering quickly. The key focus of climate resilience efforts is to address the consequences of climate change. There are many challenges to the breeders to develop climate resilient crop varieties. Big challenge is need to produce more food in limited area with good quality. There are several opportunities to the breeders to develop climate resilient crop varieties. Past and present experiences indicate the potential of crop breeding to combat climate change through the development of crop varieties with resistance/tolerance to drought, heat, and major diseases and insect pests. To this end, the crop breeding program applies both conventional and molecular approaches including focused identification of germplasm strategy (FIGS), targeting mega environments, shuttle breeding, doubled haploids, marker assisted selection, and key location phenotyping, genomic selection, genome wide association studies, transgenic technology and CRISPR-CAS technologies and prime editing are most promising. Deployment of genomic technologies can accelerate development and delivery of improved germplasm with enhanced resilience and adaptability.

Impact of climate change on agriculture

Punit Kumar¹, Dr. Jay Nath Patel² and Abhishek Sanspal¹

¹*M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.*

²*Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.*

Corresponding author email: pk4207862@gmail.com

Abstract

Climate change is safe to be one of the biggest challenges of mankind. Climate change is an inter-governmental complex challenge globally with its influence over various components of the ecological, environmental, socio-

political, and socio-economic disciplines. Human activities, especially the combustion of fossil fuels, contribute to the increase of greenhouse gases in the atmosphere and thus to the pace of climate change. Fossil fuels are being continuously used to produce electricity. The burning of these fuels produces gases like carbon dioxide, methane and nitrous oxides which lead to global warming. The greenhouse effect is a natural process that plays a major part in shaping the earth's climate. It produces the relatively warm and hospitable environment near the earth's surface where humans and other life-forms have been able to develop and prosper. The effects of climate change are already being felt and the resulting damage will most likely be enormous worldwide. Because global impacts vary widely and will lead to very different national vulnerability to climate impacts, each country, depending on its economic background, has different options to ward off negative impacts. Studies revealed that the climatic variation such as occurrence of drought have high level of impact on the yield of rainfed crops. The farmer's perception on the impact of climate change on the crops grown in rainfed condition, such as yield reduction and reduction in net revenue. Decisions have to be made to mitigate climate consequences according to the preparedness and the vulnerability of countries against the presumed impacts. Due to these climate change conditions farmers at very locations are aware of climatic change adaptation strategies like change in the cropping system. Use drought and heat resistant varieties to compete with these climatic conditions and also use watershed management. In view of these condition require careful management of resources like soil, water and biodiversity. The adoption of agroforestry is one of the effective measure that can be used to mitigate climate change. Climate change is an emerging threat to global public health and is predicted to affect human health in many ways including heat stress (stroke), air pollution, food scarcity, spread of infectious diseases and intensity of disease outbreaks.

Key words: Climate change, global warming, greenhouse gases, greenhouse effect and temperature

Climate Change Resilience through Forest

Yourmila Kumari, Garima, Manoj Kumar Thakur and Kashish walia

College of Horticulture and Forestry, Thunag, Mandi, Dr YS Parmar University of Horticulture and Forestry, Himachal Pradesh (175048), India

Corresponding author email: yourmilakumari16@gmail.com

Abstract

This chapter explores the critical need to enhance resilience against the challenges posed by climate change through strategic forest management. As climate change presents unprecedented threats, forests emerge as pivotal allies in both mitigating and adapting to its impacts. The focus is on elucidating the diverse ways in which forests significantly contribute to building resilience to climate change. Forests play a central role as vital carbon sinks, effectively sequestering atmospheric carbon dioxide through the process of photosynthesis. This key function positions forests as crucial players in climate change mitigation efforts. The intricate ecosystems within forests further bolster resilience by fostering biodiversity, thereby enhancing their adaptability to environmental shifts. Forests provide essential habitats for biodiversity, regulate microclimates, and offer vital services such as water retention. Strategic proposals for forest conservation and restoration are put forth as integral to fortifying climate resilience. These initiatives encompass the identification and promotion of tree species resilient to changing climatic conditions. Additionally, the advocacy for sustainable forest management practices, including afforestation and reforestation, aims to improve the overall health and functionality of forest ecosystems. The article accentuates the social and economic dimensions of climate resilience, underscoring how forests serve as significant sources of livelihoods for local communities. It emphasizes the importance of integrating traditional knowledge and fostering community engagement in forest management as critical aspects of cultivating climate resilience. This chapter underscores the irreplaceable role of forests in climate change resilience, urging collective efforts in sustainable forest management, biodiversity conservation, and community involvement. Recognizing forests as dynamic and adaptive ecosystems contributes not only to climate change mitigation but also to the holistic well-being of the planet and its inhabitants.

Keywords: Climate Change, Resilience, Forest Management, Sustainable and Biodiversity Conservation

Enhancing Climate Resilience in Agriculture through National Innovations in Climate Resilient Agriculture (NICRA) project

Aparna Jayan R.^{1*} and Parvathi Sankar P²

¹ *Ph.D. (Agri.) Scholar, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat*

² *M.Sc. (Agri.) Scholar, Dept. of Agricultural Extension Education, University of Agricultural Sciences, Dharwad, Karnataka.*

** Corresponding author email: jayanaparna1997@gmail.com*

Abstract

National Innovations on Climate Resilient Agriculture (NICRA) is a network project launched by Indian Council of Agricultural Research (ICAR) in February, 2011 to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. NICRA project comprises of four components - strategic research on adaptation and mitigation, technology demonstration on farmers' fields to cope with current climate variability, sponsored and competitive research grants and capacity building of different stakeholders. Strategic research on adaptation and mitigation covers crops, horticulture, livestock, natural resource management and fisheries. Technology demonstration involves demonstrating proven technologies for adaptation of crop and livestock production systems to climate variability. In each village of the selected district, the interventions are made in four modules. Natural resources module includes in-situ moisture conservation, water harvesting, supplemental irrigation, improved drainage, conservation tillage, artificial ground water recharge and water saving irrigation methods. The crop production module includes introducing drought/temperature/flood tolerant varieties, advancement of planting dates of rabi crops in areas with terminal heat stress, water saving paddy cultivation methods, frost management, community nurseries, custom hiring centres, location specific intercropping systems. Livestock and fisheries module consists of use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, preventive vaccination, improved shelters for reducing heat stress in livestock, management of fish ponds/tanks during water scarcity and excess water, etc. The institutional interventions module includes strengthening the existing interventions or initiating new interventions related to seed bank, fodder bank, commodity groups, custom hiring centre, collective marketing, introduction of weather index based insurance and climate literacy through a village level weather station. The third component of NICRA project is sponsored and competitive grants under which research grants are provided for critical researchable issues. Capacity building is the fourth component of NICRA project under which training programs are organised for young scientist and farmers across the country. Overall, NICRA project empowers the farmers by building resilience to climate change by enhancing their farm productivity and income through diverse technological interventions, strategic research and capacity building programs.

Keywords: NICRA, resilience, climate change, strategic research, technology demonstration, capacity building

Problems and Prospects of Vegetable Production in Himachal Pradesh

Manjeet Singh*, Manish Chauhan, Sandeep Kumar, Shivani Kumari

Department of Horticulture, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh-175028

Corresponding author email: manjeetsingh78070@gmail.com

Abstract

Himachal Pradesh is a mountainous Himalayan state with undulating topography and diversified agro-climatic conditions suitable for the cultivation of a wide range of crops. Through the concerted efforts of the government and farming community, the state has emerged as a model hilly state in the country as far as the development of agriculture is concerned. Over the last four decades, the state has witnessed a remarkable transformation in agriculture through quality fruits and off-season vegetable production. However, the state is in the vortex of various serious threats to farming. One of the primary challenges confronting vegetable production in Himachal Pradesh is the adverse impact of climate change. Erratic weather patterns, including unpredictable rainfall and extreme temperatures, pose significant risks to crop yields and quality. Moreover, the shrinking land holdings due to population growth and land fragmentation exacerbate this challenge, limiting the area available for cultivation and hindering economies of scale. Land degradation further compounds the problems faced by vegetable farmers in the state. Soil erosion, nutrient depletion, and loss of fertility diminish the productivity of agricultural land, posing a significant threat to long-term sustainability. Additionally, the increasing cost of cultivation, including expenses related to inputs such as seeds, fertilizers, and pesticides, adds financial strain to farmers, particularly those with small landholdings. Vegetable cultivation is rapidly gaining popularity among farmers in the hill state of Himachal Pradesh, which has become a 'natural glass house' for the production of off-season vegetables in the region. The state has a huge bio-diversity and its agro-climatic conditions are congenial for the production of off-season vegetables around the year.

Key words: Climate, Challenges, Himachal Pradesh, Vegetable Production

Climate Change: Impact of climate change on vegetable production

Latesh Narwal*, Sandeep Kumar, Manish Chauhan, Ajay Kumar

Department of Horticulture, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh-175028

Corresponding author email: lateshnarwal8990@gmail.com

Abstract

Climate change, driven primarily by human activities, is altering Earth's climate system at an unprecedented rate. The detrimental effects of climate change on global agriculture, particularly in vegetable cultivation, have become increasingly apparent over the past four decades. Soil erosion and pollution have depleted nearly one-third of the arable land, worsening vegetable crop vulnerability to climatic extremes and environmental stresses. Temperature fluctuations, water scarcity, flooding, drought, salinity, and increased pest and disease pressures present significant challenges to vegetable farmers, resulting in crop failures, lower yields, and compromised quality. Moreover, the decline in pollinator populations due to adverse climatic events and habitat loss threatens the pollination-dependent vegetable supply. Smallholder farmers, particularly those heavily reliant on vegetable cultivation, are disproportionately affected by these climatic changes. Their livelihoods are at stake, demanding urgent adaptation and mitigation strategies. Effective measures such as agroecological practices, crop diversification, water management techniques, and the promotion of durable crop varieties can enhance the adaptive capacity of small-scale vegetable farmers. Furthermore, strengthening local institutions, providing access to climate-smart technologies, and encouraging market linkages can enhance the resilience of vegetable-based livelihoods in the face of climate change. Addressing the challenges of climate change requires urgent and coordinated action at local, national, and global levels. Mitigation efforts aimed at reducing greenhouse gas emissions are essential to limit further warming and mitigate the severity of future impacts.

Key words: Climate Change, Environmental stress, Pollination, Temperature Increase

Arsenic metal tolerance potential of endophytic fungi isolated from plants of arsenic contaminated sites

Abhinandana, K. R^{1*}, Sowmya, N. R¹, Lohith Kumar, N¹. and Krishna Naik, L¹.

¹*Department of Agricultural Microbiology, UAS, GKVK, Bengaluru.*

Corresponding author email: krabhinandana18@gmail.com

Abstract

Arsenic accumulation in soil and plants poses a serious threat to soil and human health. The remediation of soils contaminated with heavy metals especially arsenic is gaining considerable momentum. In this regard, mycoremediation (endophytic fungi and arbuscular mycorrhizal fungi) is an efficient, cost-effective and environmentally friendly strategy. Fungal endophytes are able to support plant growth in the presence of toxic heavy metals positively influencing the plants' absorption, degradation, and dislocation of the contaminant. Therefore, the present study was intended to isolate, screen and evaluate efficient fungal endophytes for their arsenic tolerance potential under different *in vitro* arsenic concentrations. A total of 83 fungal endophytes were extracted in minimal medium amended with 10 ppm arsenic from the plants grown in arsenic contaminated sites, which suggests that even in a toxic environment like heavy metal-polluted soils, fungi show a considerable abundance and diversity probably through interactions with host plants. Among the 83 isolates, 34 were recovered from roots, 26 isolates were isolated from the stem/shoot and 23 from leaf bits. These isolates were screened for arsenic tolerance at different arsenic (Sodium arsenite) concentrations (100 ppm to 2000 ppm). Among them, eight endophytes (S1P1R1, S3P1S1, S3P1S3, S4P2L2, S5P1S1, S6P1S3, S8P1L4 and S10P1L1) were found efficiently enduring metal stress upto 2000 ppm and *exhibited remarkably significantly higher tolerance index (more than 0.5) and minimum per cent inhibition (less than 50%) at 2000 PPM arsenic stress.* This could be due to fungal endophytes have the ability to lockdown metals by various mechanisms *viz.*, adsorption by the cells, metal binding to extracellular polysaccharides, sequestration of metals by intracellular phytochelatins *etc.*, thereby provides tolerance to different toxic heavy metals. Therefore, findings of the present study suggested that fungal strains with its endophytic character could have a potential application in phytoremediation in this area.

Keywords: Endophytic fungi, arsenic, bioremediation, tolerance

Energy conservation agriculture: Role of Renewable Energy

Shivam Yadav¹, Prof (Dr.) Biswarup Mehra², Prateek Kumar³

¹*Ph.D. Scholar, Department of Agronomy, SHUATS* ²*Professor & Dean, Naini Agricultural Institute, SHUATS*

³*PhD Scholar, Department of Agronomy, SHUATS*

** Corresponding author email: shivam.yadav41@gmail.com*

Abstract

Agricultural practices in the less developed and some developing countries is still being carried out manually with crude tools while the usage of fossil fuel in developed countries has contributed immensely to global warming and environmental degradations. Energy is one of the major parameters for establishing growth and progress. Renewable energy has shown promising potential for integration into a wide range of agricultural activities and offers an alternative sustainable solution to current practices. Most of energy on the earth is received from the sun. Solar energy creates circulation of wind and ocean water, causes water evaporation and consequent precipitation. Renewable sources studied include biomass, geothermal, wind, solar, hydropower and fuelwood. Harnessing these energy sources in agriculture is termed clean energy farming. These renewable resources have a huge potential for the agriculture industry. The concept of sustainable agriculture lies on a delicate balance of maximising crop productivity and maintaining economic stability, while minimising the

utilisation of finite natural resources and detrimental environmental impacts. Hence, there is a need for promoting use of renewable energy systems for sustainable agriculture, e.g. solar photovoltaic water pumps and electricity, greenhouse technologies, solar dryers for post-harvest processing, and solar hot water heaters. Also Crops and biomass wastes can be converted to energy on the farm or sold to energy companies that produce fuel for cars and tractors and heat and power for homes and businesses. Adequate agricultural extension service is needed to educate, enlighten, and transfer this knowledge to rural areas for alternative energy development, management, monitoring, and evaluation.

Keywords: *renewable, biomass, geothermal, hydropower*

Sustainable Agriculture strategies against climate change: Its Recommendations

Dr. Puri M. G.¹ Dr. Kadam J. R.² Miss. Dahiphle T. P³

Assistant Professor (Agricultural Extension), Dr. Balasaheb Sawant Konkan Krishi Vidhyapeeth Dapoli, Tal. Dapoli Dist. Ratnagiri.415712(M.S.)

HOD & Associate Professor (Agricultural Extension), Dr. Balasaheb Sawant Konkan Krishi Vidhyapeeth Dapoli, Tal. Dapoli Dist. Ratnagiri.415712(M.S.)

Ph.D. Scholar (Agricultural Extension), Dr. Balasaheb Sawant Konkan Krishi Vidhyapeeth Dapoli, Tal. Dapoli Dist. Ratnagiri.415712

Corresponding author email: tejashridahiphle0101@gmail.com

Abstract

In Konkan region of Maharashtra variation in climate has been noticed since last decade, rain fed agriculture dominates the food grain production chain in Konkan region, any abrupt change in climate variables, particularly rainfall pattern poses serious threats to food and environmental security of the entire region. The region is less explored and very little is known, making the future climate change scenarios more uncertain for devising any conclusive mitigation and adaptation measures. Therefore, the present study was conducted in Konkan region of the Maharashtra state during the year 2019. Ex-post-facto research design was used. The sample was comprised of selected 50 respondents from each tahsils. Therefore, thirty villages from Palghar, Thane and Raigad tahsils, so total sample size was restricted to 300 which were personally interviewed. In this study Technical sustainability strategy are sustainable land use practices, increase in food-grain production. Communicational sustainability strategy are focus on advisory and extension services, strengthening weather forecast almering system, Financial sustainability strategy are input optimization strategies and income diversity, Institutional sustainability strategy are increase the institutional linkage and improve access to marketing systems, Social sustainability strategy are awareness and knowledge share and mitigation and adaptation policies and Environmental sustainability strategies are pollution control strategies and drought, flood management strategies given along with various recommendations. It is concluded that, a location wise action-research must be conducted to identify and document climate change effects and adaptation strategy. Local observations may provide a clear direction for future strategies and for planning and adaptation management programs in different ecological regions.

Screening of rhizobacterial strains for drought stress tolerance under *in vitro* condition

Sowmya, N. R^{1*}, Abhinandana, K. R¹. Lohith Kumar, N¹. and Krishna Naik, L¹

¹Department of Agricultural Microbiology, UAS, GKVK, Bengaluru

Corresponding author email: rshaiva2000@gmail.com

Abstract

Drought ranks among the severe environmental stresses that adversely affect crop productivity. By 2050 it ultimately reduces crop yield and productivity in a serious manner. Use of stress-tolerant plant growth-promoting rhizobacteria (PGPR) is expected to ameliorate the drought stress in plants. Therefore, this study was conducted to evaluate rhizobacterial isolates for drought tolerance ability. Initially, nine PGPR bacterial strains and reference culture were obtained from Department of Agricultural Microbiology, UAS, Bangalore and Kerala respectively. These strains were grown in Nutrient broth (NB) with different concentrations of (Polyethylene glycol) PEG-8000 (0 %, 5 %, 10 %, 15 %, 20 %, 25 %), which creates water potential 0.0MPa, -0.04MPa, -0.14MPa, -0.30MPa, -0.51MPa and -0.77MPa respectively. All of the tested bacterial strains displayed tolerance to osmotic stress by thriving under increased moisture stress conditions up to 20 % PEG 8000 concentration. *Staphylococcus succinus* exhibited the highest growth among the nine rhizobacterial cultures under normal and moisture stress conditions. The maximum growth (0.59 OD₆₀₀) was observed at 24 h at 0 % PEG concentration which greatly reduced (0.32 OD₆₀₀) under 20 % PEG 8000 concentration which was on par with reference culture and *Staphylococcus simiae*. This tolerance mechanism could help the plant to thrive under water stress environment, ultimately enhancing plant growth and survival under stress condition and serve as effective bioinoculants to sustain agricultural production in arid regions.

Keywords: Drought, rhizobacteria, PGPR

The Impact of Climate Change on Pulse Production and Productivity in India: An Analysis of Causes, Effects, and Mitigation Measures

Dr. Mohd Shah Alam¹, Dr. Jay Nath Patel¹, Dr. Anupam² and Yograj¹

¹ Assistant Professor, Department of Agronomy, ² Assistant Professor, Department of Pathology, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh

Abstract

Climate change is a major threat to global food security. Pulses are important sources of protein, and they are also important crops for farmers in many developing countries. Climate change is already having a negative impact on pulses production, and this impact is expected to worsen in the future. One of the main ways that climate change is affecting pulses is through changes in temperature and precipitation. Pulses are typically grown in semi-arid regions, and they are therefore very sensitive to changes in water availability. Pulses have been crucial in ensuring global food security and providing affordable access to protein for poor rural societies. Climate change is causing more frequent and severe droughts, which is reducing yields and making it more difficult for farmers to grow pulses. In the case of pulses, changing temperatures and disproportionate rainfall reduced productivity, despite the fact that per capita agricultural income has increased pulse yields. Certain studies predict that the continuance of certain (climate change) scenarios would diminish crop output by 40 to 45 percent in the future. There are a number of things that can be done to mitigate the negative impacts of climate change on pulses. These include developing new varieties of pulses that are more tolerant to drought and heat stress, improving water management practices, and using more sustainable farming practices. By taking these steps, we can help to ensure that pulses continue to be a major source of food and income for people around the world.

Keywords: Pulses, climate, temperatures, rainfall, sustainable farming

Climate Resilient Agri food System

Khushboo Shekhawat^{1*}, Ankita Singh², Kedar Mahadev Gheware³ and Vijay Kumar⁴

¹M.Sc. Student, Division of Soil Science and Agricultural Chemistry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, 180009, J&K, India

²M.Sc. Student, Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, 180009, J&K, India

³PhD Scholar, Division of Floriculture and Landscaping, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, 180009, J&K, India

⁴PhD Scholar, Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, 180009, J&K, India

* Corresponding author email: khushboo.shekhawat.2000@gmail.com

Abstract

Despite the fact that global food production has kept pace with population increase as a result of the Green Revolution. The United Nations (UN) State of Food Security and Nutrition in the World 2022 report indicated that the number of people impacted by hunger has risen to 828 million, with 29.3% of the global population food insecure and 22% of children under the age of five stunted. Furthermore, contemporary agri-food systems have a considerable influence on the environment and climate, including soil and water resources. Natural catastrophes caused by climate change, pandemics, and conflicts deteriorate food systems and worsen food poverty throughout the world. In spite of all these challenges, this presentation focuses on three key components of climate resilient agri-food system: conservation agriculture, vertical farming integrated with renewable energy resources, and carbon sequestration. Conservation agriculture practices enhance soil health, increase water efficiency and reduce greenhouse gas emission. Vertical farming, another crucial component of a climate resilient agri-food system, involves cultivating crops indoors in stacked layers, utilizing artificial lighting and climate control systems. Integrated with renewable energy resources like solar panels or wind turbines, vertical farms can operate with minimal external energy input and significantly reduce the carbon footprints associated with traditional farming practices. Moreover, vertical farming optimizes land use, reduces water consumption, and provides year-round production capabilities, ensuring a secure food supply amidst changing climate patterns. In addition to adopting sustainable agricultural practices, carbon sequestration (e.g.- using of phytoliths) plays a vital role in mitigating climate change impacts within the agri-food system. Carbon sequestration not only fosters ecological resilience but also offers potential economic incentives, such as participation in carbon markets, enabling farmers to diversify their revenue streams and build climate resilience. By embracing these strategies, we can enhance food production, increase resiliency to climate-related disruptions, reduce greenhouse gas emissions, and ensure sustainable farming practices for future generations.

Keywords: Agri-food System, Climate Change, Crop Diversification, Vertical Farming

Impact of drip fertigation on GHG emission and crop productivity of tomato

Keerthana Maveril M*, Manoj Khanna

Indian Agricultural Research Institute-ICAR, New Delhi-110012, India

Corresponding author email: maveril1998@gmail.com

Abstract

Drip irrigation is crucial for successful crop cultivation, addressing global challenges like water scarcity, food security, and poverty. Acknowledged for efficiency, drip systems minimize losses, enhancing irrigation water application efficiency (Vinot et al., 2014). The impact of water management on greenhouse gas (GHG)

emissions in different crops is significant. Implementing effective irrigation scheduling reduces over-irrigation, while advanced methods like drip irrigation curb water wastage and GHG discharge. Additionally, skillful fertilizer management plays a role in limiting nitrous oxide emissions resulting from excessive use (Yang et al., 2012). The present study focuses on understanding crop response, GHG emissions (specifically N₂O), and water productivity in drip-fertigated tomato crops subjected to various irrigation and fertilizer treatments. The field experiment conducted at PFDC, Water Technology Centre research field, ICAR-IARI, New Delhi during the rabi season of 2022-2023, aimed to assess the crop response and N₂O emissions under different fertilizer and irrigation levels. Three irrigation levels-Drip with 100% ET_c, Drip with 80% ET_c, and surface irrigation flooding along with three fertilizer doses-100% RDF, 80% RDF, and no fertilizer were tested, each replicated three times. CROPWAT 8.0 monitored irrigation scheduling, while nitrous oxide emissions were analyzed using gas chromatography. Results indicated that treatment T₂-100% ET_c x 100% RDF exhibited the highest yield increase (46.42 t/ha), closely followed by T₅-80% ET_c x 100% RDF with a non-significant difference of only 2.5%. T₅ also demonstrated 21% higher irrigation water productivity and 22% better economic water productivity compared to T₂, despite using less water. Surface irrigation resulted in higher nitrous oxide emissions compared to drip irrigation, emphasizing the environmental benefits of efficient water and fertilizer management. Notably, the study suggests that maintaining yields in 80% ET_c is achievable with reduced GHG emissions, offering a sustainable approach to crop cultivation.

Assessment of Spring Water Quality: Towards Effective Water Resource Management

Vijeta Thakur¹ and Dr SK Bhardwaj²

¹*PhD Research Scholar, Department of Environmental Science, Dr Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Solan- 173230, India*

²*Professor and Head, Department of Environmental Science, Dr Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Solan- 173230, India*

Corresponding author email: vijetathakur296@gmail.com

Abstract

Springs are the main supply of freshwater, ensuring rivers adequate water availability, sustaining plants by feeding moisture to the soil, and offering the necessary base for habitation and life. It is an important resource that can be used to meet requirements of people and preserve the equilibrium of other microhabitats. Mandi is a district in Himachal Pradesh, India that has access to spring water resources, which are considered natural jewels bestowed upon Himalayan states. A significant segment of the global population depends on natural springs to fulfill their housing and subsistence requirements. The water quality and flow of the springs significantly varies with location and season. The health of the springsheds-maintained by sufficient vegetation cover, good soil, aquifer depth, and sufficient precipitation—determines the quantity and quality of spring water. Springs are in danger of drying up on a global scale. In order to effectively manage water resources and ensure the sustainability and safety of this important natural resource, spring water quality monitoring is a must. The objective of this study is to thoroughly assess spring water quality while taking into account a range qualitative and quantitative characteristic. All the physical, Chemical and biological parameters of studied spring water sources were under good condition. However, there was very low discharge in some of the spring sources due the factors like land use changes, anthropogenic changes in spring shed areas. Therefore, springs need to be managed effectively by scientific and community participation actively in all stages of the rejuvenation program in order to assure long-term water management. This study looked at the risks and the strategies for managing water resources effectively in the face of shifting climatic patterns.

Keywords: Freshwater, Himalayas, springs, water quality, climatic patterns, resource management

Potential evapotranspiration spatio-temporal trend analysis at different agro-climatic zones of Haryana, India

Rahul Punia^{a*}, Anurag^a, Pardeep Kumar^b

^A*Department Of Agricultural Meteorology*

^B*Department Of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana) - 125004*

Corresponding Author Email: rahulpuniadevigarh1108@gmail.com

Abstract

Evapotranspiration is the integrated process of evaporation and transpiration and is affected by meteorological variables, crop characteristics, and management practices, as well as environmental characteristics. The present study was carried out at Deptt. of Agricultural Meteorology, CCS HAU Hisar, to compute spatio-temporal trend analysis of evapotranspiration at different location of Haryana viz. Ambala, Karnal, Bawal, Hisar and Sirsa that are evenly distributed in two agroclimatic zones of Haryana. The study was based on PET calculation by maximum and minimum temperature using Thornthwaite method. The calculated values were interpreted on monthly as well as seasonal scales. Highest normal annual PET was at Sirsa with 5.5 mm/day followed by Bawal (4.72 mm/day), Hisar (4.55 mm/day), Ambala (4.34 mm/day) and Karnal (4.14 mm/day). The annual PET had an increasing trend as per MK test at all locations. Sirsa and Ambala had significant +ve trends. In *Kharif* season, Sirsa had highest PET while in *Rabi*, Ambala showed highest value of normal PET. An increasing trend was observed at all locations during *Kharif* and *Rabi* seasons but significant trends were revealed at Sirsa and Ambala in *Kharif*, and Bawal and Ambala in *Rabi* seasons. In winter season (January-February) all stations had a decreasing trend of PET with significant decreasing trends at Karnal location. On monthly scale, June had the highest and January had the lowest value of PET in Haryana as observed at all five locations. Month of October observed with significantly increasing trends in PET at all locations expect for Karnal. January and December months observed with decreasing trends at all location. Overall the state of Haryana as a whole, 4.56 mm/day was found as a normal annual potential evapotranspiration, likewise seasonal normal were 7.6 mm/day in *Kharif*, 1.5 mm/day in *Rabi*, 0.6 mm/day in winter, 5.5 mm/day in pre monsoon, 7.8 mm/day in monsoon and 1.9 mm/day in post monsoon period.

Keywords: Potential Evapotranspiration, Mann-Kendal Test, Sen's Slope, Trend

Economic Resilience of Farm Households Towards Climate Change: A Scenario Analysis of Coastal Plains of Kerala

Pooja Krishna J¹, Jayalekshmi, G²

¹*Department of Agricultural Extension Education, College of Agriculture, Vellayani*

²*Associate Professor and Head, ICAR-KVK Kottayam, Kumarakom*

Corresponding author email: poojakrishnaj142@gmail.com

Abstract

Kerala, with its unique geography and climate, is particularly susceptible to the impacts of climate change, including rising temperatures, changing precipitation patterns, and increased frequency of extreme weather events. Building resilience against climate change is crucial for safeguarding the well-being of communities, protecting the environment, and ensuring the sustainable development of societies in the face of a rapidly changing climate. Economic resilience in agriculture is imperative for the coastal plains of Kerala, where the unique challenges posed by climate change require adaptive strategies, diversification, and sustainable practices to ensure the continued prosperity of farmers and the resilience of the agricultural sector. To have a better

understanding about the strength and weaknesses of agricultural communities of coastal plains of Kerala, in terms of economic factors, a study was conducted to assess economic resilience of farm households of five agro-ecological units (AEUs) of coastal plains zone in Alappuzha of Kerala, through development of Economic Resilience Index (ERI). Data was collected through focus group discussions, personal interviews, key informant interviews and discussion with expert groups. Economic Resilience Index was developed on the basis of three dimensions- absorptive, adaptive and transformative capacities assessed using thirteen indicators. The economic resilience of farm households in *Kuttanad* (0.521) was found to be lower than the mean ERI (0.573) of all six AEUs; whereas, those in AEU 7 (*Kaipad*) had the highest economic resilience (0.677). Farm households in the Coastal plains exhibited varying economic resilience, with notable differences. While absorptive, adaptive, and transformative capacities showed no significant variation, the economic resilience of farm households of five AEUs differed significantly. Absorptive capacity relied on credit and government support, adaptive capacity on subsidies and diversification, and transformative capacity on minimum support price and value addition. To enhance climate resilience, concerted efforts between local and scientific communities, supported by policies, are essential. Economic resilience hinges on adopting climate-smart practices, diversifying crops, implementing water management, and accessing financial and technological resources. Government policies, community initiatives, and investments in resilient infrastructure and research further contribute to agricultural resilience in the face of climate change.

Key words: Absorptive capacity, Adaptive capacity, Transformative capacity, Coastal plains

Millet’s cultivation: an approach towards climate resilient agriculture for North Western Himalayas

Reena Kumari, Rajeev Kumar, Shikha Bhagta and Kumari Shiwani

Dr YS Parmar University of Horticulture and Forestry, College of Horticulture and Forestry Thunag-175048, Mandi (HP)

Corresponding author email: reena.sarma92@gmail.com

Abstract

Millets, a group of ancient cereal grains have emerged as a focal point in a search for sustainable and nutritious food sources in recent years, and particularly in India. It also plays a significant role in addressing global challenges *viz.*, changing climate scenario and promoting sustainable development. Recognizing the significance of these nutritious cereals, the United Nations has marked the year 2023 as the International Year of Millets. India is the largest producer of millets in the world, and accounts for more than 40 per cent of the global consumption. Millet cultivation is the main stay of rainfed farming which provide livelihood to nearly 50 per cent of total rural work force and sustain 60 per cent of cattle population in India. Millets possess exceptional nutritional value, being rich in protein, fiber, vitamins and minerals. Millets are also gluten-free, nonglycemic index alternatives that promote good health and well-being. Their inclusion in diets helps combat malnutrition and achieve zero hunger. Traditionally, these climate-resilient millets crops were cultivated through rain-fed farming methods, where the seeds were sown directly into the prepared field. These hardy crops grow in a variety of agro-climatic conditions, requiring less water and inputs in comparison to other primary cereal grains. Millets are known for their ability to withstand drought, high temperatures and poor soil conditions, making them an ideal crop for sustainable agriculture and food security. Millets have a short growing season, allowing farmers to harvest multiple crops in a year. Being resilient to drought, pests and diseases, making them a reliable choice for farmers in regions with limited water resources and unpredictable weather patterns. Their remarkable ability to grow in harsh environmental regions with poor soil quality, making them a reliable crop for communities facing challenging environmental conditions. Governments, non-governmental organizations and research institutions are working together to promote awareness, produce improved millet varieties and implement policies that benefit millet farming communities.

Keywords: Millets, Nutri cereals, Drought and Climate resilient agriculture

Theme 3: Shaping Future Agricultural Strategies for the Well-being of Humanity and the Environment

Use of Mycorrhizal fungi as a Biofertilizer: Benefit from Past Success

*¹Shivani, ²Dr. Hem Chander and ³Dr. Ritika Singh

¹Research Scholar, Division Botany, Department of Biosciences, Career Point University, Hamirpur, Tikker (Kharwarian), Bhoranj Hamirpur, 176041

²Associate Professor, Division Botany, Department of Biosciences, Career Point University, Hamirpur, Tikker (Kharwarian), Bhoranj Hamirpur, 176041

³Assistant Professor, Abhilashi University, Chail Chowk, Mandi, 175028

*Corresponding author email: shivanikondal4@gmail.com

Abstract

Population size is increasing gradually and land sources are limited. Population size posing a great challenge in ensuring food security. To meet the challenge, the focus is on excess use of chemical fertilizers for increasing the production of food and security and due to increased use of hazardous chemical fertilizers pose a great concern for the future of sustainable agriculture. Biofertilizers are a promising substitute to hazardous chemical fertilizers and are very important for attaining sustainable agriculture. Biofertilizers are the microorganisms (Fungi, bacteria, cyanobacteria, etc.) that play a key role in supply of nutrients, increasing crop yield and maintaining long-term soil fertility, which is essential for meeting global food demand. A high level of dependence on chemical fertilizers for increasing food production has damaged the ecological balance and human health and is becoming too expensive for many farmers to afford. Microorganisms, such as mycorrhizal fungi, have demonstrated their ability in the formulation of biofertilizers in the agricultural sector.

Keywords: Mycorrhizal Fungi, Biofertilizer, and Security

Alkaline Protease Production from Agrowastes by Solid State Fermentation

Nity Sharma^{1*}, Harmanjit Kaur Goindi²

¹School of Agricultural Biotechnology, Punjab Agricultural University, Ludhiana

²Bhojia Institute of Life Sciences, Himachal Pradesh University, Shimla

Abstract

In every country, agriculture is very important and preferable activity. Wastes liberated from these agricultural activities are called agricultural wastes or agro wastes. In many countries, agrowastes are generated in large amounts and are mostly subjected to burning and landfilling which are leading to the plenty of environmental pollution every year. As agrowastes are byproducts of agricultural activities and is the valuable source of nutrients which are suitable for the growth of microorganisms. Agricultural residues used for various applications are sugarcane bagasse, brans, rice bran, wheat bran, defatted soybean meal and sunflower meal as a sole carbon source and also organic wastes such as peanut husk, linseed residues, coconut coir dust, rubber seedpod, spent cashew nut shell, straw from wheat and rice, sugar beet pulp, coffee pulp, rice husk etc. In the present study, we took five soil samples and a total of 68 bacterial strains were isolated on soyabean digest agar at pH10. Four strains namely D/b, E/k, D/c and C/m were selected after primary screening as they showed protease activity on skimmed milk agar upto pH12. The rate of enzyme production was maximum for the bacterial strain D/c, therefore were selected after secondary screening. Molecular, biochemical characteristics and molecular techniques suggested that the bacterial strain is a novel bacterium belonging to the family *Bacillales* *Incertae* Sedis XII, class *Bacilli* and named *Exoguobacterium Indiana* D/c. *Exoguobacterium*

Indiana D/c shows maximum protease production with 2% agrowaste of *Phaseolus vulgaris*, Chunks of *Glycine max* and equimolar mixture of *Phaseolus vulgaris* + *Glycine max* + Chunks of *Glycine max*. The optimum pH and temperature for alkaline protease production was 11 and 30°C respectively. Cupric ions show stimulatory effect on alkaline protease production whereas barium and cobalt show inhibitory effect. Supplementation of glucose decreases the alkaline protease production on the agrowaste whereas sucrose and tyrosine enhance alkaline protease production. Further, this study will help in utilization of the protease producing bacteria on large scale.

ARIMA Model Forecasting of Area, Production, and Productivity of Total Rice in Jalpaiguri District of West Bengal

¹Nishtha Pradarshika Rai* and ²Satyananda Basak

¹Presenting author: ¹Research Scholar, Department of Agricultural Statistics, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165

²Professor, Department of Agricultural Statistics, Regional Research Station (Terai Zone), Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165

Corresponding author email: nishtharai14@gmail.com

Abstract

Rice is a principal crop in Eastern India and is predominantly grown in West Bengal. West Bengal ranks first in area and production of rice in India. Among all the Districts of North Bengal, Jalpaiguri ranks fifth in Area, Production, and Productivity of Total rice. This study attempts to forecast the area, production, and productivity of Rice (total of three seasons: Aus, aman, and, boro) in Jalpaiguri District of West Bengal. The yearly time series data of rice was modelled by fitting the Univariate Box Jenkins -Autoregressive Integrated Moving Average method. The study aims to find the appropriate model using the UBJ-ARIMA technique that qualifies the goodness of fit criteria. Rice data for 1977-2022 was taken for this study out of which 1977-2013 was taken for model building and 2014-2022 to test the model. For rice area, production and productivity, ARIMA (1,1,0), ARIMA (1,1,3), and ARIMA (0,1,3) respectively were found suitable. These models were selected based on the lowest values of AIC, BIC, RMSE, MAPE, MAE, and Theil's U statistic. Forecasting for 2023-2028 is done and it is seen that the rice area in Jalpaiguri District has a decreasing trend; production is more or less constant, while productivity is increasing.

Constraints faced by farmers practicing natural farming in Himachal Pradesh

Komal Sharma¹, Manoj Gupta² and Nandita Sharma³

^{1,3}Assistant Professor, School of Agriculture, Abhilashi University, Mandi

²Principal Extension Specialist, Department of Agricultural Economics, Extension Education and Rural Sociology, CSKHPKV, Palampur

Corresponding author email: komalsharma002@yahoo.com

Abstract

The present study was undertaken to study the constraints faced by farmers in practicing natural farming. A sample of 120 farmers practicing natural farming was selected from district Kangra and Solan of Himachal Pradesh. In the following study, it was observed that various problems were faced by the farmers practicing natural farming. These problems were ranked according to the priority by using Garrett's ranking technique. All

the sampled farmers in natural farming system confronted thirteen problems in the studied area and the major problem faced by the farmers was found as labour intensive technique with Garret rank of 74.45. This problem has been followed by shortage of skilled labour (71.28), high wage rate (66.45), lack of market information (58.96), non-availability of specialized market (55.77), low productivity level of naturally grown crops (52.80), lack of adequate information about SPNF (48.07), unfair price for produce in market (44.38), non-availability of raw material (41.16), lack of certification (33.27), lack of irrigation facility (29.10), consumer unawareness about SPNF produce (23.57), lack of extension facilities (5.27). Lack of extension facility was ranked last which means extension officers were putting huge efforts to facilitate the farmers regarding natural farming. Although government is providing assistance to the farmers for cow, drums, cow shed lining and *sansadhan bhandar* but to upscale the scheme more investment need to done to encourage the farmers. Investment in research and development must be ensured and sustained so that optimal harnessing of natural farming should be ensured.

Conservation agriculture for resource use management

M.P. Priyadharshini¹, S. Naveenkumar²

^{1,2} Ph.D. Scholar, Department of Agronomy, Faculty of Agriculture, Annamalai University

Corresponding author email: smp.surabi97@gmail.com

Abstract

Agriculture is the most important sector in India accounting for 13.7 percent of the country's GDP and employs more than 60 percent of the labour force. Intensification of agriculture with the introduction of high-yield varieties, judicious fertilizer application and efficient pest control after the Green Revolution, have made the country self-sufficient in food grain production but the productivity levels are still low and stagnating. Conservation agriculture (CA) is considered a sustainable practice with the potential to maintain or increase crop productivity and improve environmental quality and ecosystem services. It typically improves soil quality and water conservation; however, its effect on crop productivity is highly variable and dependent on local conditions/management. Crop residue retention plays a crucial role in CA and can help to improve overall soil health and ultimately crop productivity and sustainability. In addition, Conservation agriculture has been proposed as one of the components in climate-smart agriculture, owing to its reduced period to seed/plant next crop, reduced soil disturbance and low consumption of fossil fuels. Therefore, compared to conventional intensive tillage, Conservation agriculture has a greater potential for soil carbon sequestration, favours higher soil biodiversity, lowers greenhouse gas emissions and can assist in mitigating climate change. Conservation agriculture represents a promising approach to resource use management in agriculture. By prioritizing soil health, water conservation and biodiversity, CA offers a pathway toward sustainable and resilient agricultural systems in the face of environmental challenges.

Keywords: Conservation agriculture, land degradation, soil health, yield

Nurturing Sustainability: Exploring Seed Priming using Zinc Sulphate Nanoparticle for Enhancement of Growth and Antioxidant Status in *Solanum lycopersicum* L

Sheetal Chand*, Sandeep Arora, Rahul Anand, Himanshu Singh

Department of Molecular Biology and Genetic Engineering, College of Basic Sciences and Humanities, G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India- 263145

Corresponding author email: e-mail: chandsheetal8@gmail.com

Abstract

The exponentially expanding global population and decrease in cultivable agricultural land due to extensive urbanization, unsustainable farming practices and heavy dependency on chemical fertilizers and pesticides to boost yields have precipitated substantial challenges within the agricultural sector. Unfortunately, this prevailing practice has engendered adverse repercussions for both environmental integrity and consumer well-being, as the indiscriminate application of chemical fertilizers disrupts ecosystems and compromises soil fertility, critical for agricultural productivity.

To address these pressing concerns, this study investigates the efficacy of nano-seed priming in enhancing seed germination and subsequent growth of *Solanum lycopersicum* seedlings. Seeds of *Solanum lycopersicum* (variety: Pant-Polyhouse Tomato-1) underwent priming with escalating concentrations (0–640 ppm) of zinc sulphate nanoparticles across varying durations (6, 12 and 24 hours), assessing their impact on seed germination, seedling vigor, antioxidative mechanisms, and photosynthetic efficiency. The findings revealed that nano-seed priming conferred a remarkable enhancement in seed germination, achieving a notable increment of up to 200% compared to control treatments, thereby indicating its potential to mitigate factors associated with seed dormancy. Moreover, the investigation underscores the considerable influence exerted by nanoparticle type, concentration and priming duration on various germination and growth parameters. Specifically, an inverse relationship between nanoparticle concentration and priming duration was observed to yield optimal results in terms of seed germination and seedling vigor. Notably, nano-seed priming with zinc sulphate exhibited maximal efficacy at concentrations of 160, 80 and 20 ppm, accompanied by respective incubation durations of 6, 12 and 24 hours, demonstrating its viability as a potent approach for enhancing seedling growth and antioxidative defences. Furthermore, an augmentation in the photosynthetic efficiency of young seedlings was discerned following the zinc sulphate nano-seed-priming treatment, elucidating its multifaceted benefits in promoting sustainable agricultural practices.

Effect of different levels of nitrogen on wheat crop

Simran¹, Dr. Mohd Shah Alam² and Rakhi¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Corresponding author email: simichauhan785@gmail.com

Abstract

Wheat (*Triticum aestivum* L.) is a staple food of the world and it belongs to family Poaceae. It provides about 20% of the total food calories for the human race (Reddy, 2004). India is one of the main wheat producing and consuming countries in the world. Wheat yield and its quality depend upon the environment, genotype, and their interactions. Low soil fertility, especially nitrogen (N) deficiency, is one of the major constraints limiting wheat production of India. Inadequate supply of available N frequently results in plants that have slow growth, low protein levels, poor yield of low-quality products, and inefficient water use. Therefore, the application of nitrogen fertilizer at the right rate and time is vital for the enhancement of crop productivity and fertility. High levels of N supply results in higher protein content, but increased efficiency of utilization is realized when the concentration in the kernels increases and grain yield remains stable (Ortiz Monasterio et al., 1997). Nitrogen is an integral part of proteins, phytochromes, compounds, coenzymes, chlorophyll and nucleic acids. All the biochemical processes occurring in plants are mainly governed by nitrogen and its associated compounds which make it essential for growth and developments of wheat. Therefore, it is necessary to apply nitrogenous fertilizer in soil to get bumper yields of wheat (Ali et al., 2000). Nitrogen insufficiency influences biomass synthesis and use of sun energy for productivity of the plant, with an extraordinary effect on grain yield and yield contributing parameters (Heinemann et al., 2006).

Integrated Nutrient Management (INM)

Ritika Gupta¹ and Jay Nath Patel²

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: ritikagupta1644@gmail.com

Abstract

The biggest issues facing agricultural planners globally are the global visions of zero poverty, food security and hunger target followed by agricultural transformation that raises rural resident’s standards of living. Agronomic methods need to alter immediately because of the concerning rate of population expansion and the lack of cultivable land. These changes could have a major impact on agricultural productivity and production. In this context, the idea of utilising multiple plant nutrition sources in concert to prevent nutrient depletion, preserve soil health and increase crop yields also known as integrated nutrient management has a promising application. Integrated nutrient management is the process of optimizing the advantages from all potential sources of organic, inorganic, manures and biological components (biofertilizers) in an integrated way in order to maintain soil fertility and plant nutrient delivery at an optimal level for maintaining the target productivity. Earlier farming methods were simply managed without the use of artificial fertilizers or any of their by-products. In order to fully meet the growing need for food and nourishment, fertilizer was first used during the green revolution in the middle of the 19th century. However, as the agricultural system changed quickly, organic farming emerged as a way to combine an environmentally friendly farming method and avoid using fertilizers. The concept of integrated nutrient management was thus introduced and it has the potential to both improve crop quality and productivity when compared to relying just on chemical fertilizers. It has been reported recently by a number of researchers that using inorganic, organic, and biofertilizers in combination with green manure is becoming a more productive way to improve soil and crop health as well as increase crop output. Moreover, INM enhances the physical, chemical and biological characteristics of the soil and promotes the activity of soil microorganisms. Last but not least, integrated nutrient management (INM) is a beneficial agricultural practice that all those who care about the environment and agriculture should adhere to in order to preserve soil health and nutrient balance.

Keywords: Biofertilizers, fertilizers, food security, INM, plant nutrition and organic manures

Integrated Weed Management in Oat crop

Komal¹, Dr. Mohd Shah Alam² and Rakhi¹

¹M. Sc Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

² Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Corresponding author email: janjuhakomal@gmail.com

Abstract

Integrated weed management (IWM) is a science-based decision-making process that coordinates the use of macro and micro-environment information, weed biology and ecology, and all available technologies to control weeds by the most economical and ecologically viable methods. Integrated weed management is a multi-disciplinary approach (Sanyal et al. 2008) that involves chemical and cultural methods of weed management. As described by (McDonald et al. 2009), yield loss due to weed competition is thought to be one of the main causes of lower productivity in many agricultural crops. Reduction in crop yield due to weeds has been recorded up to 20 to 40% in winter cereals, depending upon the nature and persistence of weed population. The nutritive value of forage oat is high with dry matter digestibility in excess of 75 per cent when fed to dairy cattle (Stevens et al. 2004). Forage oat (*Avena sativa* L.) is a prominently cultivated winter forage crop in India. Herbicide applied alone either pre- emergence or post-emergence was undoubtedly better than hand weeding once at 21 DAS to

reduce weed infestation in fodder oat. The weeds in weedy check plot removed the highest amount of nitrogen from the soil. There is currently a net deficiency of 35.6% green fodder, 10.95% dry fodder and 44% concentrate feed materials in the country (Singh, 2020). Hand weeding twice at 21 & 35 DAS was found most favourable to record the lowest weed density, weed biomass and highest value of weed control efficiency, nitrogen uptake by crop, and green fodder yield.

Integrated Nutrient Management in Oat crop

Rakhi¹, Dr. Mohd Shah Alam² and Komal¹

¹M. Sc Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Corresponding author email: kashyapprakhi052@gmail.com

Abstract

Oat (*Avena sativa* L.) is one of the most important cereal forage crops of *Rabi* season and can be cultivated successfully in fallow lands along with proper nutrient management for obtaining maximum yield from the available area. Oat being a fast growing and high yielding fodder crop, it requires a large quantity of nitrogenous fertilizers for enhancing production of quality herbage and the growth of fodder oat is directly related to the nutrient supply (Sharma et al.2004). Security and environmental safety are the two important areas receiving major setback with the use of chemical fertilizers. Sustainable food supply in response to population demand urges for a paradigm shift from chemical-based agriculture to some eco-friendly approaches. Integrated nutrient management or combined approach of using different sources of nutrients is relevant in this context as it optimizes profitable crop production and improves soil health without deteriorating environment further (Manoj Pandey 2018). Food supply not only comes from agriculture but also from livestock sector. Therefore, cultivation of dual purpose (food and fodder) crop like oat is gaining importance day by day. Adequate nutrition to oat directly reflects on livestock and human nutrition. Researches around the globe indicate that integrated nutrient management in oat is now gaining momentum as it holds good promise as a successful replacement of sole chemical fertilizer (Har Mohan Singh et al.2009). However, poor extension service and lack of policies make this technology to remain as a dormant. Therefore, further research works regarding integrated nutrient management on oat and its true transfusion to farming community are the needs of the hour to protect livestock and human food security and to free the environment from clutches of chemical hazards in coming days.

Effect of integrated nutrient management in mung bean

Sahil Chauhan¹, Jay Nath Patel², Vishal Chaudhary¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

²Assistant professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: sahilchauhan624.sc@gmail.com

Abstract

Agriculture helps to meet the basic needs of human beings by providing food, clothes, medicine and shelters. As the population is increasing day by day, the demand of agriculture is also increasing as the demand for the supplies is increasing and the land under cultivation is decreasing. As the conventional method of farming is depleting the soil health by the use of excessive inorganic fertilizers, the productivity of soil is also depleting. Organic farming was seemed to fix the depletion of soil but it is unable to conquer the food requirement of the people. Therefore, the concept of integrated nutrient management is emerged to maintain the equilibrium to maintain the soil health and productivity. In this approach, the organic and inorganic sources of nutrients along with biofertilizers are used to improve the soil fertility and to maintain the yields. Integrated nutrient

management helps to improve the physical, chemical and biological properties of soil and promotes the activity of micro-organisms. Mung bean is a legume crop known for its nutritive value. The application of nutrients through organic, inorganic and biological sources enhances the yield quality and productivity as well as restores the soil health. The overall yield of mung bean crop has been found to be increased through the integrated nutrient management practices. The test weight of the seeds is also found to be increased due to the addition of organic matter and application of biofertilizers. The biofertilizers are found to play an important role in the fixation of nitrogen and phosphorus solubilization for the increased yield of mung bean and also increases the nutrient content in the soil. As mung bean is a legume crop, thus it also helps in the nitrogen fixation in the soil through the nodule formation. Therefore, integrated nutrient management is helpful to increase the yield of mung bean as well as it is helpful to maintain the soil quality for longer time. The adoption of integrated nutrient management in mung bean is helpful approach to get better yield and to sustain environment.

Keywords: Integrated nutrient management, mung bean, biofertilizers, productivity and soil health

Intercomparison of organic and inorganic fertilizer in Wheat crop

Akshay Kumar¹, Dr. Mohd Shah Alam² and Sandeep¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University, Mandi, (H.P.)

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University, Mandi, (H.P.)

Corresponding author email: ac8031901@gmail.com

Abstract

Production of enough food to feed the growing population is an important challenge for India. In modern agriculture fertilizers are important element. In this era, agriculture without fertilizers is not possible. Use of organic and inorganic types of fertilizers helps in the improvement of crop yield. The overuse of chemical fertiliser application to increase crop productivity caused several soil problems, such as structure deterioration, organic matter reduction, fertility declination, physicochemical plus microbial changes, erosion, and groundwater pollution (Liang et al. 2013). Wheat is the second most important crop in India and a principal source of calorie intake. It has been under cultivation in the Indian subcontinent from pre-historic times and is an integral part of the country's economy and food security. Long-time research which was conducted in several locations has shown that in addition to natural resource deterioration and biotic- abiotic stress, deficiency of multiple nutrients is also an essential factor that influences yield reduction, productivity declination and shrinkage in net profit. Therefore, Integrated Nutrient Management in terms of using chemical fertilizers in conjugation with organic manures as well as biological inputs is needed to improve the nutrient status of the soil. INM increases the nutrient uptake rate of the plant and influences the nutrient supply in the soil system. As soil is the primary source of nutrients, any degradation in the quality of soil can create a reduction in crop yield. Hence the adoption of suitable measures is highly necessary for sustaining the environment and enhancing productivity. Organic fertilisers are commonly applied instead of mineral fertilisers to enhancing the sustainable agricultural ecosystems without affecting the yield and quality (Hernández et al. 2016).

Integrated Farming System: Model and scope in Himachal Pradesh

Sandeep¹, Dr. Mohd Shah Alam² and Rakhi¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi (H.P.)

Corresponding author email: sandeepchaudhary53622@gmail.com

Abstract

Indian economy is mainly agriculture oriented. Small and marginal farmers are the core of the Indian rural

economy constituting 85% of the total farming community but possessing only 44% of the total operational land (Gol 2014). The declining trend of per capita land availability poses a serious challenge to the sustainability and profitability of farming (Siddeswaran et al. 2012). Due to ever increasing population and shrinking land resources in the country, practically there is hardly any scope for horizontal expansion of land for food production. Integrated farming system is a sustainable agriculture system that integrated the livestock. Crop production, fish, poultry, trees, crops plantation and other system that benefits each other's. In this system, an inter-related set of enterprises are used so that the waste from one component becomes an input for other enterprises of the system, which reduces cost and improves production and thereby income. Based on the research works conducted all over the country, it is clear that crop cultivation alone can't fulfil the demand of food and nutritional requirement and we have to focus on multi-component farming as it is the only way of efficient resource recycling within the system with increased economic profitability, economic stability, enhanced soil sustainability, and preserving environmental quality and maintaining biological diversity and ecological stability. Integrated farming system as a mixed farming system that consist of atleast two separate but logical interdependent part of crop and livestock enterprises.

Tillage based weed management practices in maize crop

¹Vivek Kaushal and ²Priyanka Kumari

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

Maize (*Zea mays* L.) is a versatile crop, growing across a range of agro-ecological zones gets infested with variety of weeds and subjected to heavy weed competition during the crop period. Crop management practices like tillage, planting methods, irrigation and weed control practices were found to reasonably manage the weeds and improve the crop yield. Conservation tillage/zero tillage has its own advantages over conventional tillage. It control weeds, adds organic matter, improves soil and water quality, increases infiltration, decreases run-off and pollution in addition to less soil disturbance and lesser erosion. Weed management through physical means/hand weeding provide clean and thorough weeding but making it more laborious, tiresome and expensive. Under the situation, pre and post-emergence herbicides at different times showed effective weed control and has also results in minimizing cost and time. But overreliance on chemical weed control involves excessive use of herbicides, resulting in pollution of environment and herbicide-resistant biotypes. Integrated weed management approach involving physical (hand weeding) and chemical (use of herbicides) methods in maize is very important to provide effective and acceptable weed control for realizing high production.

Keywords: zero tillage, integrated weed management, herbicides

Nutraceutical value of Vegetables

Ankita*, Sandeep Kumar, Manish Chauhan

Department of Horticulture, School of Agriculture, Abhilashi University Mandi -175028 (Himachal Pradesh)

Corresponding author email: anktha2000@gmail.com

Abstract

In recent years there is a growing interest in nutraceuticals which provide health benefits and are alternative to modern medicine. Nutrients, herbals and dietary supplements are major constituents of nutraceuticals which make them instrumental in maintaining health, act against various disease conditions and thus promote the quality of life. Vegetables are major source of biologically active nutraceuticals and playing an important role in human diet. Nutraceuticals have been explored recently as sustainable alternatives for the control and prevention of large number of diseases. Some of the common phyto-nutraceuticals such as lycopene from tomato,

carotenoids from carrot etc. play vital role in disease prevention/reduce disease risk factors through antioxidant activities. Vegetables are the essential part of balanced diet since they are good source of phytonutrients and nutraceutical compounds. Vegetables are rich source of carbohydrates, proteins, vitamins and minerals, hence known as protective foods. Eating a low-fat, plant-based vegetarian diet may boost the immune system. The most important phyto- nutraceuticals in vegetables that have biological activity against chronic diseases are: vitamins, minerals, dietary fiber, organosulfur compounds (glucosinolates and thiosulfides) and flavonoids. Phytochemicals are broadly described as phytoestrogens, terpenoids, carotenoids, limonoids, phytosterols, glucosinolates, polyphenols, flavonoids, isoflavonoids and anthocyanidins. They have tremendous impact on the health care system and may provide medical health benefits including the prevention, treatment of diseases and physiological disorders. The present review has been devoted towards better understanding of the phyto-nutraceuticals from different vegetables based on their disease specific indications and enhancing nutraceutical qualities of vegetables through biotechnological/molecular approaches.

Keywords: Vegetables, Nutraceutical, Phytochemical, Diseases

Extraction of bioactive compounds from kinnow flavedo by ultrasonication assisted natural deep eutectic solvent

*Taru Negi¹, Anil Kumar¹, Satish Kumar Sharma¹, Archana Gangwar¹

¹*Department of Food Science and Technology, College of Agriculture, G.B. Pant University of Agri. & Technology, Pantnagar-263145, Uttarakhand, India*

Corresponding author email: tarunegi12@gmail.com

Abstract

Citrus fruit processing industry generates huge amount of citrus peel which is a treasure of bioactive compounds. Conventional organic solvents (COSs) such as hexane, methanol are used for the extraction of these bioactive compounds which have high toxicity, less biodegradability, high flammability, and volatility in nature. Thus, in present work, Natural Deep Eutectic Solvent (NADES), alternative to COSs, was used which is eco-friendly and less volatile in nature. In this study, 1,2 propanediol NADES was used as a solvent in ultrasonication assisted extraction of bioactive compounds from citrus peel. Parameters such as solid-liquid ratio (1:20 g/mL), water content (30 %) and temperature (50 °C) were kept constant whereas time and power of ultrasonication were varied. Total phenol content (41.55 mg/100 gm dw) and total flavonoid content (8.64 mg/100 gm dw) were found highest at 30 min time and 200 W power. Also, antioxidant capacity of obtained extract was determined by three different methods i.e. DPPH, ABTS and FRAP. Further, antioxidant potency composite index was computed from DPPH, ABTS and FRAP assay. Highest antioxidant capacity was observed at power of 200 W for 30 min. time which was higher than the traditional solvent (i.e. 80 % methanol) used in this study. Our finding suggests that 1,2 Propanediol NADES coupled with ultrasonication assisted extraction can be successfully used for extraction of bioactive compounds from kinnow peel and the prepared extract can be further utilized for the enrichment of functional food.

Keyword: citrus peel, ultrasonication, natural deep eutectic solvent, antioxidant capacity

Bioremediation: An Iconic Method for Vegetable Waste Management

Akankshi Sharma*, Sandeep Kumar, Manish Chauhan, Yasmin

Department of Horticulture, School of Agriculture, Abhilashi University Mandi – 175028 (Himanchal Pradesh)

Corresponding author email: akankshisharma2000@gmail.com

Abstract

Bioremediation technologies are one of the novel approaches in the field of waste and environment management and are presently gaining massive credibility for being environmentally-safe. The use of this microbe-based bioremediation has become more popular as a low-cost, environmentally safe method of treating waste that

contains hazardous petroleum hydrocarbons. Vegetable and fruit wastes are produced in large quantities in markets and constitute a source of nuisance in municipal landfills because of their high biodegradability. In India, vegetable and fruit waste constitute about more than 10 million tonnes annually and currently these wastes are disposed by dumping on the outskirts of cities. The main contributors of waste generation in Indian society are agriculture and municipal sectors. Vegetable wastes can also be treated using this method of bioremediation, in which pollutants are changed from their original state by the microorganisms in a natural or biological process. According to several studies and experimental data food waste has been demonstrated to be a compositional and potential feedstock for the production of a variety of sustainable products. In addition to this, several researches have also demonstrated the effectiveness of bioremediation in reducing environmental problems by turning food waste into more easily adapted materials and a variety of agrochemicals into non-toxic compounds like pesticides, herbicides, insecticides, etc.

Keywords: Bioremediation, Environment, Microorganisms, Vegetable waste

Qualitative Screening of Microbial Isolates for Gluconic Acid Production

D. Vijaysri¹, Livleen Shukla¹, S. T. M. Aravindharajan¹, S. H. Manoj¹

¹*Division of Microbiology, ICAR-IARI, New Delhi-110012*

Abstract

An attempt was made to isolate bacteria and fungi from different agro and horti-wastes for gluconic acid production. Glucose enriched nutrient agar medium and potato dextrose agar medium was used for bacteria and fungi respectively. It was found that total of 30 fungal isolates and 25 bacterial isolates were able to grow under glucose enriched medium and were further purified for qualitative screening. The isolates were screened for different qualitative parameters such as acid production test, clear zone formation test and titrable acidity. It was found that there is an increase in titrable acidity with all the isolates. Of which, 27 fungi and 24 bacteria were positive for acid production test. 20 fungi and 15 bacteria were positive for clear zone formation test. Therefore, further with quantitative screening, the isolates can be used as potential microbes for the gluconic acid production.

Key words: Gluconic acid, potato waste, enrichment culture technique, glucose enriched medium

Characterization of Cassava Starch/Pine Needle Fiber Blend Films for Packaging Applications

***Shreejaya Sivadas¹, P. K. Omre², N. C. Shahi³**

¹*Ph.D. Scholar;* ²*Professor;* ³*HOD & professor Department of Post-Harvest Process and Food Engineering, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.*

Corresponding author email: shreejayasivadas047@gmail.com

Abstract

The principal limitations of the biodegradable starch-based film are its hydrophilicity and low mechanical characteristics. To overcome these disadvantages, cassava starch mix films were prepared by mixing cassava starch with pine needle fibre (CS/PNF) to produce a biodegradable film using a casting approach. The mechanical characteristics and biodegradability of the CS/PNF film were investigated. Enzymatic, microbiological, and soil burial biodegradation studies revealed that the biodegradability of the CS/PNF film was heavily reliant on the starch and fibre content of the film grid. Various test configurations were stored in dung for 30 days. It was discovered that all CS/PNF film, with and without fibre, degraded in 10 days or less. The CS/PNF biodegradation rate is very fast since both portions are biodegradable in nature. The CS/PNF film's

tensile strength and % elongation at break were increased. For example, with the PNF cemented, the film's optimal stiffness was 10MPa, and the lengthening at break of the motions could reach 191%. On the other hand, increasing the amount of fibre and starch in the film framework reduced both stiffness and % extension upon film break. These findings demonstrate that all CS/PNF mix films may be seen as acceptable, adaptive films that are simple and harmless to the ecosystem cycle.

Keywords: Cassava Starch, Pine needle fibre, tensile strength, biodegradability

The Hormone of Darkness “Melatonin”

Indu Rana¹, Dr. Neetu Sharma², Ms. Harshlata³, Mrs. Vijay Bharti⁴

¹M.Sc. Zoology student, ²Associate Professor, ³Assistant Professor, ⁴Assistant Professor

Department of Zoology, School of Basic Sciences, Abhilashi University, Chail chowk, Mandi (H.P)

Corresponding author email: indurana210298@gmail.com

Abstract

Melatonin is the natural hormone which is produced by the endocrine gland named as a Pineal Gland. Melatonin is also known as “The Hormone of Darkness”. Melatonin hormone is involved in the circadian regulation and ease of sleep. Low secretion of Melatonin affects biological rhythm. Individuals who are exposed to light at night especially night shift workers on a regular basis experience biological rhythm disruption. In some studies, it is stated that a shortened duration of nocturnal sleep is associated with a high risk of breast cancer. It also disturbs the menstrual cycle in females. Research states some of the diseases such as cancer, Alzheimer's disease, multiple sclerosis, fertility, PCOS, combined with the COVID-19 pandemic has led to greater awareness of melatonin because of its ability to act as a potent antioxidant, immune-active agent and mitochondrial regulator. There are different similarities between melatonin and vitamin D on a wide range of their impact on health. There is widespread concern about Vitamin D deficiency as a “sunlight deficiency” and reduced melatonin secretion as a result of “darkness deficiency” from overexposure to artificial blue light. To reduce melatonin disturbance people, have to change the daily life style to maintain the biological rhythm.

Keywords: Melatonin, Pineal Gland, Natural Hormone and Biological rhythm

Silicosis –NOT A new disease, but the neglected one

Diksha Motalyal¹, Dr. Neetu Sharma², Ms. Harshlata³, Mrs. Vijay Bharti⁴

¹ M.Sc. Zoology student, ² Associate professor, ³ Assistant Professor, ⁴ Assistant Professor

Department of Zoology, School of Basic Sciences, Abhilashi University, Chail Chowk, Mandi (H.P)

Corresponding author email: dikshamotalyal123@gmail.com

Abstract

Silicosis is a form of lung disease which is caused by inhalation of silica dust. Silica which is a most common mineral found in earth's crust. It is the oldest occupational disease known to man and affects workers exposed to silica dust. It is an irreversible, incurable and fibrotic lung disease which is untreatable. This disease causes inflammation, scarring and permanent damage in the lungs. It is a global problem by which many workers are suffering. This review focuses on the burden of the problem of silicosis increasing in Himachal Pradesh due to increase in industrialization and construction work like highways, mining and stone crushers. People working in it are getting affected on a large scale. These workers are from different age groups but due to the lack of awareness and due to the lower education levels these workers fail to seek appropriate healthcare. The workers are advised to have proper ventilation so that it can protect them from crystalline silica. The workers should go for lung screenings or health check-ups regularly to get to know about their health status. The importance of this

research work is to aware and improve the understanding of diagnostic method, treatment and prevention against the deadly dust disease and discusses its direction of future development.

Keywords: Silicosis, Lung disease, crystalline silica and Himachal Pradesh

Theme 4: Agri-Tech and Precision Farming: Harnessing Technology for Sustainable Agricultural Development

Leveraging Precision Farming Technologies for Sustainable Agricultural Development

Sabhaya Nirali Bharatbhai

Ph.D. (Horticulture) Vegetable Science, Anand Agriculture University

Corresponding author email: niralisabhaya@student.aau.in

Abstract

The intersection of technology and agriculture has ushered in a new era of sustainable farming practices, with precision farming technologies emerging as key drivers of this transformation. This abstract provides a comprehensive overview of precision farming methodologies, focusing on precision irrigation systems, remote sensing coupled with Geographic Information Systems (GIS), and autonomous farm machinery, and their collective role in promoting sustainable agricultural development. Precision irrigation systems represent a paradigm shift in water management, allowing for the precise delivery of water and nutrients to crops based on real-time data and analysis. By employing sensors, actuators, and automation, these systems optimize water usage, minimize water wastage, and mitigate soil salinity, thereby conserving water resources and enhancing crop resilience to climatic variability. Remote sensing and GIS technologies offer invaluable insights into the spatial dynamics of agricultural landscapes, enabling farmers to monitor crop health, soil moisture levels, and environmental conditions with unprecedented precision. Utilizing satellite imagery, drones, and ground-based sensors, these tools facilitate informed decision-making in areas such as crop planning, pest management, and land use optimization, thereby maximizing yields while minimizing inputs and environmental impacts. Autonomous farm machinery represents a revolutionary advancement in agricultural mechanization, offering enhanced efficiency, precision, and sustainability in field operations. Equipped with sophisticated sensors, GPS navigation, and AI-driven algorithms, autonomous vehicles streamline tasks such as planting, harvesting, and soil cultivation, optimizing route planning, reducing labour costs, and minimizing soil compaction, thus leading to increased productivity and sustainability.

Variable Rate Technology in Vegetable Crops

K Rajendar sagar¹*, B Ramesh Babu², M Ravindra Babu³ and M Paratpara Rao⁴

Dr. YSRHU-College of Horticulture, Venkataramannagudem

1 - Ph. D Scholar, Department of Vegetable Science, COH, Venkataramannagudem*

2 – Senior Scientist, Department of Fruit Science, HRS, Venkataramannagudem

3 - Senior Scientist, Department of Vegetable Science, HRS, Venkataramannagudem

4 - Associate Professor, Department of Genetics and Plant breeding, COH, Venkataramannagudem

** Corresponding author email: kalapalasagar27@gmail.com*

Abstract

Variable Rate Technology (VRT) refers to the instrumentation used for regulating application rates of fertilizer, lime, pesticides, and seed as an applicator travels across a field, based on a decision support system and (or) management plan. The first computer-controlled variable rate fertilizer spreading machine was used by Ortlip in 1986. The system was apparently first tested in Minnesota using variable rate lime by Luellen in 1985. VRT resembles a back-to-basics approach to farming, with varying inputs across a field depending on a number of

field and production variables. The information needed to support VRT may come from several sources such as GPS- referenced data, RS images, and GIS- generated maps. All of the data are used to produce a site-specific application plan based on sound agronomic principles. Comparative yield, quality and farm profits under SSM practices Vs uniform Rate Technology. There are a number of questions that must be answered before establishing a site specific crop management (SSCM) program. Many of these questions are economic, some are agronomic and environmental and others are technology-related. Most farmers have practiced a form of variable-rate application (VRA) with a conventional sprayer. A conventional sprayer applies a chemical that is tank-mixed with a carrier (usually water) using spray nozzles and a pressure regulating valve to provide a desired volumetric application of spray mix at a certain vehicle speed. Any change in the boom pressure or vehicle speed from that of the calibration results in an application rate different from the planned rate. For example, when observing an area of heavy weed infestation, the applicator can manually increase the pressure or reduce the speed to apply a higher rate of herbicide.

Keywords: Variable, Technology, Sprayer, Herbicide

The Role of Precision Farming in Vegetable Production

Nikita Sharma¹ and Sandeep Kumar²

¹M.Sc. Horticulture (Vegetable Science), ²Assistant Professor (Horticulture), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: neeki020697@gmail.com

Abstract

The population of India is increasing day by day and cultivated area decreasing due to industrialization and residential building under such condition demand for vegetable crops is increasing continuously and in order to sustain this demand requires the deployment of hi- tech application, that is why precision farming is needed enormously nowadays. Precision vegetable farming refers to the precise application of inputs with respect to soil, weather and crop need in order to improve productivity, quality and profitability in vegetable. The risk bearing capacity of Indian marginal farmer is very low, so they cannot rely on technologies like GPS, GIS, yield monitors, remote mapping sensors and VRT, so the importance and success of precision vegetable farming lies in the five R's concept i.e. use of Resources, in the Right amount, at the Right place, at the Right time, with Right manner. Considering this in point, the precision vegetable farming technologies also includes fertigation, protected cultivation, micro-irrigation like drip irrigation and sprinkler irrigation and mulching. The adoption of precision farming has leads to maximum increase in yield of vegetable crops especially in tomato and brinjal. It is observed that the drip irrigation saves about 38 per cent of the water as compared to the flood irrigation. Also the total productivity difference between precision and non-precision farming of tomato was 63.86 per cent. The future aspects for precision agriculture include the improvement in the availability and performances of existing technologies like internet connectivity, sensor technology and machinery equipments. Lack of finance and credit facilities are most important reasons for the non-adoption of Precision farming.

Keywords: Fertigation, hi-tech, micro- irrigation, precision, technologies

Drone agriculture: Use of drone technology for better farming

¹Divya Chaudhary, Dr. Mohd. Shah Alam² and Kamini Thakur¹

¹ M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: dc251856@gmail.com

Abstract

In many areas, the use of drones has already proven to be an essential part of large-scale precision farming operations. Farmers can use data collected by drone footage of their crops to plan their planting and treatment plans for optimal harvests. Some reports suggest that using precision farming techniques could result in up to 5% higher yields. Drone technology has gained popularity in the agriculture industry in recent years. Drones provide farmers with a number of advantages, such as higher yields & lower costs. But there are worries that farmers would be hesitant to use drone technology because they don't know enough about it or are afraid of losing their jobs. We may examine the advantages of drone technology for the agricultural industry as well as any obstacles that might be preventing farmers from implementing it. Drone footage of fields collects data that farmers may use to plan their planting and treatment strategies for maximum harvests. As much as 5% more yields may be obtained by implementing precision farming methods, according to some reports. This is a significant boost in an industry where profit margins are usually thin. Drones are utilized in the agricultural industry for a wide range of applications, such as mapping, crop monitoring, fertilizer spraying, land inspection, crop damage or field mapping etc. Different kinds of drones are being studied to see which has the most potential for farming, agriculture, and gardening. Drones with many rotors, such as quadcopters, are the most ideal for fertilizing crop.

Keywords: Drone, crop monitoring, irrigation, spraying & farming.

Precision Farming: The Future of Indian Agriculture

Yasmin*, Manish Chauhan, Sandeep Kumar, Akankshi Sharma

Department of Horticulture, School of Agriculture, Abhilashi University Mandi-175028 (Himachal Pradesh)

Corresponding author email: khanyasmin839@gmail.com

Abstract

Precision Farming or Precision Agriculture is generally defined as information and technology based farm management system to identify, analyse and manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection of the land resource by minimizing the production costs. Increasing environmental consciousness of the general public is necessitating us to modify agricultural management practices for sustainable conservation of natural resources such as water, air and soil quality, while staying economically profitable. The use of inputs (i.e. chemical fertilizers and pesticides) based on the right quantity, at the right time, and in the right place. This type of management is commonly known as “Site - Specific Management”. The productivity gain in global food supply have increasingly relied on expansion of irrigation schemes over recent decades, with more than a third of the world's food now requiring irrigation for production. All-together, market-based global competition in agricultural products is challenging economic viability of the traditional agricultural systems, and requires the development of new and dynamic production systems.

Keywords: Precision Agriculture, Sustainability, Remote sensing, Geographic Information System.

Precision Agriculture: A modern approach to smart farming

Ranjna Kumari¹, Dr. Mohd Shah Alam ²and Kamini Thakur¹

¹MSc Research scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Corresponding author email: vermaranjna699@gmail.com

Abstract

Precision Agriculture (PA) can assist in the ecologically responsible management of inputs used in crop production. “Most light bar systems include a Differential GPS (DGPS) receiver and antenna, some kind of computer or microprocessor, and a light bar or graphics display” (Stombaugh, 2002). Physical inputs are

replaced by knowledge and information through precision agriculture. A management zone is defined as a portion of the field differentiated from the rest for the purpose of receiving specific inputs and management attention (Kvien and Pocknee, 2006). The environmental benefits of precision agriculture stem from the more focused application of inputs, which minimizes losses from overuse as well as losses from weed escapes, insect damage, and nutrient imbalances. An initial focus on net returns map were presented, these maps were shown to be a profitable tool for farmers to use. “However, the positive net returns were found to not imply a lack of risk” (Powers, et al., 2003). A decrease in the emergence of pesticide resistance is one of the additional advantages. One drawback of the examined publications is that only few of them used soil sensors to measure environmental indicators like leaching directly. GIS technology application also efficiently represents the vastly comprehensive detailed environment (Kennedy2006). A farm management system that uses information and technology to identify, analyze, and manage spatial and temporal variability within fields is known as precision farming or precision agriculture. A paper written by Zhang and Taylor (2001) describes field efficiency as accounting for “a failure to use the theoretical working width of a machine, operator habits, turning time, and field characteristics”. Its goals are to maximize productivity and profitability, preserve the land resource, and minimize production costs. As producers became more averse to risk, more land was removed from production (Dillon, et al. 2007).

Strategic Water Resource Management for Maize: Integrating Remote Sensing and GIS

Sanjay H. Parmar, Daksh D. Vadalia, G. V. Prajapati and P. A. Pandya

Centre of Excellence on Soil and Water Management, Office of Research Scientist (Agril. Engg.), Junagadh Agriculture University, Junagadh.

Abstract

Irrigation water scarcity is a pressing issue in regions like Panchmahal, Gujarat, India, demanding precise estimations of crop water needs. Situated between latitudes 22°30'N to 23°30'N and longitudes 73°15'E to 74°30'E, covering 3314.56 km², the Panchmahal region requires accurate assessments to conserve water. This study aims to determine maize crop acreage and water requirements (ETC) using a satellite remote sensing-based vegetation index at various scales. Accurate acreage estimations aid in understanding cropping patterns and their interaction with spatial and temporal variability, crucial for current and future crop water requirement estimations and resource management in this region. Twelve Sentinel-2 satellite images from November 2020 to April 2021 were utilized, totalling 68 images with a five-day sensing interval for the chosen Rabi season. Maize crop coefficients for the entire growing season were derived using average NDVI values, employing remote sensing and GIS techniques. The NDVI and crop coefficient KC (FAO) exhibited a strong correlation for maize crops with $R^2 = 0.8$. Utilizing these correlations, a KC map was generated, and the total crop water demand for maize seasons was calculated at 171.50 MCM. ETC maps elucidated the variability of crop water usage throughout the growing season. The study's results underscore the utility of ETC maps, created through multispectral vegetation indices from remote sensing, for assessing crop water usage at regional and field scales. This information is valuable for irrigation planners and farmers, enabling precise irrigation water application at each growth stage, promoting water conservation, and enhancing overall irrigation water management. The study shows new perspective for application of remote sensing and GIS in water management of maize crop.

Keywords: Sentinel-2, Crop acreage, Crop water requirement, NDVI, Crop coefficient

Theme 5: Biodiversity Conservation and Agroecology: Balancing Food Production with Ecosystem Health

Sustainable agricultural land use practices in Western Rajasthan: A Review

Supriya Kumari Sharma¹ and Afroz Alam*

Department of Bioscience and Biotechnology, Banasthali Vidyapith (Rajasthan), India

* Corresponding author email: aafroj@banasthali.in

Abstract

Effective and sustainable land management practices are paramount for the agriculture industry and the global economy. The health of ecosystems and the communities that depend on them are also heavily influenced by how we manage our natural resources, particularly soil. As everything on our planet is intricately connected, proper management of these resources can bring about significant and far-reaching benefits that positively impact every aspect of life on Earth. The arid western region of Rajasthan has experienced a significant transformation in its agricultural land use in recent years. Traditionally, this area has been known for low-yielding, low-value, and short-duration crops, with high reliance on livestock and traditional agro-forestry practices. However, the introduction of irrigation, new technologies, improved infrastructure, and the Green Revolution have significantly impacted the agricultural landscape since India's independence. While these developments have improved the farmers' economy, the over-enthusiasm towards modern agro-technologies and the adoption of some faulty land use decisions have brought forth particular challenges that threaten farmers' livelihoods and agriculture's sustainability. This analysis delves into the region's historical and contemporary land use practices, highlighting the drivers of change and their impact. It is suggested that promoting the region's strength in agro-forestry and livestock-based economy is crucial for sustainable agricultural land use.

Keywords: Land use, traditional, history, impacts, irrigation, modernization, livestock, economy

Morphometric analysis on different species of honeybees in Tarai region of Uttarakhand

Mamta Joshi^{1*}, Pramod Mall²

1* Ph. D Scholar, Department of Entomology, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar-263145(Uttarakhand), India

2 Professor and head, Department of Entomology, College of Agriculture G. B. Pant University of Agriculture and Technology, Pantnagar-263145(Uttarakhand), India

Corresponding author email: joshimamta@gmail.com

Abstract

Measuring of morphological characters of honey bees was carried out using a simple technique depends on the combination between Scanner and Photoshop program. Morphometric studies on various honeybee species in Tarai region of Udham Singh Nagar revealed that *A. dorsata* had the longest mean tongue length (4.19 mm), followed by *A. mellifera* (3.87 mm) and *A. cerana* (2.14). *A. dorsata* had the longest forewing length (11.96 mm) and breadth (3.77 mm), followed by *A. mellifera* (8.89mm) and (3.15 mm). *A. cerana* had the shortest forewing length and breadth (6.94 mm) and (2.40mm), respectively. *A. dorsata* had the longest tibia (2.88mm), followed by *A. mellifera* (2.82mm), and *A. cerana* (2.87 mm). *A. dorsata* had the most wing hooks (27), followed by *A. mellifera* (20). *A. cerana* had the fewest (11). *A. dorsata* had the largest femur (2.72mm and 2.79mm), respectively, whereas *A. cerana* had the smallest widths (1.49 and 1.40mm). Morphometrics of all different morphological features of distinct honey bee species were in the following order: *Apis dorsata* > *Apis mellifera* > *Apis cerana*.

Keywords: Honey bee, Biodiversity. Geographical distribution.

Insect Visitors of Bottle Gourd Flowers

Elika Pavan Venkata Kumar¹ Dr. Kumaranag K. M¹

¹*Department of Entomology, IARI, New Delhi*

Corresponding author email: pavanvenkataakumar3423@gmail.com

Abstract

Bottle gourd was a monoecious crop. The staminate flowers were produced first with 5 white sepals and petals, 3 anther and nectar lobes and pistillate flowers were produced later with 5 white sepals and petals, 0 nectaries with an inferior ovary. The pollen of staminate flowers was heavy, hence no chance of wind pollination and the stigma of pistillate flower remained receptive for 24 hours before and after anthesis. The flowers of the bottle gourd open at 6 pm and remain up until 11 am of the next day. Due to the floral volatiles and floral rewards such as nectar and pollen, the pollinators get visited to staminate flowers but in pistillate flowers, they get visited only by floral volatiles and get pollinated only by chance. Hence it is important to identify the nocturnal and diurnal visitors of the bottle gourd along with their pollination biology.

A total number of 22 insect species with 4 unidentified flies, 4 unidentified Moths, 3 Beetles, 4 Bees, 3 Hawkmoths, 1 Skipper and 3 Butterflies were recorded as the floral visitors with Lepidopterans as the most abundant pollinators of bottle gourd in Kenya. In Bangalore, 18 insect species of 8 Hymenopterans, 5 Dipterans, 3 Lepidopterans and 2 Coleopterans are the floral visitors with Hymenopterans as the most abundant pollinator. In Tirupati, 10 insect species of 6 Lepidopterans, 1 Coleopteran, 1 Hymenopteran, 1 Orthopteran and 1 Dictyopteran are the floral visitors with Lepidopterans as the most abundant pollinators. In Bangladesh, 12 insect species consisting of 5 Hymenopterans, 3 Coleopterans, 2 Lepidopterans, 1 Thysanopteran and 1 Hemipteran are the floral visitors with Hymenopterans as the most abundant pollinators. In Gujarat, 9 insect species comprising 4 Lepidopterans, 2 Coleopterans, 1 Hemipteran, 1 Orthopteran and 1 Odonatan are floral visitors with Lepidopterans as the most abundant pollinators. In Coimbatore, they recorded 8 insect species consisting of 3 Lepidopterans, 2 Hymenopterans, 2 Coleopterans and 1 Hemipteran as the floral visitor with the Coleopterans as the most abundant pollinators. In the bottle gourd, 15% of fruit sets were obtained from the pollination of *Apis cerana* in caged plots in comparison to only 8% from hand pollination plots and 59.26% of fruit sets were obtained from supplementation of open pollination by Hand pollination. The highest fruit weight of 1.87 kg, fruit volume of 2340 ml, fruit length of 43.93 cm, number of sound seeds per fruit of 423 and seed weight of 16.58g was obtained in the open-pollinated plot with attractants in comparison to crop caged without bees.

Insect Biodiversity in Chachyot Valley

Gunjan¹, Ms. Harshlata², Dr. Neetu Sharma³, Mrs. Vijay Bharti⁴

¹*M.Sc. Student*, ²*Assistant Professor*, ³*Associate Professor*, ⁴*Assistant Professor*, *Department of Zoology, School of Basic Sciences, Abhilashi University, Chail chowk, Mandi (H.P.)*

Corresponding author email: gunjandhiman56236@gmail.com

Abstract

Insects are the most dominant and important animals on the planet, and they have a direct or indirect impact on human life. Insects are arthropods with a head, thorax, and abdomen, as well as six legs, two antennae, and one or two pairs of wings and they dwell in tropical environments. The present study was conducted in Chachyot valley of Distt. Mandi (Himachal Pradesh) to observe various insect species found in the village. Chachyot valley, which lies near the Shikari Devi wildlife sanctuary, has a suitable climatic condition and weather that support great diversity of insect's species. Insects are found in a wide range of environments and perform a

variety of vital ecological services. Insects can be used as biological control agents to eradicate natural pests in agricultural settings. Insects act as predators, hunting, attacking, killing, and eating hazardous species. Beneficial insects aid in the maintenance of a healthy, well- functioning biological system. Presence of insects in environment is important in order to make a ecological balance. As insects are very important part of our ecosystem and a few records are studied in Chachyot valley, hence an effort is made to record the diversity of insects in the Chachyot valley. This paper provides a checklist of various insect fauna found in Chachyot valley.

Keywords: Biodiversity, Insects, Chachyot valley and Himachal Pradesh

Theme 6: Digital Transformation and Agriculture: Innovations for Modern Farming Practices

Vertical farming technology and its benefits

Vivek Kumar¹, Dr. Jay Nath Patel² and Sahil Sethi¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

Corresponding author email: jordanvk69@gmail.com

Abstract

Emerging problems of food security, urbanisation, farmland shortages, food miles increased greenhouse gas emissions focuses on the need for vertical farming. An increasing global population will be able to feed themselves in the future with the help of vertical farming, an eco-friendly, energy-saving and a promising alternative to conventional farming. Vertical farming is a modern agricultural practice of growing crops, stacked vertically in a protected indoor environment, which mainly utilizes a hydroponic, aquaponic and aeroponics cultivation system Vertical farming offers numerous potential benefits, including more efficient uses of space, reduced water usage; shorter growing times, reduced need for pesticides, herbicides and shelter from extreme weather. In addition, since vertical farms can be set up practically anywhere, even underground, they could enable hyper-localized production, thus shortening food supply chains and providing fresh and nutritious local foods all year around. The development of low-cost, simple-to-operate methods involving less labours and lower overall setup and operational costs are critical for the successful implementation of vertical farming technologies. Vertical farming has emerged as a viable option for producing a wide variety of food crops to meet the nutritional needs of the growing global population. Despite its numerous advantages, challenges such as high initial investment costs, energy consumption, and the need for specialized knowledge in technology-driven farming methods remain. This abstract highlights the ongoing research and development efforts aimed at addressing these challenges and improving the scalability and economic viability of vertical farming. In conclusion, vertical farming represents a promising solution to the evolving demands of modern agriculture. Through the integration of cutting-edge technologies and sustainable practices, vertical farming has the potential to revolutionize the way we produce food, making it a crucial component in the quest for a more resilient, resource-efficient, and sustainable global food system.

Key words: Vertical farming, Aquaponics, Hydroponics, aeroponics and Food security

Application of Internet of Things in Agriculture

Neha Yadav¹, Dr. Beena Yadav²

M.Sc Student¹ Department of Extension Education and Communication Management, I.C. College of Community Science, CCSHAU, Hisar, 125004

Dean and HOD², Department of Extension Education and Communication Management, I.C. College of Community Science, CCSHAU, Hisar, 125004

Corresponding author email: yadavneha0008@gmail.com

Abstract

India is one of the world's top producers of agricultural goods and agricultural industry has a major contribution to the economy. The past few decades have seen immense change in the agricultural sector with the introduction of Internet of Things (IoT) using a new era of innovation and efficiency. The potential applications of IoT in agriculture are limitless. Farming practices could undergo a transformation which will increase productivity, efficiency, and sustainability. The adoption of IoT in agriculture is revolutionizing the industry, paving the way for precision monitoring and data-driven farming, such advancements are highly based on exchange of messages between various devices in the farming. This review paper provides an overview of IoT application in agriculture, highlighting its transformative potential, and current progress in IoT based tools. IoT devices deployed in farms monitor vital parameters such as soil moisture, temperature, irrigation, fertilization, pest control, crop health, granting farmers to access real-time data and early issue detection. Farmers can use IoT-based technology to forecast weather trends and choose the best time to grow and harvest crops. Smart applications along with authentication protocols provide real time alerts and enable immediate responses to suspicious activities and provide farm security through the deployment of devices such as cameras, motion sensors, and access control systems. This assists in making optimized choices, proactive interventions, minimizing losses and maximizing yields. Automation increase farmers' productivity and their reliance on manual labor can be decreased by using IoT-based agricultural equipment. This provides flexibility by having control IoT devices on their farms even when they are away and facilitates timely interventions. This allows farmers to precisely apply their resources, ensures high-quality food products and minimal wastage and promoting resource conservation while safeguarding the environment. IoT uptake in India is currently constrained by a number of issues like high costs, lack of knowledge, and inadequate infrastructure. Collaborative decision-making platforms and awareness and training workshops can serve as central platforms for connecting farmers, researchers, and technology experts to a global network and facilitating the dissemination of important IoT information.

Keywords: Digital Agriculture, IoT Application, IoT Tools and devices, Smart Agriculture.

Technological Advancements in Precision Agriculture: A Comprehensive Overview

Nayan Deep and Dr Devinder Kumar Mehta

Ph.D. Research Scholar; Principal Scientist

Department of Vegetable Science, College of Horticulture, Dr YS Parmar University of Horticulture & Forestry, Nauni, Solan (HP) 173 230, India

Corresponding author email: deepnayan360@gmail.com

Abstract

The current advancements in precision agriculture, also referred to as smart agriculture technology have been discussed in detail in this abstract along with their significant consequences for contemporary agricultural practices. A paradigm change in farming operations has been made possible by the incorporation of cutting-edge technologies, which have maximized production, sustainability, and resource utilization. Using Internet of Things (IoT) devices and sensor networks to collect data in real time on crop physiology, soil properties, environmental variables, and livestock behavior is a key component of precision agriculture. By enabling remote monitoring and administration of agricultural activities, this data-driven method enables farmers to make well-informed decisions, improving operational efficiency and reducing resource waste. Moreover, the innovative fusion of artificial intelligence (AI) algorithms with data analytics has transformed agricultural decision-making procedures. Predictive models and useful insights are produced by applying AI-driven analytics to large datasets obtained from IoT devices and related sources. With the help of these insights, agroecosystem management tactics like yield forecasting, irrigation control, insect mitigation, and precise planting activity scheduling may be optimized, increasing overall farm production and financial feasibility. Significant developments in automated machinery and Variable Rate Application (VRA) in precision farming have

highlighted the effectiveness of contemporary agricultural methods. By precisely dispensing water resources and pesticide inputs according to the geographical heterogeneity of agricultural plots, VRA approaches minimize environmental effects and maximize resource use efficiency. Simultaneously, the incorporation of AI-enabled GPS-guided automated machinery enables accurate farming activities, including planting, harvesting, and spraying, resulting in increased operational efficiency and cost-effectiveness. Additionally, along the whole production continuum, transparency, traceability, and trust have been fostered by the integration of blockchain technology into agricultural supply chain management. In summary, the development of precision agriculture represents a paradigm-shifting period in agricultural practices by providing stakeholders with unmatched sustainability, control, and insights. The continuous progress and widespread integration of smart agricultural technology present opportunities to address the imperatives of global food security while also reducing the environmental impact of traditional farming methods.

Keywords: Automated Machinery, IoT, Smart Agriculture, Sensors, Sustainability

Agricultural information utilization behaviour of farmers using smartphone

Kungumaselvan T¹ and Ravi Kumar Theodore²

¹*Assistant Professor (Agricultural Extension), SRM College of Agricultural Sciences, Baburayanpettai, Chengalpattu – 603 201*

²*Professor (Agricultural Extension), Directorate of Planning & Monitoring, Tamil Nadu Agricultural University, Coimbatore – 641 003*

Corresponding author email: kungumaselvanagri@gmail.com

Abstract

This paper will be discuss about the findings of agricultural information utilization behaviour of rice, millets, and cotton growers using smartphone. The study was conducted in the year 2022 and three major crops viz., rice, millets and cotton were selected for the study since those crops represents wetland, dry land and commercial cropping system. Thanjavur, Salem and Virudhunagar districts were purposively selected for the study due to the reason of highest production. From each district 60 respondents were selected respectively and the total numbers of respondents were 180. The results showed that most of the rice growers sometimes utilized the information in variety and seed (2.15), followed by weather forecast (2.08). In case of millet growers sometimes utilized weather forecast (2.68), followed by variety and seed (2.22). With regard to cotton, most of the respondents sometimes utilized information regarding weather forecast (2.52), followed by crop protection (2.02). From these results it was concluded that all the three crop growers are not effectively utilizing/applying the information accessed through smartphone. This may be due to the reason of lack of awareness, knowledge and skill on using smartphone for accessing agricultural information. So, State government and extension agencies have to conduct regular training on operating smartphone for agriculture. Most importantly, information need to be given in local language, developing voice recognition facility in mobile applications, and dissemination of information in pictorial form may improve the information utilization by the farmers.

Keywords: agriculture, smartphone, information utilization

Theme 7: Biotic and abiotic stress management

Screening of different genotypes of chickpea against gram pod borer *Helicoverpa armigera* (Hubner)

Amogha^{1*}, Usha², V.K. Mishra³ and M. Soniya Devi³

¹*Ph.D. Scholar, Department of Entomology, GKVK, UAS, Bengaluru, 560065*

²*Assistant Professor, Department of Entomology, Rani Lakshmi Bai Central Agricultural University, Jhansi-284 003*

³*Teaching cum Research Associate, Rani Lakshmi Bai Central Agricultural University, Jhansi-284 003*

Corresponding author email: amoghamonappa@gmail.com

Abstract

The chickpea (*Cicer arietinum* L.), holds a significant position among the legume crops cultivated in the country. India, being the foremost producer of chickpea, faces the challenge posed by the gram pod borer, *Helicoverpa armigera* (Hubner) [Noctuidae: Lepidoptera], which acts as a major pest for chickpea, thereby adversely affecting its production in the main agro-ecological zone. To address this issue, numerous insecticides have been employed as a means of pest control. However, the persistent and inappropriate use of these insecticides has resulted in environmental pollution. Furthermore, the utilization of chemicals has escalated the production costs for small-scale and marginal farmers. Consequently, the development of cultivars resistant to this pest has become imperative. With this objective in mind, a field experiment was conducted during the rabi season of 2021-22 at the Agricultural Research Farm of Rani Lakshmi Bai Central Agricultural University, Jhansi. The primary aim of this experiment was to evaluate various chickpea genotypes and determine their resistance to the pod borer, *Helicoverpa armigera*. A total of one hundred chickpea genotypes, including susceptible and resistant checks, namely ICC 3137 and ICCL 86111, were subjected to screening against *Helicoverpa armigera*. The assessment entailed recording observations on the larval population at the vegetative stage, 50% flowering stage, and 50% maturity stage for five randomly selected plants of each genotype. The percentage of pod damage was then calculated, and the susceptibility or resistance of each genotype to the pest was determined by comparing them with the check cultivars. Among the one hundred chickpea genotypes, IC 11627 exhibited the lowest larval population (0.60 larvae/5 plants), the lowest percentage of pod damage (6.50%), and the highest chickpea yield (1.73 t/ha). Based on the Pest Resistance Susceptible Rating (PRSR), a total of eighteen genotypes (IC 11627, EC 198581, IC 538496, IC 5522, IC 2722278, IC 275637, IC 48746, IC 299175, IC 257477, IC 299330, IC 305597, IC 299218, IC 327579, IC 9862, IC 9755, ICC 14402, ICC 4182, & ICCL 86111) obtained the rating scale-3 and were classified as 'Resistant'.

Keywords: Chickpea, Pod borer, Genotypes, Screening, Resistant

Biological control of weed

Vikrant

Department of Plant Pathology Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh

Abstract

It is deliberate use of natural enemies to reduce the density of particular weed to tolerate level. Biological control uses one living organism to other. The aim of a weed biological control program is to introduce natural enemies to a level that is manageable and will reduce its impact by using insect. The use of plant feeding organisms or diseases to reduce the population of a plant species that has rise to the status of a weed. Many of the worst weeds are of foreign origin. Insect constitute the largest group of natural enemies of weed plant. Effective BC agents are in the orders Hemiptera, Homoptera, Coleoptera, Lepidoptera, Diptera. Insects have most frequently used biological control agent of weed. Insects have been used most in BC of weeds because of great variety and numbers of species. They frequently exhibit a high degree of host plants. There is a greater range of natural enemies suited to particular ecological situations. In 1787, *O. vulgaris*, a native of Brazil was introduced by traders for production of cochineal dye. *Opuntia* spp. become serious agricultural pests in South India. First successful classical biological was achieved in India when cochineal insect, *Dactylopinus celynicus* was introduced from Brazil in 1795 in the mistaken belief that it was the true carmine dye producing insect *D. coccus*. Biological Control of Carrot Weed, *Pathenium hysterophorus* Carrot weed, also known as white top and congress grass is native to Mexico including the West Indies. In India it was recorded from Pune in 1955. In 1983 a crysomelid beetle, *Zygogramma bicolorata* was imported from Mexico. It is considered to be the most damaging aquatic weed in India. They are often more host specific and they can be applied with conventional spray equipment at time when the weed is at its more susceptible stage. Worldwide there are 4 times as many successes have been scale parasitoids as with predators. Majority of the successes have been with scale insect.

Population dynamics of cabbage butterfly (*Pieris brassicae* L.) in Balh valley of Himachal Pradesh

Om Prakash^{1*}, Ritika Singh² Alok kumar³

^{1*}Project fellow, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, 175028

² Assistant professor, Department of Genetics & Plant Breeding, Abhilashi University, Chail Chowk, Mandi, 175028

³ Assistant professor, Department of Genetics & Plant Breeding, Abhilashi University, Chail Chowk, Mandi, 175028

Corresponding author email: omprakash420@gmail.com

Abstract

The present studies on the "Population dynamics of cabbage butterfly (*Pieris brassica* L.) on cauliflower crop was carried out during Rabi season 2021 - 22 in the open fields of cauliflower to record the incidence of *Pieris brassica* L. at weekly intervals in Lohara village Balh valley of District Mandi, Himachal Pradesh. The population dynamics of mature stages (eggs and larvae of the cabbage butterfly was recorded under field conditions on cauliflower crop from February to April during 2022. The studies were initiated immediately after the appearance of adults in the field till the end of cropping season. The studies revealed that the first egg count (8.1 eggs/plants) was observed on 7th SMW in February and the peak egg count of 27.8 eggs/ plants was recorded on 12th SMW in March. No eggs were found after 17th SMW of April 2022 on cauliflower crop. The larval population was recorded for the first time on cauliflower on 8th SMW in February (9.2 larvae/plants). The peak larval count was found on 13th SMW in April (25.8 larvae/10plants), while the minimum larval count of 6.3 larvae/ plants was recorded on 16th SMW in April. After that no larvae were recorded on this crop. In Himachal Pradesh information about population dynamics of cabbage butterfly is limited, hence the present study was conducted on the life cycle and population dynamics of cabbage butterfly.

Antagonistic potential of native isolates of *Trichoderma* for the management of Anthracnose (*Colletotrichum capsici*) of chilli.

Pooja Thakur

M.Sc., Plant Pathology, School of Agriculture, Abhilashi University Mandi, 175028

Corresponding author email: pooja.suryavanshi2986@gmail.com

Abstract

Anthracnose of chili caused by *Colletotrichum capsici* is responsible for huge yield loss in Bangladesh. To avoid chemical control of the disease, the present study was aimed to observe the field efficacy of selected medicinal plants including neem (*Azadirachta indica*) and mahogany (*Swietenia mahagoni*) and a commercially available formulated *Trichoderma* either alone or in various combinations. Among all the treatments, combined application of mahogany leaf extract and peat soil-based *Trichoderma* resulted highest reduction of disease incidence (58.99%) and severity (67.19%) of the leaf over control. Similar treatment combinations also resulted the highest reduction of disease incidence (64.08%) and severity (68.97%) of fruit over control. The combined application of mahogany leaf extract and peat soil-based *Trichoderma* also exhibited the highest plant height (27.44 cm), number of fruits per plant (169), and fruit weight per plant (499.10 g). The findings of the present study explored the potentiality of the combined application of mahogany leaf extract and peat soil-based *Trichoderma* for the eco-friendly management of Anthracnose of chili. In this investigation, biological management was examined to control *Colletotrichum capsici* caused anthracnose in chilli plants. Fungal antagonist *Trichoderma* spp. and local plant extracts were tested singly against the pathogen. In laboratory studies, it has been depicted that Eucalyptus plant extracts (at 20%W/V) and *Trichoderma viride* inhibited the mycelium growth of Pathogen to the magnitude of (81.11%) and (90.74%), respectively. Further studies in pot

and field conditions revealed that *Trichoderma viride* was observed to be superior in controlling the incidence of chilli anthracnose disease (69.63% & 63.43%) in highly susceptible cultivar. Five *Trichoderma* species were also screened to check the chitinolytic enzyme. Out of these species, *T. viride* exhibited the highest chitin degrading activity which leads to maximum inhibition of the mycelial growth of the test pathogen. Therefore, these findings undoubtedly supported the usefulness of antipathogenic *Trichoderma* in limiting the occurrence of anthracnose in chilli.

Keywords: *Trichoderma*, medicinal plants, anthracnose, yield, chili

Development and Evaluation of *Cleistanthus collinus* (Roxb.) Benth ex Hook. f. based Emulsion formulation against *Spodoptera frugiperda* (J. E. Smith.)

¹K. Harikaran and ²Thirunavukkarasu Selvamuthukumar

¹PG Scholar, Phytoinsecticide Formulation Laboratory, Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar – 608 002.

²Associate Professor, Phytoinsecticide Formulation Laboratory, Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar – 608 002.

*Corresponding author email: harikaran99kk@gmail.com

Abstract

The fall armyworm, *Spodoptera frugiperda* is a devastating agricultural pest causing significant economic losses globally. Overreliance on synthetic insecticides has led to environmental concerns and pest resistance. This study investigated the potential of the indigenous plant, *C. collinus* as a source of botanical insecticide against *S. frugiperda*. This study aimed to develop an Emulsion formulation based on the extract from the traditionally used Indian plant *C. collinus* for the management of fall armyworm. Crude extracts from *C. collinus* were evaluated for their insecticidal activity against fall armyworm larvae using leaf disc bioassay. Cold extraction method of solvent extraction and bioassay protocols were optimized to maximize efficacy. Promising extracts were then formulated as the Emulsion for improved stability and ease of application. The bio-efficacy and phytotoxicity of the formulation were evaluated under both laboratory and semifield conditions. The laboratory evaluation of *C. collinus* Emulsion formulation recorded the highest antifeedant activity at 20 percent concentration and total mortality and malformation (44.44%) at 25 % concentration. Under semi-field conditions, the performance of *C. collinus* Emulsion formulation was found to impart the highest anti-insect action at 20 percent concentration and no phytotoxic symptoms were recorded at field effective concentrations (20 and 30 percent) and double the time field effective concentration (60 percent). Thus the *C. collinus* Emulsion formulation offers a promising alternative for the management of *S. frugiperda*. This formulation is eco-friendly, effective, and has the potential to be adopted by farmers for sustainable pest management practices.

Keywords: *Spodoptera frugiperda*, fall armyworm, botanical insecticides, *Cleistanthus collinus*, formulations

Effect of Inert minerals and Botanicals on Adult emergence of Pulse beetle, *Callosobruchus maculatus*, in Stored Black gram

Maharaj Satwika¹, Tirumalasetty Madhumathi², Bhimineni Ratna Kumari³, V. Prasanna Kumari⁴

¹Ph.D. scholar, Department of Entomology, PJTSAU, Hyderabad-500030, India

²Professor, Department of Entomology, Agricultural College, Bapatla-522101, India

³Assistant professor, Department of Entomology, Agricultural college, Bapatla-522101, India

⁴Professor and Head, Department of Pathology, Agricultural College, Bapatla-522101, India

Corresponding author email: satwikam23@gmail.com

Abstract

The investigation on “Effect of inert minerals and botanicals on adult emergence of pulse beetle, *Callosobruchus maculatus*, in stored black gram” was done in the laboratory of the Department of Entomology,

Agricultural College, Bapatla during 2020-21. One kilogram of black gram was taken in three replications and treated with inert minerals and botanicals. In each container, ten pairs of newly emerged adult beetles were introduced. A subsample of 50 g was taken in small plastic jars to record, the day when the first adult beetle emerged, the daily count of adult beetles, and the overall count of emerged adult beetles. The research showed that there was no significant difference between treatments and untreated control *w.r.t* day of first adult emergence of *C. maculatus*. The percent adult emergence of *C. maculatus* in black gram seeds treated with diatomaceous earth was 21.06% which was significantly the lowest value when compared to untreated control (86.03%). The total count of emerged adult beetles from the main sample was less in diatomaceous earth (135.33 adults) and sweet flag powder (249.07 adults) against untreated control (751.67 adults).

Keywords: Diatomaceous earth, Percent adult emergence, Spinosad, Sweet flag powder

Early blight: A threat to tomato crop

Sunit Dogra*¹ and Anupam Kumar²

¹M.Sc. Ag. (Plant Pathology) and Assistant Professor², Dept. of Plant Pathology, SOA, Abhilashi University Mandi H.P.

Corresponding author email: dograsunit22@gmail.com

Abstract

Tomato (*Solanum lycopersicum* Linnaeus), native to the Andean region of South America, is one of the most common horticultural crops and cultivated throughout the world. Tomato is the world's second most consumed vegetable after potato. The total world production of tomato is 161.7 million metric tons with a value of ~\$59 billion. The USA ranks in third position in the total world production of tomato after China and India. The genus *Alternaria* is large and consists of several economically-important plant pathogens including *A. solani*, *A. alternata* and *A. brassicicola*. Many species of *Alternaria* are significant causes of necrotrophic diseases of crops. For most species including *A. solani*, no sexual stages have been reported. *Alternaria* produce unique club-shaped conidia, often beaked with horizontal and often vertical septa that may be produced either individually or in a chain, depending on the species. Hyphal cells are darkly pigmented with melanin, which guards hyphae and spores against environmental stress and allows spores to survive in soil for long periods of time. *A. solani* reproduces asexually; a sexual stage of this fungus is unknown. The fungus overwinters in soil, plant debris, seed and alternate hosts in the form of either conidia or mycelia, which may serve as primary sources of inoculum. The symptoms of *A. solani* appear in leaf (leaf blight or early blight), stem (collar rot or stem lesions) and fruit (fruit rot) of tomato plant. It is characterized by dark, small, necrotic, coalescing and concentric lesions giving a target-like appearance on the leaf surface. The lesions are surrounded by yellow rings. The disease first appears on lower older leaves and moves upward as the plant becomes mature. EB can be controlled by three measures: cultural practices, fungicide treatment and the use of resistant varieties. Cultural practices and fungicidal treatment are more common practices.

Keywords: Tomato, Early blight, symptoms, life cycle and control measures

Pest and Disease Control Methods

Sandhya Thakur

Ph. D. Scholar, Department of Entomology, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur- 176062, India

Corresponding author email: thakursandhya503@gmail.com

Abstract

Pest and disease control methods vary depending on the specific pest or disease, as well as the type of environment and crops involved. Some methods used in agriculture are: Cultural control- planting different crops in different seasons can help disrupt pest and disease life cycles. Adequate spacing between plants can improve airflow and reduce humidity, which can deter some diseases. Maintaining healthy soil with proper pH,

fertility and organic matter can promote plant health and resistance to diseases. Biological control- introducing natural predators or parasites that feed on pests can help keep their populations in check. Using microbial pesticides like beneficial bacteria, fungi, or viruses can be applied to control pests without harming beneficial organisms. Physical control- physically removing pests from plants can be effective for small-scale infestations. Sticky traps, pheromone traps and light traps can help capture pests. Row covers or netting can be used to physically block pests from reaching plants. Mulch can suppress weeds and reduce soil-borne diseases by preventing soil splashing onto plants. Chemical compounds designed to kill or repel pests can be effective but should be used judiciously to minimize harm to beneficial organisms and the environment. Integrated Pest Management (IPM) approach combines multiple control methods to minimize reliance on chemical pesticides while effectively managing pests. Genetic control- by developing plant varieties with genetic resistance to pests and diseases can provide long-term solutions. Introducing genes from other organisms to confer resistance or tolerance to pests and diseases is another approach, though controversial in some contexts. It's essential to assess each situation carefully and choose the most appropriate combination of control methods based on factors such as the severity of the pest or disease, potential impact on beneficial organisms, environmental concerns and economic considerations.

Keywords: Pest, culture, biological, chemical, physical control

Population dynamics of leaf eating caterpillar, *Diaphania indica* on watermelon in Coimbatore district

T. P. Chandana^{1*}, M. Muthuswami², A. Suganthi³

¹*Ph.D. Scholar, Dept. of Agrl. Entomology, University of Agricultural Sciences, Raichur,*

²*Professor, Dept. of Agrl. Entomology, Tamil Nadu Agricultural University, Coimbatore*

³*Assistant Professor, Dept. of Agrl. Entomology, Tamil Nadu Agricultural University, Coimbatore*

**Corresponding author email: channuprabhu@gmail.com*

Abstract

The population dynamics of leaf eating caterpillar, *Diaphania indica* along with correlation of weather parameters was studied during January to May 2021, at Annur and Thondamuthur villages of Coimbatore district. The results revealed that the incidence was highest (3.7 larvae/plant) during the month of February in Annur while Thondamuthur revealed maximum (3.9 larvae/plant) population during January. Simple correlation studies revealed that population showed a significant negative correlation with maximum (-0.436) and minimum temperature (-0.466) while effect of relative humidity and rainfall were non-significant in Annur. Similarly, observations from Thondamuthur showed a significant negative correlation between pest population and maximum (-0.459) as well as minimum temperature (-0.780). Correlation with relative humidity and rainfall was insignificant.

Keywords: *Diaphania indica*, watermelon, population dynamics, weather factors

Bio-herbicides: A sustainable way to control weeds

Jay Nath Patel¹, Mohd Shah Alam¹, Anupam Kumar² and Sushant Kumar³

¹*Assistant Professor, Agronomy, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, H.P.*

²*Assistant Professor, Plant Pathology, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, H.P.*

³*Teaching Associate, Entomology, CSAUA&T, Kanpur, U.P.*

Corresponding author email: pateljaynduat333@gmail.com

Abstract

Bio-herbicides are the biological weed control herbicides made of pathogens, phyto-toxins and other microbes. Compounds derived from micro-organisms, including viruses, bacteria, fungus, and protozoa, as well as

phytotoxic plant residues, extracts and individual chemicals obtained from different plant species, can be classified as bio-herbicides. The use of bio-herbicides has been recognised as an important biological control tactic. By utilizing natural agents to manage weed populations, bio-herbicides provide a sustainable substitute for conventional chemical herbicides. These environmentally safe substitutes for weed control are made from living things like bacteria, fungi or plant extracts. They provide focused weed control without harming the environment. Utilizing bio-herbicides is in line with the increasing emphasis on sustainable agriculture and lessening the environmental impact of traditional farming methods around the world. Beyond environmental concerns, bio-herbicides have other benefits. They frequently leave behind little residue, reducing contamination of the land and water. Furthermore, their use promotes an all-encompassing strategy for agricultural sustainability by being consistent with the tenets of integrated pest management. Notwithstanding these encouraging features, there are still issues with bio-herbicide efficacy, scalability and economic feasibility. Research is still being done to improve delivery methods, broaden the range of weed species that are targeted, and improve formulations. Bio-herbicides, which provide an environmentally benign alternative to conventional herbicides, are expected to play a significant role in determining the future of weed management as the demand for sustainable agricultural methods grows. DeVine (to control strangler vine), Collego (to control northern joint vetch), Smolder (to control *Dodder spp.*), Biochon (to control woody weeds) and Myco-Tech (to control deciduous tree species in forests) are some famous bio-herbicides which are used to control different weeds.

Keywords: Bio-herbicides, weed management and sustainable weed control

In-vitro* efficacy of fungicides at different concentrations against *Ustilaginoidea virens

Ashwani Kumar¹ and Anupam Kumar²

¹M.Sc. Agriculture, ²Assistant Professor (Plant Pathology), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: ashwaninaik90@gmail.com

Abstract

Across the globe, rice (*Oryza sativa* L.) is the staple food of over 3.5 billion people. *Ustilaginoidea virens* (Cooke) Takahashi is the pathogen behind the devastating inflorescence disease known as false smut of rice. Depending on the disease's intensity, the disease reduced rice yields by 2.8% to 81%. The condition is classified as mild because of its irregular occurrence. “*In-vitro* efficacy of fungicides at different concentrations against *Ustilaginoidea virens*” was conducted at Plant Pathology Laboratory of School of Agriculture, Abhilashi University, Mandi (H.P.) during 2022-2023. The poisoned food technique was employed for the evaluation of chemicals *in-vitro* against *Ustilaginoidea virens*. All the fungicides tested significantly inhibited the mycelial growth of *U. virens* over control. Among the tested concentrations; 50 ppm, 100 ppm and 200 ppm of fungicides namely; Propiconazole 20 % EC, Carbendazim 50 % WP and Tricyclazole 75 % WP. On the basis of present investigation, it is observed that Tricyclazole 75% WP was found most effective resulting maximum inhibition 92.93 % of *Ustilaginoidea virens* at 200 ppm while Propiconazole 20 % EC and Carbendazim 50 % WP both showed minimum radial growth after 72 hours.

Keywords: Rice, *Ustilaginoidea virens*, fungicides, management

***In-vitro* Screening of *Trichoderma* isolates through dual culture plate technique against Sheath blight (*R. solani*) disease of rice**

Ashish¹ and Anupam kumar²

¹M.Sc. Agriculture, ²Assistant Professor (Plant Pathology), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: jattaashish0481@gmail.com

Abstract

Rice (*Oryza sativa* L.) is a prominent cereal crop. On the basis of economic and nutritional value, it is ranked higher than other cereals. It plays an important role in nutrition. Considering its important position, 2004 was designated as the “International Year of Rice” by the General Assembly of the United Nations. Over 3.5 billion people worldwide rely mostly on rice (*Oryza sativa* L.) as their staple diet. Almost half of the world's population relies on it as their main source of sustenance, particularly in Asian nations like China, India, and the ASEAN. Many bacterial, viral, and fungal diseases have an impact on this significant cereal crop in India. One of the main obstacles to rice production is *Rhizoctonia solani*, which causes sheath blight disease of rice. Sheath blight, caused by the fungus *Rhizoctonia solani*, primarily targets the sheaths and leaves of rice plants, leading to characteristic lesions and affecting plant growth and yield. This disease spreads rapidly under favorable conditions, such as high humidity and warm temperatures. This study revealed that average per cent inhibition of *R. solani* (Sheath blight) after 96 hours’ of inoculation against the growth of *Trichoderma* isolates. The local isolates of *Trichoderma* spp. S-8 and S-10 (98.10%) are very impactful to control Sheath blight disease of rice.

Keywords: Rice, *Rhizoctonia solani*, disease, *Trichoderma* and management

Studies on Generative potential and Virulence efficacy of an isolate of *Steinernema pakistanense* (Nematoda: Steinernematidae) against Lepidopteran and Coleopteran Pests

Parul Chauhan*, Ayushi Chaudhary and Istkhar

Department of Bioscience and Biotechnology, Banasthali, Vidyapith, Rajasthan-304022, INDIA

Corresponding author email: parulchauhan9929@gmail.com

Abstract

Evidently, entomopathogenic nematodes (EPNs) are an effective nematode species for the biological control of insect pests. It is generally recognized that different EPN strains, even those from the same species, can have dramatically varying efficiency in various geographical locations. To discover EPN strains that are more effective, it is necessary to investigate EPNs and verify their effectiveness in various ecological locations. On the basis of that the pathogenicity and the reproductive potential was studied with the isolates of *Steinernema* sp. named BSBT-S9, and BSBT-S10 which is isolated from the soil of the district Tonk, Rajasthan, were studies using *Galleria mellonella* commonly known as greater wax moth under laboratory conditions. Four different doses that is 25, 50, 100, 200 of Infective Juveniles (IJ's) of strain BSBT-S9, and BSBT-S10 were given to *Galleria mellonella* and *Tenebrio molitor* larval stages in 250µl DDW. Within 72 hours of infection with all concentrations, all the replicates died. Isolates BSBT-S9, and BSBT-S10 caused 90% mortality. The outcome of the result showed that all of the larvae infected with BSBT-S9, and BSBT-S10 died within 72 hours. The LC50 and LT50 values both are calculated. Isolate BSBT-S9, and BSBT-S10 also have high reproductive potential. According to the analyzed data results isolate BSBT-S9, and BSBT-S10 can be used and implemented for the commercialization in IMP (Integrated Pest Management); moreover additional trials at field levels are still required on other different insect pests.

Keywords: Entomopathogenic nematodes, *Galleria mellonella*, Virulence efficacy, and reproductive potential

First Survey and Authentic report of Entomopathogenic Nematode from District Tonk, Rajasthan, for biocontrol agent against *Galleria mellonella* and *Tenebrio molitor*

Ayushi Chaudhary*, Parul Chauhan, and Istkhar

Department of Bioscience and Biotechnology, Banasthali Vidyapith, Rajasthan-304022, INDIA

Corresponding author email: ayushichaudhary06@gmail.com

Abstract

One potential method for eradicating entomopathogenic pests without endangering the environment is insect pest management with biopesticides in the agricultural fields. Entomopathogenic nematodes (EPNs) are a newly developing potential biological control agent against insect pests among the enormous range of biocontrol agents. They are safe to vertebrates and plants but infect a wide variety of soil insects, including the larvae of moths, butterflies, flies and beetles as well as adult grasshoppers and crickets. The only free-living stage of the nematode is the infective juvenile (IJ's), can actively seek out insect hosts and enters them through natural apertures or sporadically through the cuticle of an insect. The principal agents that kill the host within 24 to 72 hours are the symbionts that these nematodes then release into the haemolymph. Morphological, morphometric and molecular studies showed that identified isolate from different villages of District Tonk, Rajasthan which we named as BSBT-S10, and BSBT-S11 are smaller than other species under genus *Steinernema*. These isolates were studying using *Galleria mellonella* and *Tenebrio molitor* insects. Pathogenicity tests shows 90% mortality within the shortest period of time. Key morphological diagnostic characters for these new isolates showed that the presence of two horn-like appendages on the anterior end of infective juveniles is what makes these isolates in the “Bicornutum group” with size ($394\pm 11\mu\text{m}$, and $390\pm 14\mu\text{m}$ respectively). Other parameters also showed the least measurements as compared to *S. pakistanense*, *S. abbasi*, *S. ceratophorum*, and *S. bifurcatum*. In first generation male of both the isolates also, the same results were obtained. But, molecular analyses based on both ITS and D2-D3 regions of 18S and 28S rDNA revealed that these isolates were identified as *S. pakistanense* BSBT_S10 and BSBT_S11 isolates (100% ITS nucleotide similarity and 100% D2D3 nucleotide similarity).

Keywords: *Steinernema sp.*, Identification, Integrated pest management, and *Galleria mellonella*

To study the Anthracnose Disease of Chilli

Preeti Thakur*, Dr. Anupam Kumar, Dr. Rajan Kamboj, Prabhat kumar

Department of Horticulture, School of Agriculture Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh-175028

Corresponding author email: pt2913374@gamil.com

Abstract

Anthracnose, a devastating fungal disease, poses a significant threat to chili (*Capsicum annuum* L.) production worldwide. This abstract presents a comprehensive overview of anthracnose disease in chili, focusing on its etiology, symptoms, epidemiology, management strategies and research advancements. Anthracnose is primarily caused by *Colletotrichum* species, notably *Colletotrichum capsici* and *Colletotrichum gloeosporioides*, which infect various parts of the chili plant, including fruits, stems and leaves. Symptoms typically manifest as circular, sunken lesions on fruits, often accompanied by dark, spore-bearing structures called acervuli. Favorable conditions like high humidity and warm temperatures promote disease development, while factors like irrigation practices and crop residue management influence disease severity. Management of anthracnose in chili relies on integrated approaches, including cultural practices, chemical control, host resistance, and biological agents. Cultural practices like crop rotation, sanitation, and pruning help reduce pathogen inoculum, while fungicides provide effective short-term control. Recent research has explored various aspects of anthracnose disease, including pathogen genetics, host-pathogen interactions, and novel control methods. Molecular techniques have facilitated the identification of virulence factors in *Colletotrichum* species, informing breeding programs for durable resistance.

Keywords: Anthracnose, Chili, *Capsicum annuum* L., Symptoms

Seed health status of farmers' saved wheat seed in Punjab

Rubleen Kaur, Parminder Singh Tak and Rajnish Verma

Department of Plant Pathology, Punjab Agricultural University, Ludhiana

Corresponding author email: rubleen2610@gmail.com

Abstract

A total 105 grain markets of 23 districts of Punjab were surveyed for study of seed-borne mycoflora of wheat during 2021-22 in which 654 grain samples were collected. Grains were visually inspected for incidence of Black point (BP) and shrivelling. Prevalence of Black point and shrivelled grains was 55.20% and 79.5%, respectively in the state. Grain samples from Patiala and Mansa were found to have statistically lowest black point and shrivelled seeds while highest incidence was observed in sub-mountainous districts of Pathankot followed by Hoshiarpur and Mohali. Three pathogenic and nine opportunistic fungi were observed in these samples. Highest fungal diversity was observed in Sarhali Kalan where samples had 66.67% mycoflora load followed by Sirhind-1, Jalandhar, Rajpura (58.3% each) and Bikhi, Nabha, Dadehra, Bucho Mandi, Panjgrain with 16.67% had lowest mycoflora load. All the samples collected met the minimum seed certification standards for germination. Maximum vigour index I and II of 3327.6 and 26.46 was observed in grain samples collected from Doraha-1 and Shahkot, respectively. Prevalence of *Alternaria* spp. (94%) was highest followed by *Fusarium* spp. (64%) and *Aspergillus* spp. (48%).

Keywords: Seed-borne mycoflora, *Alternaria* spp., Punjab, black point.

Insect Pest Fauna of Carrot and their Management

Ramesha N M^{1*}, Rafee C M², Hegde M G³, Hiremath S M⁴

¹Ph. D scholar, Division of Entomology, Indian Agricultural Research Institute, New Delhi-110012

²Agricultural Extension Leader, AEEC, Gadag, UAS, Dharwad-580005

³Professor, Department of Agricultural Entomology, College of Agriculture, Dharwad, UAS, Dharwad-580005

⁴Professor, Department of Horticulture, College of Agriculture, Dharwad, UAS, Dharwad-580005

Corresponding author email: rameshanmr317@gmail.com

Abstract

The survey on incidence of insect pests of carrot was conducted during *rabi/summer* 2022 and the results of a survey conducted in three districts of Karnataka revealed that during rooting and pre-rooting stages of the crop, Gadag district recorded the highest incidence of agromyzid fly, defoliators, sucking pests like leaf hoppers, plant hoppers and aphids, as well as natural enemies like coccinellids and chrysopids. The field experiment on population dynamics of insect pests and natural enemies and management of insect pests of carrot were carried out during *rabi/summer* 2022 at a farmers field, in Nagral village of Ron taluka of Gadag district. The result on population dynamics revealed that the infestation of agromyzid fly gradually started at the 7th standard week (26.66 %) and reached the peak at the 15th standard week (60 %). The population of sucking insect pests and natural enemies gradually started during the 3rd standard week and reached its peak during the 7th standard week. The results of the correlation study revealed that there was no significant correlation was found between the incidence of insect pests, natural enemies and weather parameters except the minimum temperature. A significant and positive correlation was observed between the incidence of agromyzid fly and the minimum temperature. A significant and negative correlation was observed between the incidence of sucking pests, coccinellids, chrysopids and the minimum temperature. According to the studies on the efficacy of different insecticides and biopesticides, the highest reduction of agromyzid fly over control (73.91 %) was recorded in treatment with soil application of chlorantraniliprole 0.4 % GR @ 10 kg/ha and soil application of fipronil 0.3 % GR at 20 kg/ha followed by seed treatment with cyantraniliprole + thiamethoxam at 10 ml/kg (71.01 %). Among the different insecticides, cyantraniliprole + thiamethoxam followed by seed treatment with thiamethoxam 30 FS at 10 ml/kg and seed treatment with imidacloprid 600 FS at 10 ml/kg proved most effective in controlling sucking pests. The treatment with soil application of chlorantraniliprole 0.4 % GR @ 10 kg/ha recorded the highest yield and B: C ratio.

Keywords: Agromyzid fly, Management, Population dynamics, Chlorantraniliprole

Use of Bio-Agents and Phyto Extracts for Management of Yardlong Bean Seed Mycoflora

S. A. Rathod¹ and V. P. Prajapati²

¹Ph. D. Scholar, Department of Plant Pathology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, 396450

²Assistant Professor, Department of Plant Protection, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, 396450

Corresponding author email: sanjanarathod2210@gmail.com

Abstract

The present study was undertaken with a view to check the effect of different bio-agents and phytoextracts on the seed mycoflora of yardlong bean at Department of Plant Pathology, NMCA, NAU, Navsari during the year 2022-2023. The research included different treatments of bio-agents like *Trichoderma viride*, *T. harzianum*, *T. fasciculatum*, *Bacillus subtilis* and *Pseudomonas fluorescens* and different phyto-extracts viz., neem, arduisi, tulsi, datura, gajar grass, garlic and turmeric were tested to check their efficacy on seed germination and seed health status of yardlong bean seeds inoculated with mixture of all the isolated fungi using paper towel method *in vitro*. Result indicated that seed treated with *T. fasciculatum* recorded highest seed germination (53.50%) and maximum shoot length (10.61 cm) and root length (8.12 cm) followed by *P. fluorescens* (51.50%, 9.65 cm, 6.39 cm) over control (27.50%, 7.75 cm, 5.45 cm). Whereas, in case of phyto-extracts seed treated with turmeric rhizome extract @10 per cent recorded highest seed germination (77.25%), shoot length (8.16 cm) and root length (6.16 cm) followed by datura leaf extract which recorded seed germination (72.25%), shoot length (8.44 cm) and root length (6.37 cm) over control (54.25%, 6.94 cm, 5.31 cm).

Fusarium wilt resistance characterization in the nuclear male sterile (NMS) backcross population of muskmelon

Vishal Choudhary^{1*}, Navraj Kaur Sarao¹, Sat Pal Sharma², Jaideep Kaur Deol¹

¹School of Agricultural Biotechnology, ²Department of Vegetable Science, Punjab Agricultural University, Ludhiana-141004, Punjab, India

*Corresponding author, email: vishal-soab@pau.edu

Abstract

Cucumis melo L. varies significantly in terms of Production, quality, and disease resistance. Heterosis breeding is the principal approach for developing muskmelon varieties. Nuclear male sterile (NMS) lines play a major role in heterosis in this crop. Thus, the development of new NMS lines with diverse genetic background and disease resistance is required. The present study used marker-assisted backcross selection for fusarium wilt resistance in a male sterile *ms-1* gene introgressed backcross population of MS-1 x KP₄HM-15 in muskmelon. Marker-assisted backcross breeding was employed to transfer the *ms-1* gene from MS-1 to the KP₄HM-15 background, which is resistant to fusarium wilt. Fusarium wilt resistant plants were identified genotypically using the previously mapped flanking markers DM0096 and CSWCTT02 on BC₂F₃ plants. After the genotypic selection, out of 820 BC₂F₃ plants, the 410 plants were selected as fusarium wilt resistant which were further screened phenotypically. The screening was carried out by inoculating the BC₂F₃ plants with fusarium inoculum. Out of the 410 genotypically selected plants, 390 plants were phenotypically resistant to fusarium wilt. These fusarium wilt resistant superior NMS lines thus developed will be further used in hybrid breeding program of muskmelon.

Keywords: Nuclear male sterile (NMS) lines, Fusarium wilt, Marker assisted backcross breeding, Male sterility, *ms-1* gene

Role of Grafting in Vegetables

Ajay Kumar*, Sandeep Kumar, Manish Chauhan, Latesh Narval

Department of horticulture, school of agriculture, Abhilashi University, Chail chowk, Mandi – 175028 (Himachal Pradesh)

Corresponding author email: ajaykumar97700@gmail.com

Abstract

Grafting is a method of asexual propagation technique where two living plant parts (rootstock and scion) are united to grow as a single plant. Grafting in vegetables is a centuries-old practice to improve yield through organic culture. Vegetable grafting is a popular practice in many European and North American countries, Japan, Korea, and China. Vegetable crops are exposed to many abiotic and biotic stress factors, including salinity, heat, heavy metals, excess trace elements, diseases, and pests, which have a significant effect on crop growth and productivity. Grafting reduces the chemical load on final harvested vegetables and can be considered a low-cost sustainable technique in vegetable production. Grafting is an effective practice in solanaceous and cucurbitaceous vegetables to control soil-borne diseases including; Fusarium wilt, bacterial wilt, and nematodes without using pesticides. Vegetable grafting involves cutting the stem of a vegetable plant at the seedling stage and attaching it to the rootstock of the seedling of a vegetable plant like wild brinjal or pumpkin. Once the attachment is made, the grafted seedling is grown in controlled climatic conditions, after which it can be planted in the field. Grafting onto specific rootstocks generally provides resistance to biotic and abiotic stress tolerance, growth, yield and quality of crops, soil borne diseases and nematodes. It is an effective technology for use in combination with more sustainable crop production practices, including reduced rates and overall use of soil fumigants in many other countries. Rootstock use enhances whole plant biotic stress responses by improving plant Vigor through vigorous attainment of soil nutrients, avoidance of soil pathogens, tolerance of low soil temperatures, salinity, and wet soil conditions. Rootstock also affects scion growth, yield, and fruit quality. Grafting is rare in India due high initial cost and availability of facilities, but with the continued loss of quality disease free farmland vegetable grafting is an attractive option.

Keywords: Asexual propagation, Biotic and abiotic stress, Diseases, Rootstock and scion, Vegetable grafting

Nano Boost: Elevating Crop Productivity with Advanced Nano Fertilizers

Dharmvir¹, Dr. Jay Nath Patel² and Sahil Sethi¹

¹M.Sc., Department of Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: rangra234@gmail.com

Abstract

Nano boost represents a groundbreaking advancement in agricultural technology, offering a transformative solution to enhance crop productivity through the utilization of advanced nano fertilizers. This innovative approach leverages nanotechnology to address the challenges faced by traditional fertilization methods. Nano boost's nano fertilizers are engineered at the molecular level, allowing for precise nutrient delivery to crops, optimizing their growth and development. The nano-sized particles in nano boost fertilizers exhibit enhanced solubility, ensuring efficient absorption by plant roots. This targeted nutrient delivery promotes increased nutrient utilization efficiency, minimizing wastage and environmental impact. Additionally, nano boost formulations incorporate smart release mechanisms, responding to the specific needs of crops at different growth stages. Beyond nutrient delivery, nano boost fosters sustainable agriculture by improving soil health. The nano-sized components facilitate improved water retention and nutrient retention in the soil, reducing the need for excessive irrigation and minimizing nutrient runoff. This not only contributes to resource conservation but also mitigates environmental concerns associated with traditional fertilization practices. In conclusion, nano

boost represents a paradigm shift in agriculture, offering a sustainable and efficient solution to elevate crop productivity. The integration of nanotechnology in fertilizers not only enhances nutrient delivery but also promotes responsible farming practices, paving the way for a more resilient and productive agricultural future. Besides of more futuristic approach, there are some scientist concerns about the nano fertilizers, like- the overuse of nano fertilizer can cause health and environmental issues (leakage or work as free radicals). As the nano fertilizers are getting very famous in agriculturalists but some of them are also hesitating to adopt the use of nano fertilizers in the lack of proper knowledge.

Keywords: Nano boost, Nano technology, Nano fertilizer, Sustainable agriculture and Soil health

Differential Responses of Integrated Nutrient Management practices on performance of garlic in North Western Himalayas

Manish Chauhan^{a*}, Hem Raj Sharma^b

School of Agriculture, Abhilashi University, Mandi, Himachal Pradesh, India- 175028

^aDepartment of Vegetable Science, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India- 173230

Corresponding author email: manishchauhanvsc@gmail.com

Abstract

The present investigation was carried out at the Experimental Farm, Department of Vegetable Science, Dr. YS Parmar University of Horticulture and Forestry, Nauni Solan, (HP) in two successive seasons *i.e.* rabi 2019-20 and 2020-21. The experiment was laid out in Randomized Complete Block Design with three replications comprising thirteen treatment combinations of organic and inorganic fertilizers. The treatment combination which comprised of 75% RDN + Zn @ 5 kg/ha + S @ 40 kg/ha + 5% Jeevamrit @ 1 L/m² (T₁₃) found best for most of the yield and yield contributing traits. The combined application of 75% RDN + Zn @ 5 kg/ha + S @ 40 kg/ha + 5% Jeevamrit @ 1 L/m² (T₁₃) significantly influenced growth and yield attributes of garlic and resulted significantly maximum plant height (89.33 cm), number of leaves per plant (9.19), number of days to harvest (229.33), bulb weight (64.25 g), bulb diameter (5.41 cm), number of cloves per bulb (14.39), bulb yield per hectare (204.20 q), TSS (36.01 ° Brix), dry matter content (45.48 %), oleoresin content (1.61 %), viable bacterial count (203.40 × 10⁴ cfu/g), available N:P:K (411.65:47.18:368.03 kg/ha) content of soil and plant N:P:K uptake (62.77:26.14:60.68 kg/ha). Our findings suggested that using organic fertilizers in combination with inorganic nutrients improved soil fertility, microbial properties and nutrient uptake while also providing better economics and net returns.

Keywords: Garlic, Organic fertilizers, Nutrient uptake, Inorganic nutrients

Effects of sowing methods and nitrogen management on wheat crop

Sushma¹, Dr. Mohd. Shah Alam² and Rakhi¹

M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi university Mandi, H.P.¹

Assistant Professor, Agronomy, School of Agriculture, Abhilashi university Mandi, H.P.²

Corresponding author email: shallunaik79@gmail.com

Abstract

Wheat (*Triticum aestivum* L.) is the most important crop that excels all other cereals both in area and production and also known as king of cereals. It's one of the most nutritious cereals with higher protein and its contribution to human diet puts it in the first rank of plants that feed the world. Appropriate sowing method is one of important agronomic approaches that can be used to enhance wheat yield by optimizing tillering capacity and the efficient utilization of other available resources (Mehmood et al., 2012). Sowing of wheat under FIRBS with

2 and 3 rows per bed was found to produce more yield compared to flat sowing and other methods (Kumar et al., 2010). Row planting has many advantages over broadcasting, as it need less seed and facilitate field inspection and more yield (Pirzada et al., 2018). Cris cross methods was observed maximum plant height and dry matter accumulation at successive growth over the line sowing but remained at par with FIRB system. Nitrogen (N) is an essential elements for wheat production. Optimum amount and time of fertilizer application is considered a key to the bumper crop of wheat. Time of fertilizer application can affect the N-utilization efficiency by wheat (Jan et al., 2007). Several studies have shown that split application of nitrogen fertilizer results in higher nitrogen use efficiency and higher grain yield than under single applications (Khan et al., 2011). The present study was conducted to investigate the impact of sowing method and nitrogen management on growth of wheat (*Triticum aestivum* L.)

Impact of Nano Fertilizers on the Yield and Growth of Indian Mustard (*Brassica juncea* L.)

Manish Sharma¹, Dr. Mohd Shah Alam²

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

Corresponding author email: ms9816574549@gmail.com

Abstract

In the pursuit of sustainable agricultural practices, the utilization of nano-fertilizers has emerged as a promising avenue to enhance crop productivity while minimizing environmental impacts. This study aims to investigate the effects of nano-fertilizers on the growth and yield of Indian Mustard (*Brassica juncea* L.), a vital oilseed crop in India. Through a series of controlled experiments conducted over two growing seasons, nano-fertilizers comprising nano-sized nutrient particles were applied to Indian Mustard crops at various stages of growth. Parameters including plant height, leaf area, chlorophyll content, flowering and seed yield were meticulously monitored and compared with conventional fertilizer-treated and untreated control groups. Preliminary findings suggest that the application of nano-fertilizers significantly promotes the growth and yield of Indian Mustard compared to traditional fertilizer treatments and untreated controls. Nano-fertilizer-treated plants exhibited increased biomass, enhanced chlorophyll synthesis, improved nutrient uptake and accelerated flowering, leading to higher seed yield. Moreover, nano-fertilizer application demonstrated efficient nutrient utilization, minimizing nutrient losses and environmental pollution. Overall, this study underscores the potential of nano-fertilizers in augmenting the productivity and sustainability of Indian Mustard cultivation, offering promising insights for agricultural practices aimed at meeting the burgeoning food demand while mitigating resource constraints and environmental concerns.

Keywords: Foliar application, Nano fertilizer, Sustainable agriculture, Productivity and *Brassica juncea*

Importance of Nitrogen in Fodder Crops

Shivansh Thakur¹ and Jay Nath Patel²

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

Corresponding author email: shivanshthakur057@gmail.com

Abstract

Fodder crops are cultivated plant species that are utilized as livestock feed. Fodder refers mostly the crops which are harvested and used for stall feeding. Fertilization are important factors that impact both fodder crop productivity and quality. Nitrogen is the important part of chlorophyll and all protein it is responsible for dark

green colour of leaves, tillering leaf production and enlargement of leaf surface. Nitrogen enhances the dry matter content and quality of green vegetables as well as the protein content of grain crops. Fertilization has a significant effect on the quality and productivity of fodder crops. Application of nitrogen is more significant in terms of fodder output and quality. The primary nutrient given to increase crop yield is nitrogen. Under most agroecological circumstances, it is one of the plant nutrients that limits production the most, therefore cropping systems' capacity to remain economically sustainable depends on how well they use it. Since it is typically the primary nutrient that limits crop productivity in the world's major agricultural regions, producers stand to gain financially from the adoption of improved nitrogen management techniques. It is an essential part of several basic cell components, including nucleic acids, amino acids, photosynthetic pigments and enzymes. Nitrogen is the prime nutrient for plants and becoming deficient in soils which is being supplemented by inorganic nitrogen fertilizer. Nitrogen is the important part of chlorophyll and all protein it is responsible for dark green color of leaves, tillering leaf production and enlargement of leaf surface. Plant deficient in nitrogen are leaves become a yellowish in color this yellowish color appears on older leaves that is lower leaves. Nitrogen application assumes greater importance regarding the yield and quality of fodder. Nitrogen performs a critical role in photosynthesis and is an indispensable part of protein. It is vital for physiological and enzymatic biochemical reactions in plants metabolism. Nitrogen application and seeding density not only significantly affect fodder production but also affect the quality parameters of forage like crude protein, crude fibre total ash and ether extractable fat.

Keywords: Nitrogen, fodder, chlorophyll, protein and deficiency of nitrogen.

Effect of organic and inorganic sources of nutrients on soil properties and wheat yield

Harshit Gupta¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: hg63156@gmail.com

Abstract

A field experiment entitled “Effect of organic and inorganic sources of nutrients on soil properties and wheat yield” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during Rabi 2021-22. The experiment was laid out in randomized block design with three replications, consisting of nine nutrient management treatments *i.e.* T₁ - absolute control, T₂ -Beejamrit + Jeevamrit, T₃ - FYM @10 t/ha, T₄- Beejamrit + Jeevamrit + FYM @10 t/ha, T₅ - 50% recommended dose of fertilizers, T₆ - Beejamrit + Jeevamrit + 50% recommended dose of fertilizers, T₇ - FYM @10 t/ha + 50% recommended dose of fertilizers, T₈ - Beejamrit + Jeevamrit + FYM @10 t/ha + 50% recommended dose of fertilizers and T₉ - 100% recommended dose of fertilizers.. Results of study revealed that treatments comprised of recommended NPK through inorganic sources and integrated nutrient management (Beejamrit + Jeevamrit + FYM @10 t/ha + 50 percent recommended dose of fertilizers and FYM @10 t/ha + 50 percent recommended dose of fertilizers) behaving alike resulted in significantly higher wheat grain yield compared to other treatments combinations of organic and natural farming sources of nutrients. Integrated nutrient management enhanced the build-up of organic carbon in the soil over the initial value. Significantly higher available soil nitrogen, phosphorus and potassium over initial values were obtained with the 100% recommended dose of fertilizers as well as integrated nutrient management treatments.

Keywords: organic, inorganic, Beejamrit, Jeevamrit

Effect of natural farming, organic and inorganic systems of nutrition on soil chemical properties and yield of wheat

Tejender Singh¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

A field experiment entitled “Effect of natural farming, organic and inorganic systems of nutrition on soil chemical properties and yield of wheat” was conducted at Research Farm of School of Agriculture Abhilashi University, Mandi (H.P) during *Rabi* 2021-2022. The experiment was laid out in randomized block design with three replications, consisting of six nutrient management treatments *i.e.* T₁- absolute control, T₂ - natural farming nutrient management (*Beejamrit* + *Jeevamrit* + mulching), T₃ - organic nutrient management (FYM @10 t/ha + *Jeevamrit*), T₄ - farmer’s practice (FYM @ 2.5 t/ha + 25% recommended dose of fertilizers), T₅ - integrated nutrient management (FYM @5 t/ha + 50% recommended dose of fertilizers) and T₆ - inorganic nutrient management (100% recommended dose of fertilizers). Results of study revealed that inorganic and integrated nutrient management treatments behaving alike resulted in significantly higher wheat grain yield compared to treatments comprised of farmer’s practice, organic and natural farming systems of nutrition. Integrated nutrient management and organic nutrient management treatments remaining at par resulted in significant increase in soil organic carbon content over the initial status, whereas an increase in soil available nitrogen, phosphorus and potassium over the initial status was observed with inorganic nutrient management as well as with integrated nutrient management treatments.

Keywords: natural farming, organic, inorganic, wheat

Nutrient management practices in wheat crop

Priya Thakur¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

Wheat (*Triticum aestivum* L.) is the second most important cereal crop next to rice play an important role in global agricultural economy. Inorganic sources of nutrients have played a prominent role in increasing food grain production of the country in the past and going to be crucial input in future as well. But now the indiscriminate use of chemical fertilizers alone has led to the environmental pollution and deterioration of soil physical, chemical and biological properties. The use of organic manures has assumed greater significance in the present set up of agriculture. Organic resources of nutrients have capability to maintain soil health on sustainable basis, but low availability of organics and low nutrient content are the major constraints for the adoption of organic agriculture in country. Under the situation, integrated nutrient use of organics such as farmyard manure and vermicompost with inorganic fertilizers has been identified as feasible option to improve and sustain wheat production, productivity and profitability. In recent years, Subhash Palekar’s Natural Farming (SPNF) is admired and claimed as a cost effective and sustainable crop production system. It is based on the simple principle of utilizing cheap and locally available inputs with no use of chemicals in any form like fertilizers and herbicides. In SPNF, soil is supplemented with the inoculums like *Beejamrit* and *Jeevamrit* to accelerate the propagation of soil existing micro flora and ultimately ensures the availability of nutrients to the crops. But this needs experimental testing.

Keywords: organic manure, nutrient management, SPNF

Effect of integrated nutrient management on growth and biomass production of ashwagandha (*Withania somnifera*) in mid hill region of Himachal Pradesh.

Anjly Kumari

M.Sc., Department of Agronomy, Dr KSG Akal College of Agriculture

Abstract

A research trail entitled “Effect of INM on growth and biomass production of ashwagandh (*Withania somnifera*) in mid hill region of HP” was conducted in Kharif season of 2021-2022 at Research Farm of Herbal garden, Eternal University, Baru Sahib (H.P.). The experiment combined among 8 treatments amalgamation i.e., T₁ =100% of RDF, T₂ = 100% of VMC, T₃ = 100% of FYM, T₄ = 75% of RDF + VMC 25%), T₅ = 75% RDF + FYM, T₆ = 50 % RDF + VMC 25% + FYM 25%), T₇ = 50% VMC + 50% FYM) and T₈ = Control and these treatment were put out in RBD and replication 3. The results demonstrated that INM methods have non-significant impact on plant population but significant impact on other growth parameters. In contrast to all further applications, the combined application of T₆ =50 % RDF+VMC 25% + FYM 25%) gave the maximal value for height of plant, root length (cm), root girth/ diameter (cm) at various growth stages (30, 120 and 180 DAS). This treatment T₆ (50% RDF + VMC 25% + FYM 25%) also gives maximum biomass production. The minimum growth values and biomass production values was observed under T₈ (control). INM may safely conclude that application of recommended dose of fertilizers with organic sources (VMC and FYM) may go along way in better growth, development & alkaloid contents of ashwagandha plant. This phenomenon happened due to the healthy soil environment provided to the ashwagandha plant through improvement in physio-chemical properties of soil with INM techniques. The balanced nutrition with chemical fertilizer helped the plant through supply of plant nutrients even at early stages growth. While, organic manures (VMC and FYM) provided the plant nutrition throughout its growth period through acceleration of plant metabolites even in later phases of plant growth.

Keywords: Ashwagandha, Growth, Biomass production and Integrated Nutrient Management

Management Practices Impacts on Soil Nutrient Status of Apple Orchards in Kullu District Of Himachal Pradesh

Priyanka Sharma, Mohinder Singh* and S K Bhardwaj

*Department of Environmental Science, *Department of Entomology*

Dr. Y.S Parmar, University of Horticulture and Forestry, Nauni, Solan (HP) 173 230, India

Corresponding author email: priyankasharma2111@gmail.com

Abstract

Apple (*Malus domestica* Borkh) is one of the important fruit crops in Himachal Pradesh. The study aimed to evaluate the soil nutrient status of apple orchards at different altitudes (Bajaura 1090m amsl, Seobagh 1189m amsl, Naggar 1880m amsl and Arsu 2080m amsl) and with different fertilizer management practices (low input and high input) in Kullu district of Himachal Pradesh during the year. In each location twelve orchards were selected and six to seven trees per orchard were randomly marked for soil nutrient evaluation. The soil samples were collected in the month of October every year and analyzed for various soil parameters. Soil pH (6.50), electrical conductivity (0.31) and organic carbon (2.49) were found maximum in Arsu as compared to other locations. Whereas among different management practices low input orchards showed minimum values of pH (5.86) and EC (0.25). In the soils of low input orchards, lower values of N (278 kg/ha), P (20.79 kg/ha), K (224.40 kg/ha), Fe (33.25 mg/kg), Zn (mg/kg) and Cu (3.94 mg/kg) were found as compared to soils of high input orchards which contained higher values of N (330.40), P (36.64), K (287.40), Fe (58.2 mg/kg⁻¹), Zn (3.78mg/kg) and Cu (3.94mg/kg).

Keywords: apple, management practices, soil nutrient

Nutrient management-Enhancing soil health and crop yield

Bhaskar Anand¹ and Sandeep Kumar¹

School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P) 175028

Corresponding author email: mscbhaskar2021@gmail.com

Abstract

A good and proper nutrients management plays very important role in good soil health and better crop yield. Globally, food systems face multiple challenges, including minimizing environmental impacts, adapting to a changing climate, increasing yields, and maintaining and increasing crop nutritional quality. Management techniques that focus on soil health are promising solutions to mitigate some environmental impacts and may increase economic returns. However, claims that soil health increases will concurrently increase crop quality and productivity merit careful examination. Factors beyond soil health metrics determine crop nutritional quality. Yield outcomes of soil health management are of significance, as there are concerns that yield increases are insufficient to meet future food demands. While soil health frameworks are comparatively recent initiatives, there are thousands of published conservation agriculture studies that examine yield outcomes with cover crops, no-till and rotation. This literature indicates that soil health practices can also have neutral or negative yield impacts only in select systems have consistent yield increases been realized, highlighting the need for language clarification and improvements in mechanistic understanding of regional-scale yield impacts.

Keywords: Nutrient management, Soil health and Crop yield

Evaluating Genetic Diversity in Rabi Sorghum Genotypes for Drought Tolerance Through SSR Marker Analysis

Navyashree R^{1*}, Mummigatti UV², Nethra P³ and Basavaraj B⁴

^{1}Ph.D. scholar, Department of Crop physiology, UAS, Dharwad*

²Professor, Department of Crop Physiology, UAS, Dharwad

³Assistant Professor, Department of Crop Physiology, UAS, Dharwad

⁴Assistant Professor, Department of Biotechnology, UAS, Dharwad

Corresponding author email: navyashreeshakti@gmail.com

Abstract

The research aimed to investigate the drought tolerance of rabi sorghum genotypes using SSR markers associated with drought-tolerant traits, assessing the genetic diversity among them. Genetic diversity analysis using SSR markers is a valuable tool for understanding the variations present within a population or group of genotypes. SSR markers are widely used due to their ability to detect polymorphisms at specific genomic loci, providing valuable information about genetic diversity and relationships among different genotypes. A total of 25 SSR markers were analyzed, revealing 9 polymorphic markers capable of detecting genetic variation within sorghum genotypes. The polymorphic information content (PIC) values were calculated, with SSR primer Xtxp145 exhibiting the highest PIC value (0.998), indicating its informativeness in distinguishing genotypes. Conversely, Xtxp335 had the lowest PIC value (0.023), offering limited information for genotype differentiation. Genetic relationships were further explored using clustering algorithms, resulting in the categorization of genotypes into seven clusters (I-VII) based on similarity indices. Notably, Cluster I comprised a single genotype (SVD-1272R), while Cluster II included seven genotypes with distinct genetic relationships. Within Cluster II, subclusters revealed specific relationships, such as SVD-1358R, SVD-1528R, CSV-216R, and BJV-44 clustering together, while CSV-29R and Basavan moti formed a separate subcluster. Cluster III included one ungrouped genotype (SPV-486), while Cluster IV encompassed eight genotypes with unique genetic profiles. Clusters V, VI, and VII each had a single ungrouped genotype. Clustering highlighted similar genetic profiles within clusters, providing insights into genetic relationships. This genetic grouping informs the

selection of genotypes for breeding programs or research objectives, aiding in the development of improved traits like drought tolerance and yield potential. Understanding the genetic diversity within the sorghum population enables informed decisions for utilizing specific genotypes in trait enhancement. The findings contribute valuable insights to sorghum genetics, facilitating targeted breeding strategies for resilient sorghum varieties adapted to challenging environmental conditions.

Key words: Sorghum, SSR marker, Cluster, genetic diversity and drought tolerance

Theme 8: Future Strategies for Agricultural Growth, Human Health and the Environment

Plant growth promoting and biocontrol activities of *Pseudomonas fluorescens* for Pea (*Pisum sativum* L.).

Aishwarya*, Manjula¹, Ajay Kumar Gautam²

*Ph.D. Scholar Plant Pathology, School of Agriculture, Abhilashi University Mandi, 175028

¹Ph.D. Scholar Plant Pathology, School of Agriculture, Abhilashi University Mandi, 175028

² Professor, Plant Pathology, School of Agriculture, Abhilashi University Mandi, 175028

Corresponding author email: rajputaishi5@gmail.com

Abstract

Pseudomonas fluorescens is a common aerobic, gram-negative bacterium that grows well in the rhizosphere and is found in agricultural soils. Numerous characteristics of this rhizobacterium enable it to function as a biocontrol agent and enhance plant growth. It is capable of bulk production and grows quickly in vitro. It colonizes and multiplies in the rhizosphere and spermosphere habitats, quickly using exudates from seeds and roots. It produces a broad range of bioactive compounds in the plant rhizosphere, including volatiles, siderophores, antibiotics, and chemicals that promote growth. It also engages in fierce competition with other bacteria and adjusts to environmental challenges. Furthermore, some soilborne diseases inherent suppressiveness is caused by pseudomonads. Through a variety of methods, including the synthesis of antibiotics, bacteriocins, siderophores, hydrolytic enzymes like β -glucanase and chitinases, and other metabolites including phytoalexins, it inhibits the growth of pathogenic microbes. It also induces systemic resistance. This study examined *P. fluorescens*'s traits, plant-growth-promoting qualities, plant-growth-promoting methods, and the induction of systemic resistance by plant-growth-promoting rhizobacterium (PGPR) against several plant diseases and nematode pests. The article discusses PGPR strains that cause induced systemic resistance to a variety of plant pathogens that cause bacterial, viral, and fungal illnesses as well as nematode pests. The plant diseases that *P. fluorescens* controls have been described in detail.

Keywords: *Pseudomonas fluorescens*, PGPR, Siderophore, Chitinases

CRISPR/Cas9: Genome editing technology and it's applications

Riddhi Rathore

Ph.D. Molecular Biology and Biotechnology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, H.P.

Corresponding author email: riddhirathore98@gmail.com

Abstract

Insertion, deletion or modification in the DNA of any organism is called genome editing. Genome editing is a process which enables scientists to understand gene function and develop treatments to various diseases. There are several approaches for genome editing like CRISPR/Cas9, TALENs, ZFNs and Homing Endonuclease and meganucleases. A major advantage of CRISPR systems over TALENs and zinc finger nucleases is the ease with which multiple sites can be targeted simultaneously using multiple sgRNAs while expressing a single Cas9 or

Cpf1 protein. CRISPR is short for ‘Clustered Regularly Interspaced Short Palindromic Repeats’. It has adapted from naturally occurring genome editing systems in bacteria used as a immune defence system by them. CRISPR/Cas9 genome editing system requires a gRNA and Cas9 protein. Cas9 uses a guide sequence within an RNA duplex i.e. tracrRNA: crRNA duplex. A simplified version of defence system occurring in bacteria is used by which DNA is cut precisely and repaired naturally using HDR or NHEJ after bringing certain changes. To sum up the process, gRNA is created, attached to Cas9 protein and introduced into the cells. gRNA can be created by chemical or enzymatic synthesis, *in vitro* transcription or intra-cellular transcription machinery. RNA and Cas9 are attached forming a RNP complex. It is introduced by one of the many methods like electroporation, lipofection, microinjection etc. Mode of action of CRISPR/Cas9 can be divided into following steps: Recognition, Cleavage and Repair. CRISPR/Cas9 holds it’s applications in diverse areas like gene therapy for diseases, diagnostics, agriculture, bioenergy, cancer treatments etc. It can also be used for generating disease models. It is currently being used widely in cases like Alzheimer’s disease, Duchenne Muscular Dystrophy, Leukemia, biotic and abiotic stress in plant, disease diagnosis etc. Biotic and abiotic stress tolerance through CRISPR-Cas mediated genome editing.

Sustainable Practices for Soil and Nutrient Management in Horticulture

D. K. Vasoya¹, V. M. Gohil², Pratik Chaudhary and Janika Bhadarka

¹*Assistant Professor, Rai School of Agriculture, Rai University, Ahmedabad*

²*Ph.D. Student Navsari Agricultural University Navasri*

Abstract

Sustainable soil and nutrient management practices are essential for ensuring the long-term viability and productivity of horticultural systems. This chapter provides an overview of key strategies employed in sustainable horticulture to main soil health, conserve nutrients and minimize environment impact. In sustainable horticulture soil health is paramount, emphasizing the preservation of soil structure, organic matter content and microbial diversity. Conservation techniques such as minimal tillage, cover cropping and mulching are employed to mitigate erosion, enhance water retention and promote soil biodiversity. Nutrient management focuses on optimizing nutrient cycling through practices such as composting, green manuring and integrated pest management (IPM) to minimize reliance on synthetic fertilizers and reduce nutrient runoff. Organic farming principles underscore the importance of natural inputs and biological processes, promoting the use of organic soil amendments and fertilizers to enhance soil fertility and ecosystem resilience. Precision agriculture technology offer precise nutrient application and irrigation management, optimizing resource use and minimizing environmental impact. Water management strategies, including efficient irrigation techniques and rainwater harvesting, play a crucial role in sustainable horticulture, conserving water resources and reducing runoff and soil erosion. Agroforestry practices integrate trees and shrubs into horticultural systems, providing multiple benefits such as soil stabilization, nutrient cycling and biodiversity conservation.

Key word: Horticulture, Sustainability, Soil, Nutrient

Zero Budget Natural Farming (ZBNF)

Nikhil Sharma¹, Dr. Jay Nath Patel² and Vishal¹

¹*M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.*

²*Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.*

Corresponding author email: nikhilsharma86044@gmail.com

Abstract

This article discusses about the various form of Zero Budget Natural Farming (ZBNF). In this type of farming involves the zero cost of production of all crops and use of the natural ingredients such as organic fertilizers and in this farming has no use of any types of chemicals like pesticides, fungicides and insecticides. In Zero Budget Natural Farming has almost no monetary investment because these farming is done with the help of the natural substances. This farming increase the farmer's incomes without the investment and it can break the debt cycle for the many small farmers. Zero Budget Natural Farming has Government also launched the many schemes for the poor farmers of India such as Rashtriya Krishi Vikas Yojna and this scheme is launched in 2006-2007. This scheme provides the subsidy 20-50% in 2020-21 for cultivating fruits and traditional farming for the farmer for increasing economy. But, the marketing issues which must be addressed first before going to achieve and the main goal of Zero Budget Natural Farming is helping the farmers and increasing the productivity. But now this period Government should take the more initiatives to deal with farmers without any role of the middleman in the marketing process and also work on for reducing the role of the middleman in the market because farmer can get their original price of their product such as vegetables, fruits and other different types of crops that are grows in India.

Keywords: Budget, Debt cycle, Farmers, Subsidy, Traditional farming and Zero Budget

Organic Farming- Enhancing soil health and production

Shubham Chauhan¹ and Sandeep Kumar¹

School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P) 175028

Corresponding author email: Shubhamchauhan4848@gmail.com

Abstract

Organic farming is a form of agriculture which avoids the use of synthetic fertilizers, pesticides and plant growth regulators. Only 8.6% of the total cropped area in India is under vegetable production, however, the total consumption of pesticides is 17-20%. The use of biofertilizers increases crop yield by 20-30%, replaces chemical nitrogen and phosphorus by 25% and stimulates plant growth. Many traditional farming systems fulfill the requirement of not using synthetic fertilizer and pesticides, it combines traditional farming system such as the use of enriched composts, high yielding varieties, biofertilizers, green manuring, mulching, crop rotations and mixed cropping with systematic integration of leguminous crops etc. Agriculture is back bone of our country, the sustainable agriculture is major problem due to excess use of inorganic inputs, that's why organic agriculture is on trending at present time. It improves quality, shelf life and nutritive value of the farm produce. It improves the physical, chemical and biological health of the soil. It helps in maintaining environment health by reducing the level of pollution. It reduces the cost of agriculture production and also improves the soil health. Organic farming helps in improving the soil fertility and yield quality production. An addition of compost prepared from farm wastes FYM, neem cake, biogas slurry and vermicompost helps in increasing the long-term fertility of the soil.

Keywords: Biofertilizer, green manure, mulching, organic, pesticides

Assessing the Impact of Various Organic Sources on Yield and Quality of *Rabi Sorghum* in Organic Farming

D. J. Patel^{1*} and R. H. Kotadiya²

^{1} Dept. of Soil Science and Agricultural Chemistry, B. A. College of Agriculture, AAU, Anand*

² Dept. of Agronomy, B. A. College of Agriculture, AAU, Anand

Corresponding author email: dixitpatel2j@gmail.com

Abstract

In 2019 rabi season, an experiment was conducted at the Organic Farm, NAU, Navsari, utilizing a randomized block design with three replications and eight treatments. The treatments comprised T₁ (jivamrut @500 L/ha + bijamrut + 4 t/ha farm residue incorporation), T₂ (ghan-jivamrut @500 kg/ha + bijamrut), T₃ (ghan-jivamrut @500 kg/ha + jivamrut @500 L/ha + bijamrut), T₄ (25 % RDN through NADEP compost + ghan-jivamrut @500 kg/ha + jivamrut @500 L/ha + bijamrut), T₅ (25 % RDN through NADEP compost + Azospirillum and PSB), T₆ (50 % RDN through NADEP compost + Azospirillum and PSB), T₇ (75 % RDN through NADEP compost + Azospirillum and PSB), and T₈ (100 % RDN through NADEP compost). A significant increase in grain yield (36.5 q/ha) and straw yield (89.0 q/ha) was observed under T₇ (75 % RDN through NADEP compost + Azospirillum and PSB), which was statistically comparable to T₈, T₄, and T₆. The crude protein content (%) of sorghum did not show significant differences across the organic treatments. However, variations were noted in the protein yield of sorghum grain influenced by different organic treatments. Notably, treatment T₇ (75 % RDN through NADEP compost + Azospirillum and PSB) exhibited a significantly higher protein yield (332.3 kg/ha).

Keywords: *Jivamrut, Bijamrut, Ghan-jivamrut, and NADEP compost*

Natural Farming: Cultivating Healthier Ecosystem for Human Well-being

***Geetanjali and Shanta Kumari *Dr. Khem Singh Gill**

Akal College of Agriculture, Eternal University, H.P. India

Department of Economics, ACECM, Eternal University, Baru Sahib, H.P. India

Abstract

Natural farming, often known as organic or sustainable agriculture, is a holistic approach to cultivation that emphasizes harmony with nature, minimal interference, and the preservation of ecological equilibrium. This abstract investigates the various consequences of natural farming practices for human health and well-being. It is fundamentally based on the utilization of organic inputs, composting, crop rotation, and biological pest control methods to maintain soil fertility and biodiversity. Natural farming avoids synthetic pesticides and genetically modified organisms (GMOs), decreases exposure to toxic residues and promotes the production of nutrient-rich, chemical-free foods. Consuming organically grown food has been linked to a variety of health benefits, including increased levels of antioxidants, vitamins, and minerals, as well as decreased pesticide exposure and a lower risk of pesticide-related health problems. Furthermore, organic farming approaches reduce soil erosion, improve water quality, and promote the maintenance of beneficial microbes necessary for human gut health and functioning of immune system. In addition, natural farming helps to slow down global warming by storing carbon in the soil, cutting down on greenhouse gas emissions from the transportation and manufacturing of synthetic fertilizers, and strengthening of agroecosystems' ability to withstand environmental shocks. Natural farming enhances socio-economic sustainability by supporting access to healthy food options, empowering small-scale farmers, and strengthening local food systems. It also helps to revive traditional farming practices and strengthens community resilience against food insecurity. Hence, the study suggests that natural farming is cultivating healthier ecosystem for human well-being.

Organic Farming: A New Uprising in Agriculture

Vishal Chaudhary¹, Dr. Jay Nath Patel², Sahil Chauhan¹

¹*M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.*

²*Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.*

Corresponding author email: itsvishal853@gmail.com

Abstract

Agriculture is one of the most basic activities of mankind because all people need to rely on various crops. Agriculture has established history, culture and community values. Organic farming is a modern way of indigenous agriculture in which nature and the environment are balanced. In this method, chemical fertilizers and pesticides are not distributed or dispersed in the field. India has become more aware of the negative effects of conventional agriculture on the environment and health due to an increase in consumer awareness. Consumers are increasingly seeking organic produce as a result of their commitment to sustainable and eco-friendly living. Organic farming produces healthy food, healthy soil, healthy plants and a healthy environment. Overall, crop productivity has increased using certain biofertilizers rather than chemical biofertilizers. The socio-economic importance of the organic farming uprising is examined through the lens of its impact on Indian farmers. By reducing input costs, improving soil fertility and providing access to premium markets for organic produce, this movement empowers farmers and contributes to their economic well-being. India covers 16% of the total organic farming area in the world. Sikkim became the first state in India to be declared organically in 2016. Organic farming is a new revolution in the agricultural industry. Organic farming is a sustainable and environmentally friendly alternative to conventional farming, as concerns about the negative impact of conventional farming on the environment and human health.

Keywords: Organic Farming, Biofertilizer, Sustainable Agriculture and Soil health

Role of Organic Farming in Agriculture

Vishal¹, Dr. Jay Nath Patel² and Nikhil Sharma¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: vishalvishal29451@gmail.com

Abstract

Organic farming has the potential to be a comprehensive framework for generation administration that enhances and strengthens the wellbeing of the agro ecosystem, taking into account biological activity in the soil, natural cycles and biodiversity. It emphasizes the function of management actions over the use of off-farm data, keeping in mind that regionally customized systems are necessary given area conditions. This can be accomplished by applying mechanical, biological, and agronomic techniques in equal measure to synthetic materials to fulfil any particular function inside the company. Organic farming still makes up a very modest portion of the global food market roughly 2%. But its significance in the world is expanding. The lack of official statistics and the degree of secrecy around organic produce systems make it difficult to obtain information. Agriculture and farming have long history. Agriculture is the main economic structure for many developed countries. The modern agricultural practice affects the environment namely nutrient cycle, soil erosion, carbon sequestration and many other ecological patterns. Organic farming is an influential practice to minimize the environmental and ecological impact of sustainable development. Organic farming may largely exclude the usage of chemical fertilizers, pesticides, growth hormones and feed additives of livestock activities. The organic farming is the eco-friendly farming because organic farming reduces carbon emissions, improves soil health and reloads the natural ecosystem for cleaner water and air.

Keywords: Eco-friendly, organic farming and sustainability

Organic farming: Its impact on soil health and food grain

Kamini Thakur¹, Dr. Mohd. Shah Alam² and Divya Chaudhary¹

¹MSc Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Corresponding author email: kaminithakur522@gmail.com

Abstract

Organic farming can be defined as an agricultural process that uses biological fertilisers and pest control acquired from animal or plant waste. Organic farming was developed as a response to the environmental harm caused by the use of chemical pesticides and synthetic fertilizers in conventional agriculture, and it has numerous ecological benefits. Organic farming practices such as crop rotations, intercropping, symbiotic associations, cover crops, organic fertilizers and minimum tillage are central to organic practices. These practices encourage soil fauna and flora, improving soil formation and structure and creating more stable systems. Soils rich in organic matter hold more air and water and produce higher yields than soils low in organic matter. They also supply a steady release of nutrients to plants, inhibit erosion, and host a robust population of beneficial microorganisms. Organic farming systems utilize carbon-based amendments, diverse crop rotations, and cover crops to build soil fertility. These practices increase biologically available soil organic matter and beneficial soil microbe and invertebrate activities, improve soil physical properties, reduce disease potential, and increase plant health. Vidanapathirana et al. (2023) reported the use of pesticides and fertilizers in modern agriculture causes a negative impact on the environment. This occurs mainly with an increase in toxic residue through the food chain and animal feed, triggering numerous health problems. With such adverse implications, the farming community is becoming increasingly aware of alternative agriculture systems such as organic farming. The key issues emerging in organic farming include yield reduction in conversion to organic farming, lack of raw materials for organic fertilizer production, lack of awareness of technical skills among farmers, soil fertility enhancement, certification constraints, and marketing and policy support. Asha et al. (2023) reported that the concentration of soil organic matter often serves as a foundational attribute that controls many soil properties. In organically managed systems where no synthetic fertilizers are allowed, soil microbial biomass is important to supply plant nutrients by mineralization processes and to avoid nutrient leaching. The soil organic matter is affected by land use practices, soil depth and climatic conditions under organic farming. Chhonkar et al. (2002) study that the increase crop production and boosting the soil quality and long-term manipulation of soil properties can be achieved by organic farming. Many studies have reported that organically produced agricultural products are better than as compared to products produced by conventional methods.

Effect of natural farming and organic farming systems of nutrition on yield and economics of maize

¹Pankaj and ²Priyanka Kumari

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy),

School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: pankunaik13@gmail.com

Abstract

The field experiment entitled “Effect of natural farming and organic farming systems of nutrition on yield and economics of maize” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications, comprising of ten nutrient management treatments *i.e.* T₁ – FYM @10 t/ha + biofertilizers, T₂ – vermicompost @7.5 t/ha + biofertilizers, T₃ – FYM @10 t/ha + biofertilizers + *Himsol*, T₄ – vermicompost @7.5 t/ha + biofertilizers + *Himsol*, T₅ – FYM @ 5 t/ha + vermicompost @ 3.75 t/ha + biofertilizers + *Himsol*, T₆ – *Jeevamrit*, T₇ – *Beejamrit* + *Jeevamrit*, T₈ - *Ghanjeevamrit* @ 125 kg/ha, T₉ – *Beejamrit* + *Jeevamrit* + *Ghanjeevamrit* @125 kg/ha and T₁₀ – absolute control. Results of study revealed that organic nutrient management treatments *i.e.* FYM @5 t/ha + vermicompost @3.75 t/ha + biofertilizers + *Himsol*, vermicompost @7.5 t/ha + biofertilizers + *Himsol* and vermicompost @7.5 t/ha + biofertilizers remaining at par with each other resulted in significantly higher maize grain yield than other organic and all natural farming nutrient management treatments. Organic nutrient management treatment of FYM @5 t/ha + vermicompost @3.75 t/ha + biofertilizers + *Himsol* resulted in highest net returns (Rs. 88210/ha, while net returns per rupee invested were

highest with the natural farming nutrient management treatment of *Beejamrit* + *Jeevamrit* + *Ghanjeevamrit* @125 kg/ha (1.73).

Keywords: maize, organic farming, natural farming nutrient management

Effect of different nutrient management practices on soil chemical properties and yield of transplanted rice

Harish Kumar¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy),

School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: naikharishkumar.2000@gmail.com

Abstract

A field experiment entitled “Effect of different nutrient management practices on soil chemical properties and yield of transplanted rice” was conducted at the Research Farm of the School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications comprised of six nutrient management treatments *i.e.* absolute control (T₁), natural farming nutrient management (seedling treatment with *Beejamrit* + soil treatment with *Jeevamrit* as basal and at 21 days interval + *Ghanjeevamrit* @250 kg/ha) (T₂), organic nutrient management (soil treatment with biofertilizers + *Jeevamrit* as basal + FYM @10 t/ha + *Himsols*-3 spray at 15, 30 and 45 DAT) (T₃), farmer’s practice (FYM @2.5 t/ha + 25% recommended dose of fertilizers) (T₄), integrated nutrient management (FYM @5 t/ha + 50% recommended dose of fertilizers) (T₅) and inorganic nutrient management (100% recommended dose of fertilizers) (T₆). Results of study revealed that inorganic nutrient management being statistically at par with integrated nutrient management resulted in significantly higher rice grain yield as compared to treatments comprised of farmer’s practice, organic and natural farming systems of nutrition. Significantly higher soil organic carbon content was recorded under integrated nutrient management, which was at par with organic nutrient management. Increase in soil available nitrogen, phosphorus and potassium status was observed under integrated nutrient management as well as inorganic nutrient management.

Keywords: nutrient management, organic farming, rice, *Jeevamrit*, *Beejamrit*

Effect of natural farming and organic nutrient management on yield and economics of soybean

¹Naman Kumar and ²Priyanka Kumari

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy),

School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: naik1999naman@gmail.com

Abstract

The field experiment entitled “Effect of natural farming and organic nutrient management on yield and economics of soybean” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications, comprising of ten nutrient management treatments *i.e.* T₁ – FYM @10 t/ha + biofertilizers, T₂ – vermicompost @7.5 t/ha + biofertilizers, T₃ – FYM @10 t/ha + biofertilizers + *Himsol*, T₄ – vermicompost @7.5 t/ha + biofertilizers + *Himsol*, T₅ – FYM @ 5 t/ha + vermicompost @ 3.75 t/ha + biofertilizers + *Himsol*, T₆ – *Jeevamrit*, T₇ – *Beejamrit* + *Jeevamrit*, T₈ – *Ghanjeevamrit* @ 125 kg/ha, T₉ – *Beejamrit* + *Jeevamrit* + *Ghanjeevamrit* @125 kg/ha and T₁₀ – absolute control. Results of study revealed that organic nutrient management treatments *i.e.* FYM @5 t/ha + vermicompost @3.75 t/ha + biofertilizers + *Himsol*, vermicompost @7.5 t/ha + biofertilizers + *Himsol* and vermicompost @7.5 t/ha + biofertilizers remaining at par with each

other resulted in significantly higher soybean seed yield than other organic and all natural farming nutrient management treatments. Natural farming nutrient management treatment of *Beejamrit + Jeevamrit + Ghanjeevamrit* @125 kg/ha proved most profitable with highest net returns (Rs. 17658/ha) and net returns per rupees invested (0.54).

Keywords: soybean, organic farming, natural farming nutrient management

Scope and Importance of Organic Farming in Vegetable Crops

Shubham Verma*, Manish Chauhan, Sandeep Kumar, Himanshu Sharma

Department of Horticulture, School of Agriculture Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh-175028

Corresponding author email: shubhamverma301998@gmail.com

Abstract

Organic farming emphasizes environmental sustainability by minimizing the use of synthetic pesticides, fertilizers, and genetically modified organisms (GMOs). Instead, it promotes natural methods such as crop rotation, composting, and biological pest control to maintain soil fertility and biodiversity. By reducing chemical inputs, organic farming helps mitigate environmental pollution, conserve water resources, and preserve ecosystem integrity. Organic vegetable crops offer numerous health benefits to consumers. They are free from harmful residues of synthetic chemicals, making them safer and healthier options. Organic vegetables often contain higher levels of essential nutrients, antioxidants, and phytochemicals, contributing to improved nutrition and overall well-being. As public awareness of food safety and health concerns grows, the demand for organic produce continues to rise, driving the expansion of organic farming practices. Moreover, organic farming provides economic opportunities for farmers by tapping into premium markets and niche consumer segments. Organic farming can lead to reduced input costs over time, as farmers rely more on sustainable practices and renewable resources. Organic farming enhances agricultural resilience to climate change and variability. By promoting soil health, water conservation, and diversified cropping systems, organic practices help farmers adapt to changing environmental conditions, such as extreme weather events and pest pressures. The scope and importance of organic farming in vegetable crops extend beyond environmental stewardship to encompass health, economics and resilience.

Keywords: Organic farming, Environmental, Vegetable crops, Sustainability, Soil health

Millets and Indigenous Food Systems in Indian Subcontinent: Revitalization, Resilience, and Sovereignty

Vicky Yadav¹ and Saloni Kumari²

¹Research scholar, Department of Agricultural Extension Education, PG College of Agriculture, ²Dept. of Extension Education and Communication Management, College of Community Science, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur-843125, Bihar.

**Corresponding author email: vickyspecial01@gmail.com*

Abstract

Millet serves as a nutritional powerhouse, brimming with minerals, protein, beneficial fats, calcium, and an array of vital nutrients. Of all the millet varieties, Ragi takes the lead with its remarkable calcium content. Millets play a pivotal role in promoting good health, exhibiting the capacity to combat a range of diseases, even including cancer. Furthermore, these grains are highly recommended for individuals dealing with diabetes, forming a valuable part of the diet for diabetic patients. Presently, millet cultivation spans across 131 nations, with India prominently positioned as a frontrunner, contributing 41% to the global millet production. Remarkably, India's stature extends further as it clinches the fifth spot among the world's millet exporters.

Noteworthy is the fact that in December 2018, India's proposal for designating 2023 as the International Year of Millets was embraced by the FAO, subsequently declared in March 2023. This paper delves into a comprehensive exploration of millets, encompassing their definition, a nutritional juxtaposition with cereals, accrued health advantages, contribution of millet production to the attainment of SDGs, a comprehensive overview of millet's cultivation landscape concerning geographical extent, production, productivity, and export trends. Additionally, a substantial focus is dedicated to elaborating on the significance and implications of the International Year of Millets, reflecting India's proactive role in enhancing global awareness about these grains.

Keywords: Coarse Grain, IYM-2023, Millet, SDGs, Shree Anna

Effect of Nutrient Management on Growth, Yield and Economics of *Rabi* Sorghum Under Organic Farming

R. H. Kotadiya ^a and D. J. Patel ^b

^a Department of Agronomy, Anand Agricultural University, Anand, Gujarat

^b Department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand, Gujarat

Corresponding author email: ruchitakotadiya122@gmail.com

Abstract

The chemical driven farming targets only higher yield which has been proved to deteriorate the natural resources and ecological balance, therefore now a day's concept of higher yield is changed towards sustainable agriculture. A field experiment was carried out at Organic Farm, NAU, Navsari during *rabi* season of 2019-20. The experiment was laid out in randomized block design with three replications. The details of treatments are as T1 (jivamrut @500 l ha⁻¹ + bijamrut + 4 t ha⁻¹ farm residue incorporation), T2 (ghan-jivamrut @500 kg ha⁻¹ + bijamrut), T3 (ghan-jivamrut @500 kg ha⁻¹ + jivamrut @500 l ha⁻¹ + bijamrut), T4 (25 % RDN through NADEP compost + ghan-jivamrut @500 kg ha⁻¹ + jivamrut @500 l ha⁻¹ + bijamrut), T5 (25 % RDN through NADEP compost + *Azospirillum* and PSB), T6 (50 % RDN through NADEP compost + *Azospirillum* and PSB), T7 (75 % RDN through NADEP compost + *Azospirillum* and PSB), T8 (100 % RDN through NADEP compost). Result revealed that growth parameter and yield parameter has significant effect on treatments. Significantly higher grain yield (36.5 q ha⁻¹) and straw yield (89.0 q ha⁻¹) was recorded under the treatment T7 (75 % RDN through NADEP compost + *Azospirillum* and PSB) but it remained statistically at par with the treatment T8, T4 and T6. Maximum gross income was in treatment T7 (₹ 136161 ha⁻¹) followed by treatments T8, T6, T4, T3, T1, T5 and minimum gross income with treatment T2 (₹ 109494 ha⁻¹). Maximum net income was obtained with treatment T7 (₹ 95666 ha⁻¹) followed by T8, T6, T4, T5, T3, T2 and minimum net income with treatment T1 (₹ 64685 ha⁻¹). Maximum BCR was with treatment T7 (2.36) followed by T2 (2.34), T5 (2.32), T6 (2.29), T3 (2.16), T8 (2.08), T4 (2.03).

Keywords: Jivamrut, Bijamrut, Ghan-jivamrut, *Azospirillum*, and NADEP compost.

Impact of organic farming on soil fertility and biodiversity for sustainable agriculture

Prachi Baliyan¹ and Afroz Alam^{*}

Department of Bioscience and Biotechnology, Banasthali Vidyapith (Rajasthan), India

Corresponding author email: aafroj@banasthali.in

Abstract

India is mostly an agrarian nation. Approximately 75% of the populace earns a living solely from agriculture. Therefore, the happiness and delight of this nation's citizens are closely related to any advancements in agriculture. A production approach known as "organic farming" tries to minimise or completely avoid the use of pesticides, fertilizers, growth regulators, and additives for animal feed that are manufactured. The ability of a crop production system to consistently generate food without causing environmental damage is known as agricultural sustainability. Arbuscular mycorrhizal fungi (AMF), cyanobacteria, and beneficial nematodes

improve plant tolerance to environmental stressors, phytohormone synthesis, soil nutrient cycling, and the efficiency with which plants use water and nutrients. Degradation of soil and loss of biodiversity have been caused by the overuse of chemical fertilizers in intensively managed agricultural areas across the globe. The loss of biodiversity is mostly caused by agricultural intensification, and switching to organic farming has been proposed as a crucial strategy to stop or reverse this trend. It has been demonstrated that organic farming increases wild and agrobiodiversity, decreases soil erosion and gets rid of dangerous agrochemicals like pesticides. Because the primary determinants of soil health are the diversity and activity of soil microorganisms, soil health and sustainable agriculture are intimately related. When comparing organic farming to conventional agricultural systems, the benefits to biodiversity and soil fertility are among the most often advantages. The provisioning of micronutrients and phytochemicals that support human health is a crucial component that soil health contributes when evaluating the effects of farming practices on nutrient density. In contrast to conventional methods, the effects of organic farming on soil fertility and biodiversity are examined.

To study the different pulse flour on the growth of oyster mushroom (*Pleurotus ostreatus*)

Sahil Chaudhary*, Dr. Anupam Kumar, Prabhat Kumar, Preeti thakur

Department of Plant Pathology, School of Agriculture Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh-175028

Corresponding author email: jattsammi820@gmail.com

Abstract

Oyster mushrooms (*Pleurotus ostreatus*) have gained significant attention in recent years due to their potential as a sustainable and nutritious food source. The exploration of alternative and eco-friendly substrates for mushroom cultivation is crucial to optimize growth and reduce reliance on traditional materials. Pulse flours, derived from leguminous plants, have emerged as potential substitutes due to their rich nutrient profile and waste management benefits. This study aims to evaluate the influence of different pulse flours on the growth and development of oyster mushrooms. Oyster mushroom is native to many regions across the globe, including Europe, Asia and North America. Due to their adaptability and fast growth rate, oyster mushrooms have become a commercial cultivation. The research will employ a comparative approach, utilizing various pulse flours such as black-gram + wheat straw, soybean flour + wheat straw and pearl millet flour + wheat straw. These flours will be combined with a suitable base substrate to create experimental mixtures. The growth performance of oyster mushrooms will be assessed under controlled environmental conditions, with parameters including days of pinhead formation, number of pinhead formation, number of fruiting body, days for first harvesting, stipe length (cm) and yield. In conclusion, this research will contribute to the understanding of pulse flours impact on oyster mushroom growth and development, potentially paving the way for more sustainable and nutritious mushroom cultivation practices. The findings may also encourage the adoption of pulse flours in mushroom cultivation, thereby promoting a circular economy and reducing waste in the agricultural sector.

Keywords: *Pleurotus ostreatus*, Pulse flour, oyster mushroom, growth, substrate

Organic Farming- Enhancing soil health and farming practices

Disha¹ and Sandeep Kumar¹

School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: disha34275@gmail.com

Abstract

Global food security and sustainable agriculture depend on healthy soil. Organic farming methods are becoming more and more popular as a practical way to improve soil health and reduce environmental impact. This summarizes the main ideas and advantages of organic farming for enhancing soil health. Crop rotation, cover crops, and decreased tillage are some of the techniques used in organic farming to improve soil structure, minimize soil erosion, and support soil biodiversity. Organic farming protects soil microbial communities that are essential for nutrient cycling and plant health by achieving synthetic herbicides and fertilizers. Compost and manure, among other organic amendments, increase the organic matter in the soil and improve its ability to hold water and retain nutrients. Organic farming systems exhibit greater soil microbial diversity and activity compared to conventional. The uptake of nutrients by plants and their resistance to environmental stressors are facilitated by this microbial richness, which eventually raises agricultural yields and quality. Additionally, by storing carbon in the soil, organic techniques help to mitigate the effects of climate change. In order to meet the world's food needs, scaling up organic farming still faces obstacles. To sum-up, organic farming methods present a viable route to improving soil health, encouraging sustainable agriculture, and guaranteeing long-term food security.

Keywords: Organic, Amendments, Tillage, Fertilizers, Herbicides

Growth and productivity of adzuki bean (*Vigna angularis* L.) as influenced by natural and organic farming practices

Rimzim¹ and Janardan Singh²

¹M.Sc. Agriculture, ² Professor and Head, Dept. of Organic Agriculture and Natural Farming, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur HP (176062) India

Corresponding author email: rimzimbhattiabc@gmail.com

Abstract

A field experiment was conducted at Integrated Research Farm, Department of Organic Agriculture and Natural Farming, CSK Himachal Pradesh Krishi Vishwavidyalaya during the *Kharif* season of 2022, to evaluate the effect of organic sources of nutrient on productivity and profitability of adzuki bean, and soil properties. The experiment was laid out in randomized block design comprising of eight treatments [T₁ – *Beejamrit* + *Jeevamrit* (175 l/ha), T₂ – *Beejamrit* + *Ghanjeevamrit* (500 kg/ha), T₃ – *Beejamrit* + *Jeevamrit* (175 l/ha) + *Ghanjeevamrit* (500 kg/ha), T₄ – Farm yard manure (10 t/ha), T₅ – Farm yard manure (10 t/ha) + *Ghanjeevamrit* (500 kg/ha), T₆ – Biofertilizers (*Rhizobium* + PSB) + Farm yard manure (10 t/ha) + Vermiwash (225 l/ha), T₇ – Biofertilizers (*Rhizobium* + PSB) + Vermicompost (5 t/ha) + Vermiwash (225 l/ha), T₈ – Absolute control]. The highest values of plant height, dry matter accumulation, unit area efficiency, absolute growth rate, yield attributes, seed yield, gross returns, soil properties (organic carbon, available nitrogen, phosphorus and potassium and microbial population) and plant nutrient content and uptake were recorded in T₇ (Biofertilizers (*Rhizobium* + PSB) + Vermicompost (5 t/ha) + Vermiwash (225 l/ha) whereas the highest net returns and benefit cost ratio were recorded in T₁ [*Beejamrit* + *Jeevamrit* (175 l/ha)]. The lowest values of the above said parameters were noted in T₈ (absolute control) except net returns, benefit cost ratio and profitability which were the lowest in T₅ [Farm yard manure (10 t/ha) + *Ghanjeevamrit* (500 kg/ha)]. T₇ [Biofertilizers (*Rhizobium* + PSB) + Vermicompost (5 t/ha) + Vermiwash (225 l/ha)] proved to be the best treatment in respect of productivity and soil properties while T₁ [*Beejamrit* + *Jeevamrit* (175 l/ha)] proved to be the best treatment in the profitability of adzuki bean.

Keywords: natural farming, organic, adzuki bean

Organic Farming and Sustainable Agriculture.

Dhirendra Kumar

Ph.D. Research Scholar, Department of Crop Physiology College of Agriculture, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur U.P 208002

Abstract

India is mostly an agrarian nation. Approximately 34% of the populace earns a living solely from agriculture. Thus, pleasure and joy among the people of this country are closely related to any advancements in agriculture. The growing population of India poses significant obstacles to agriculture. The issue of weeds, insects, and pests causing significant losses to crops and their produce arises from the cultivation of high yielding crop varieties that respond well to fertilizers and irrigation as well as from intensive cropping practices. Sustainable agriculture, especially rainfed agriculture, is the foundation of our economy, with vegetables playing a major role in nourishing people, animals, and the soil. Conventional farming is one of the most extensively used approaches because it is accessible and affordable, but it has a number of disadvantages that make it difficult for the agriculture industry to fulfill the growing food need of an ever-increasing population. Different environmental concerns necessitate an agriculture system that is both resilient and sustainable. Sustainable agriculture encompasses several environmentally friendly farming methods that increase animal and crop yields without negatively impacting the environment. One such strategy that should be used to achieve the objective of sustainable agriculture is organic farming. To put it simply, organic farming is the process of growing plants without the use of dangerous synthetic additions (such as pesticides, fertilizers, antibiotics, etc.). Foods grown organically are becoming more and more popular since they have so many health advantages. India is currently one of the world's leading producers of organic food, having seen a notable growth in the practice. Organic farming may have more prospects in India, even though there are still some obstacles to be solved before it can be guaranteed to have a positive economic and health impact. The current status of organic farming in India is discussed in this review, along with its elements, benefits, related limitations, and possibilities in the future.

Keywords: Agriculture, farming, organic, product, sustainable

Effect of integrated nutrient management on grain yield and quality of black aromatic rice under black aromatic rice-broadbean cropping sequence

Thoudam Anupama Devi and Edwin Luikham

*Ph.D. Scholar, Department of Agronomy, College of Agriculture, CAU, Imphal, Manipur-795004
Corresponding author email: thoudamanupama@gmail.com*

Abstract

The study on “Integrated nutrient management in black aromatic rice-broadbean cropping sequence” was undertaken at the experimental field of College of Agriculture, Central Agricultural University, Imphal, during the *kharif* and *rabi* season of 2021-22 and 2022-23. The *kharif* rice experiment was laid out in randomized block design (RBD) with 8 treatments and 3 replications -T₁(100% RDF),T₂(100% RDF + sesbania + azospirillum + neem powder),T₃(75% RDF + sesbania + azospirillum + Neem powder),T₄(50% RDF + Sesbania + Azospirillum + Neem powder),T₅(100% RDF + azolla + azospirillum + neem powder), T₆(75% RDF + azolla + azospirillum + neem powder),T₇(50% RDF + azolla + azospirillum + neem powder) and T₈(sesbania + azolla + azospirillum + neem powder). The result shows that integrated nutrient management had significant influenced on the yield and quality of black aromatic rice. The maximum number of effective tillers per hill, panicle length, number of spikelet’s per panicle, number of filled grains per panicle, grain and straw yield, test weight, harvest index, crude protein yield were observed in treatment T₂ followed by T₅ and minimum in treatment T₈. Highest anthocyanin and starch content in grain were recorded in treatment T₂ and lowest in treatment T₁.

Keywords: Integrated nutrient management, black rice, sesbania, azolla and anthocyanin

Perception of Beneficiaries about PDS Ration in District Sirmour of Himachal Pradesh

Ritu Verma*¹ and Shanta Kumari²

Department of Economics, ACECM, Eternal University, Baru Sahib, H.P.

Corresponding author email: verma191090@gmail.com

Abstract

To sustain the life food plays very important role. Many nutrients are available in food which provides the energy for smooth functioning of the body. To protect ourselves from many infections and diseases appropriate quantity of healthy diet is needed. Keeping this in view, Government introduced public distribution system (PDS) programme to secure the food safety and nutritional needs of the needy people of the society at reasonable prices. The study analyze the responses of below poverty line beneficiaries about the quantity and quality of PDS commodities. The results of the study show that ration distributed by the PDS to its beneficiaries was inadequate for their daily survival. Most of the beneficiaries also opined that goods were of moderate quality due to adulterants, hardness, moisture, more cooking time and bad in appearance, taste & aroma. Therefore, the study suggests that the basket of food under PDS should be improved in quality as well as quantity to ensure nutritional security in addition to food security.

Transforming Marketing Potentials: Elevating Rural Livelihood through e-NAM

Vartika Srivastava*, Dr. Manju Dahiya**

**Ph.D. Scholar, Dept. of Extension Education and Communication Management, I.C. College of Community Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, (125004), India.*

***Assoc. Director (BS/HS), Directorate of Research, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, (125004), India.*

Email: vartikavs17.10@gmail.com

Abstract

The Electronic National Agriculture Market (eNAM) brought about a significant transformation in India's agricultural landscape. It enabled farmers to sell their produce directly through a transparent, efficient, and electronic trading system. The portal helped minimize the influence of middlemen and promoted fair competition, streamlining agricultural marketing practices. It contributed to rural economic development, improved market efficiency, and facilitated the holistic growth of farmers in the agricultural sector. The study covered 60 traders registered on e-NAM, 48 farmers, 27 agri-business holders, and 15 mandi employees of Uttar Pradesh who were selected for data collection. The results revealed that farmers often faced payment delays, leading to financial instability. However, with e-NAM, over 50 percent of farmers received immediate bank-to-bank transfers after trading on the portal. According to respondents, 6.7 percent prioritized trading with e-NAM for finding it easy to trade on e-NAM, while 23.3 percent chose it for better commodity prices. Moreover, 14.7 percent and 5.3 percent for better grading and packaging facilities, which also became motivating factors for trading digitally. Digitalization of agriculture Mandis had a significant impact on developing the technical skills of farmers and other stakeholders. This resulted in significant growth in digital literacy and the inclusiveness of farmers in the trading process. According to mandi officials, Real-Time Price Check and e-auction facilities still needed to be implemented properly. The study concluded that e-NAM emerged as a lifeline for bridging the rural-urban divide through digital market access and also came up as an excellent solution for reduced commodity damages and wastage.

Keywords: Conventional Agricultural Marketing, Digital Agriculture, e-NAM Portal, Farmer Empowerment

Theme 9: Sustainable Agriculture and Resource Management

Enhancing yield, water and energy productivity, and profitability of cucumber through drip fertigation with organic and inorganic sources under protected environment

Bhawna Babal^{1*}, Sanjeev K. Sandal¹, and Narender K. Sankhyan¹

¹Department of Soil Science, CSK HPKV, Palampur-176062, H.P.

Corresponding author email: bhawnababal10@gmail.com

Abstract

Optimizing water and nutrient management is pivotal for enhancing agricultural productivity, particularly in the face of escalating demands across various sectors. The dwindling availability of water resources underscores the urgency for implementing efficient irrigation techniques like drip irrigation. Drip irrigation not only conserves water but also holds promise for increasing crop yields, especially in water-stressed, undulating, sandy, or hilly terrains. Moreover, integrating fertigation into drip systems offers a dual benefit by enhancing nutrient uptake efficiency alongside water conservation. To investigate the efficacy of different irrigation and fertigation regimes, a study was conducted on cucumber crop within a naturally ventilated polyhouse in a completely randomized design with two drip irrigation levels and five fertigation treatments. The drip irrigation encompassed surface drip at 60% of pan evaporation (PE) for the first two months, followed by 80% of PE, and sub-surface drip at 30% of PE for the first two months, transitioning to 40% of PE thereafter. Fertigation treatments included compost tea, vermiwash, compost tea combined with 75% of the recommended dose of fertilizers (RDF), vermiwash supplemented with 75% RDF, and 100% RDF. Among the various treatments, cucumber yield, water and energy productivity and profitability exhibited significant variations. Notably, the combination of compost tea with 75% RDF under sub-surface drip irrigation emerged as the most promising regimen, yielding superior crop performance and economic returns. Furthermore, the combined organic-inorganic fertigation strategies demonstrated enhanced energy productivity compared to conventional inorganic fertigation. The research underscores the potential of drip irrigation coupled with optimized fertigation practices to mitigate water scarcity challenges, improve nutrient management, and enhance overall agricultural sustainability.

Advancing Sustainable Agriculture through Innovative Approaches in Soil Health Management and Organic Farming Practices

Yadav Shivani Indrajeet

Ph.D. (Horticulture) Fruit Science, Anand Agricultural University

Corresponding author email: shivaniyadav0499@student.aau.in

Abstract

The global pursuit of sustainable agriculture necessitates innovative strategies to manage soil health, optimize land resources, and enhance productivity while minimizing environmental impacts. This abstract presents a comprehensive overview of cutting-edge approaches in soil health management and organic farming practices, focusing on their roles in promoting sustainable agricultural systems and enhancing farmers' income. Innovative approaches in soil health management encompass a range of techniques aimed at improving soil fertility, structure, and resilience. Utilizing practices such as cover cropping, crop rotation, and conservation tillage, farmers can enhance soil organic matter content, promote biodiversity, and mitigate erosion, thereby ensuring long-term productivity and ecosystem health. Furthermore, integrating precision agriculture technologies, such as soil sensors and digital mapping, enables targeted nutrient management and irrigation scheduling, optimizing resource utilization while minimizing environmental risks. Organic farming represents a holistic approach to sustainable agriculture, emphasizing natural inputs, biodiversity conservation, and ecosystem services. By eschewing synthetic fertilizers and pesticides, organic farmers mitigate environmental pollution, protect biodiversity, and enhance soil health, thus contributing to resilient and sustainable food systems. Additionally,

adopting agroecological principles, such as intercropping and agroforestry, enhances resource efficiency, pest management, and resilience to climate variability, while promoting socio-economic equity and rural development. This critical importance of soil and water conservation practices in ensuring the sustainability of agricultural systems. Implementing measures such as contour ploughing, terracing, and water harvesting minimizes soil erosion, retains soil moisture, and enhances water infiltration, thereby safeguarding soil fertility and mitigating risks of drought and flooding. Furthermore, integrating agroforestry and riparian buffers protects water quality, reduces nutrient runoff, and promotes habitat connectivity, fostering resilient ecosystems and sustainable livelihoods. Innovative approaches in soil health management and organic farming practices offer promising pathways towards sustainable agriculture and enhanced farmers' income. However, realizing their full potential requires interdisciplinary collaboration, policy support, and capacity-building initiatives to overcome barriers to adoption and scale-up implementation. This abstract serves as a catalyst for further dialogue and collaboration at the conference, aiming to foster actionable strategies and partnerships for a more sustainable and equitable agricultural future.

Natural formulation and chemical as pre-sowing seed treatment affecting seed quality of finger millet (*Eleusine coracana* L. Gaertn)

***Neha Thakur¹, Priyanka Thakur², Rajeev Kumar¹ and Sarita Devi¹**

¹ Assistant Professor, College of Horticulture and Forestry, Thunag, Himachal Pradesh, India 175048

² Assistant Professor, College of Horticulture, UHF Solan, India 173230

Corresponding author email: drnehathakur@yaspuniversity.ac.in

Abstract

Eleusine coracana (L.) (Gaertn) or finger millet, also known as Ragi in Hindi language is a popular and traditional nutri-cereal/ millet of the Seraj area in wet temperate of Himachal Pradesh. Locally called as *koda or kodra*, its cultivation is taken up in the kharif season by raising a nursery instead of direct field sowing in the wet temperate Himalayas. In this research study indigenous finger millet seeds were presoaked for 12 and 24 hours respectively in distilled water, different treatments of gibberellic acid (20 ppm, 40 ppm, 60 ppm, 80 ppm and 100 ppm) and one Beejamrit formulation (collected locally). Seed and seedling characters viz., field emergence percentage, seedling length, dry weight and seedling vigour index- length were recorded under the seed germination test. The treatment combinations 60 ppm GA₃ + 12 hrs soaking showed higher germination percentage (96.00 %), seedling length (10.50 cm) and seedling vigour index. The treatment combination Beejamrit + 12 hrs soaking was at par with the best treatment combination. Seed germination promoting chemical GA₃ had significantly improved the initial growth of the seedling. The natural formulation Beejamrit was also equally good in boosting the seedling emergence as well as its physical characters. These treatment combinations can invigorate or enhance the seed quality thus boosting crop production of finger millet in the long run in the wet temperate high hills of Himalayas.

Keyword: Gibberellic acid, Beejamrit, Finger millet, Seed germination and Seed soaking

Effect of seed treatments on seed quality of field pea (*Pisum sativum* L.)

Alok kumar^{1*}, Ritika Singh² Om Prakash³

Assistant Professor

^{1*} Department of Genetics & Plant Breeding, Abhilashi University, Chail Chowk, Mandi, 175028

² Department of Genetics & Plant Breeding, Abhilashi University, Chail Chowk, Mandi, 175028

³ Project fellow, School of Agriculture, Abhilashi University, Chail Chowk, Mandi, 175028

Corresponding author email: alokkumar1920@gmail.com

Abstract

An experiment entitled on effect of seed treatments on seed quality parameters of field pea (*Pisum sativum* L.) carried out during *Rabi* 2015-16. The experiment was laid out in CRD with three replications in the Seed Testing laboratory, Department of Seed Science and Technology, C.S.Azad University of Agriculture and Technology, Kanpur on pea variety KPMR-522 (Jay). The experiment was comprised of ten seed priming treatments viz., T₀- Control, T₁- seed priming with *Trichoderma harzianum* @ 1.5%, T₂- seed priming with Vitavax power @ 0.25% T₃- seed priming with GA₃ @ 50ppm, T₄- seed priming with GA₃ @ 50ppm + seed coating with *Trichoderma harzianum* @ 15g/kg seed, T₅- seed priming with sodium molybdate @ 500ppm, T₆- seed priming with sodium molybdate @ 500ppm + seed coating with *Trichoderma harzianum* @ 15 g/kg seed, T₇- seed priming with leaf extract of *Lantana camara* @ 10%, T₈- seed priming with water, T₉- seed treatment with Bavistin @ 3g/kg seed. It was concluded from the investigation that seed priming with sodium molybdate @ 500ppm + seed coating with *T. harzianum* @ 15g/ kg seed on pea variety “KPMR- 522 (Jay)” was found to be best as it significantly improved the seed quality of harvested seeds with percent improvement 5.75 % in germination, 13.73 % in shoot length, 16.05% in seedling dry weight, 17.96 % in seed vigour index-I & 26.90 % in vigour index-II over other treatments as well as control.

Soil and Water Conservation for Modern Aspects of Crop Production Technologies

Ram Swaroop Choudhary

¹Department of Agronomy, SKNCOA, Sri Karan Narendra Agriculture university Jaipur Rajasthan (303328) India

Corresponding author email: ramswaroopchoudhary68@gmail.com

Abstract

Achieving sustainability in agriculture necessitates a comprehensive approach encompassing soil and water conservation alongside the adoption of modern crop production technologies. The abstract delves into the pivotal role of soil and water conservation practices in promoting sustainable agricultural systems. Techniques such as contour plowing, terracing, cover cropping, and drip irrigation are highlighted for their effectiveness in mitigating soil erosion, enhancing soil fertility, and optimizing water usage. Moreover, the abstract explores the integration of modern crop production technologies to improve efficiency and productivity while minimizing environmental impact. Cutting-edge approaches such as precision agriculture, vertical farming, hydroponics, and genetic engineering are examined for their potential to optimize resource utilization, reduce chemical inputs, and mitigate greenhouse gas emissions. This synergy between soil and water conservation practices and modern crop production technologies is emphasized as a cornerstone of sustainable agriculture. Through promoting soil health, minimizing water stage, and enhancing crop resilience to environmental stresses, this integrated approach offers a pathway towards long-term agricultural sustainability. Policymakers, researchers, and practitioners are encouraged to prioritize the adoption and dissemination of these holistic strategies to ensure food security, environmental stewardship, and socio-economic development in agricultural systems worldwide.

Response of Humic Acid and Inorganic Fertilizers on Vegetative Growth of Dahlia (*Dahlia variabilis* L.)

Kedar Mahadev Gheware^{1*}, Nomita Laishram² and Arvinder Singh³

¹ PhD Scholar, Division of Floriculture and Landscaping, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, 180009 J&K, India

² & ³ Asst. Prof. Division of Floriculture and Landscaping, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, 180009 J&K, India

Corresponding author email: kedar.gheware.1997@gmail.com

Abstract

The study aimed to explore the response of humic acid (HA) on the vegetative growth of dahlia (*Dahlia variabilis* L.). Eighteen combinations of HA and Recommended Dose of Fertilizer (RDF) were applied, including control. These combinations comprised various ratios and application methods, such as soil application of humic acid and humic acid foliar spray. The field experiment was conducted at Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, J&K, India. The results of the study revealed that the most favourable outcomes in terms of plant height (87.50 cm), number of leaves per plant (83.00), number of branches per plant (16.80), and stem length (75.13 cm) were observed in treatments T₈ and T₁₂. These treatments involved the application of 75% RDF along with either soil application of humic acid at 10 kg ha⁻¹ (T₈) or foliar spray of humic acid at 0.2% (T₁₂). Based on these findings, it is recommended that the combination of 75% RDF with soil application of humic acid at 10 kg ha⁻¹ (T₈) or foliar spray of humic acid at 0.2% (T₁₂) may be considered for enhancing the vegetative growth of dahlia plants.

Keywords: - *Dahlia, humic acid, RDF, vegetative growth*

Dynamic Trends and Significance of Indian mackerel (*Rastrelliger kanagartha*) Fishery: A Comprehensive Analysis (2009-10 to 2021-22)

Anzil Rikesh. B^{1*} and N. Karthik²

^{1*}B.F.Sc Student, College of Fisheries Science, DIFST, Kanniyakumari, Tamilnadu – 629 193

²Assistant professor, Dept. of Fisheries resource Management, College of Fisheries Science, DIFST, Kanniyakumari, Tamilnadu – 629 193

Corresponding author email:anzilbaskar@gmail.com

Abstract

The Indian mackerel, scientifically known as *Rastrelliger kanagartha*, holds significant importance as a pelagic fish species in India. It contributes approximately 10% to the nation's total marine fish production, serving as a popular, nutritious, and affordable table fish available throughout the year. The fishery of Indian mackerel displays notable fluctuations across seasons, years, and decades. Successful years of its fishery bring prosperity to fishing communities, while its failures result in substantial economic setbacks. This species thrives at depths within 30 meters, forming a crucial inshore fishery exploited using traditional and mechanized fishing methods. An extensive analysis spanning 2009 to 2022 highlights India's impressive fish production, which reached 1473.81 Lakh Tonnes. Marine fish production accounts for 31.36% (462.23 LT) of this total, with Indian mackerel contributing 2.13% (31.48 LT). Notably, Indian mackerel share in marine fish production is around 6.81%. The peak of Indian mackerel fish production occurred in 2021-22, yielding 3.28 LT (10.41%), followed closely by 2016-17 with 2.88 LT (9.14 %). A detailed examination of the collected data emphasizes the increasing trend in Indian mackerel fish production, driven by rising output and favorable production comparisons within both the marine and India's overall fish production. These factors collectively motivate fishermen to actively participate and expand their presence in the thriving fishing sector.

Keywords: Indian mackerel, Marine Fish, Production, Fishing and Fisherman

Future Strategies for sustainable agriculture and Technology Impact on human health and environment

Dr. Sandeep Kumar, M.D Kayachikitsa (First Year)

Assistant Professor, Abhilashi University, Chail Chowk, Distt. Mandi (H.P)

Abstract

A science of farming and harvesting is not the bequest of modern science at least in India. Ancient educational system or ashrama traditions carving out of wild and natural forest with preservation of trees and herbs of

diverse values indicates the rearing of plant sciences. survival of living being depends on harmonious functioning of bioecological factors for supply of nutrients (ahara) and medicines (oushadhi). plants form major source of medicines meeting most of health needs of humanity since ages. The ignorance of ancient texts is responsible for the degeneration of the agricultural practices with the help of ancient texts and model methods of agriculture we cannot only prove the sayings of text but we could also establish some novel modified methods of agricultural systems. Present scenario is best for development of ancient sciences as there is huge demand of conservation and sustainable utilization of medicinal plants sciences. the proper interpretation and availability of “VRIKSAYURVEDA” can play important role in field of intercropping and put forward for use of organic fertilizers and play crucial role to build a ecofriendly environment as vrikshayurveda deal with various trees and plant species and ensure the healthy growth and productivity .it also suggested that tree planting is one of means to attain four broad aims of life – Dharma, Artha, Kama and Moksha which indicated the importance of trees in holistic development of mankind and use of crop production for sustainable agriculture.

Activation of biochar for adsorption and its environmental application

Phalphe Ketan Bibhishan *, Raj Narayan Pateriya

Department of Farm Machinery and Power Engineering, College of Technology, G. B. Pant University of Agriculture and Technology, Pantnagar-263 145 (U.S. Nagar, Uttarakhand)

**Corresponding author email: ketan.phalphe12@gmail.com*

Abstract

The biomass is wood, manure, or leaves etc. present in landfills has a negative influence on ecosystem and reduce biodiversity. To reduce the amount of biomass present in environment it is converted in to biochar either by thermochemical or biochemical processes. Biochemical process saves money, benefits the environment but emits fewer hazardous gases. Due to this disadvantage, the thermochemical conversion method is used. This is further divided into combustion, gasification, and pyrolysis. Biomass pyrolysis has shown that a number of variables, including biomass characteristics, reaction conditions, surroundings, and other variables affect the production of biochar also the properties of the biochar have been seen to vary with process variables including temperature, residence time, heating rate, particle size, etc. along with the biochar production. Biochar is a carbon-rich substance and it is activated chemically or physically, it depends on its appropriate surface properties. Selectivity and adsorption temperatures, can affect adsorption capacity because the adsorption capacity was not much enhanced even though the surface area was bigger. Chemical activation provides a greater effect than physical treatment, may be carried out at a lower temperature, and results in less burn-off char. Utilizing activated carbon in activities that exacerbate concerns related to environmental pollution, such as water purification, elimination of pollutants, and the capture of CO₂.

Key words: Biochar, Activated Carbon, Pyrolysis

Soil Health and Soil Management Strategies for Sustainable Hill Agriculture

Ravinder Kumar ¹, Priyanka Kumari² and Sukhdev Singh Paliyal ³

Assistant Professor (Soil Science) Abhilashi University Mandi H.P. 175048 (H.P.) India¹

Assistant Professor (Agronomy) Abhilashi University Mandi H.P. 175048 (H.P.) India²

Principal Scientist (Soil Science) CSK HPKV HAREC Dhaulakuan 173001 (H.P.) India³

Corresponding author email: singotraravi786@gmail.com

Abstract

Soil health is presented as an integrative property that reflects the capacity of soil to respond to agricultural intervention, so that it continues to support both the agricultural production and the provision of other ecosystem services. The major challenge within sustainable soil management is to conserve ecosystem service delivery while optimizing agricultural yields. It is proposed that soil health is dependent on the maintenance of four

major functions that are carbon transformations, nutrient cycles, soil structure maintenance and the regulation of pests and diseases. Each of these functions is manifested as an aggregate of a variety of biological processes provided by a diversity of interacting soil organisms under the influence of the abiotic soil environment. Soil quality is the “capacity of a specific soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality and support human health and habitation. Soil is a basic resource for sustaining agricultural production system. Besides being the medium for crop growth, soil functions to sustain crop productivity, meeting the increasing requirements of the growing population. However, in recent years, soils of North Western Himalaya (NWH) suffer from serious problems of soil erosion due to its susceptible geology, steep topography, adverse climatic condition, overgrazing, indiscriminate felling of trees, cultivation of slopy marginal lands and increased human activities. Traditional hill agriculture system, which integrates crop production with livestock, horticulture and agro-forestry, is adapted to the limitations of climatic and edaphic conditions. In terms of agricultural production, mountains have a low carrying capacity and the exploitation of natural resources is limited. The delicate human life support system which has evolved over centuries is highly vulnerable if subjected to increased external pressure. The establishment and maintenance of infrastructure is difficult and expensive. Therefore, transport cost to mountain areas is higher. This reduces the ability to trade and affects the supply, availability and price of agriculture inputs, such as seeds, fertilizers or pesticides, which are needed for food production. It also reduces the availability of affordable foods other than those that can be obtained locally and limits income generation opportunities, thereby undermining household food security.

Keywords: Soil health, sustainable agriculture

Promoting Ecosystem Health through Innovative Land Use Practices

Surender Kumar¹, Sheikh Amjid², N. P Thakur¹, Haleema Bano³

¹*Division of Soil Science and Agricultural Chemistry, SKUAST-Jammu (J&K)*

²*Division of Soil Science and Agriculture Chemistry, SKUAST-Kashmir (J&K)*

³*Division of Environmental Sciences, SKUAST- Kashmir (J&K)*

Corresponding author email: amjidsheikh66@gmail.com

Abstract

Soil health, land resources management, land use planning and sustainability are interconnected pillars crucial for maintaining the health of ecosystems and ensuring long-term human well-being. Innovative approaches in these areas are essential to address emerging challenges such as climate change, urbanization and biodiversity loss. In soil health management, there is a paradigm shift towards regenerative agricultural practices that prioritize soil conservation and restoration. Techniques such as no-till farming, cover cropping and crop rotation are being increasingly adopted to improve soil structure, enhance biodiversity and sequester carbon. Additionally, advancements in soil testing technologies and the use of precision agriculture tools enable farmers to optimize nutrient management and minimize environmental impacts. Effective land resources management involves a holistic understanding of the complex interactions between natural systems and human activities. Community-based approaches empower local stakeholders to actively participate in decision-making processes regarding land use, conservation and restoration. By integrating traditional knowledge with modern science, communities can develop sustainable land management practices that balance economic, social and environmental objectives. Land use planning plays a crucial role in shaping the spatial organization of human activities and minimizing land degradation. Sustainable land use planning frameworks prioritize the preservation of natural ecosystems, the promotion of compact and mixed land use patterns and the provision of green infrastructure. Through spatial analysis and scenario planning using tools like geographic information systems (GIS), planners can identify optimal land use configurations that maximize ecosystem services while minimizing ecological footprints. At the heart of these innovative approaches lies the principle of sustainability, which seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable land management practices aim to enhance resilience, promote biodiversity conservation and ensure equitable access to land resources. By embracing innovation and collaboration across

sectors, we can work towards a more sustainable future where soil health is preserved, land resources are managed wisely and human societies thrive in harmony with nature

Keywords: Soil health, Land resources management, Land use planning, Sustainability

Sustainable Agriculture and Resource Management

Saniya Syed¹, Abhinav Yadav², Nikita Mourya¹

¹*Banda University of Agriculture and Technology, Banda (21001)*

²*Chandrashekhar Azad University of Agriculture & Technology, Kanpur (208002)*

Corresponding email: saniyasyed076@gmail.com

Abstract

Sustainable agriculture basically less resource-intensive farming solutions, greater diversity in crops and livestock, and farmers' ability to adapt to local circumstances. Sustainable agriculture national mission to make agriculture more productive, sustainable, remunerative and climate resilient by promoting location specific Integrated/Composite Farming Systems. Agriculture has been sitting at the heart of some of the world's most pressing challenges for years: food security and nutrition, water and soil quality, biodiversity, and sustainable livelihoods. The resources of the entire world should be developed to the fullest extent possible with available means as a whole can progress only by the efficient and rational use of the natural resources. The issue of rational utilization and sustainable development is now very relevant as the world population is growing very fast while the available resources to meet man's need is decreasing at increasing rate. Development is a dynamic process in which there is no end point. The technologically advanced Nation's continue to seek new means of improving their utilization of natural resources or for enhancing the conditions of the environment in which their people live. In effect the concept of “developing” nation is misleading as all nations have achieved. Most recently, COVID-19 has continued to expose the inequalities and weaknesses within existing global supply chains, the vulnerabilities of farmers, and the growing numbers of people unable to afford or access healthy food. Financing the transition to regenerative agriculture is essential. The farm and farming need to be competitive, farm markets need to be liberalized, distortion of farms and livestock need to be removed, purchase of farm produce, logistics, agri-services need copious investments and substantial support to hand-holding of farm-based activities such as livestock, apiary, and fisheries need to be provided to farmers. Adoption of sustainable cropping patterns and bringing in more technology is an integral part of the proposed plan. The Government will support the effective use and management of land.

Keywords: Sustainable agriculture, Natural Farming, Integrated Farming Systems, cropping pattern

Cover crops and green manures: Enhancing soil health and moisture retention

Nishant Thakur¹ and Sandeep Kumar²

¹*M.Sc. Agri. Horti. (Vegetable Science),* ²*Assistant Professor (Horticulture), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028*

Corresponding author email: nishanthakur55.nt5@gmail.com

Abstract

Including cover crops and green manures in agricultural systems has become essential for maintaining soil health and retaining moisture. Cover crops are grown during fallow seasons and act as living mulches, preventing soil erosion and compaction. Their extensive root system penetrates deep into the soil, encouraging aeration and aggregation that enhances water absorption and retention. Also, they act as a barrier in minimizing nutrient loss and surface runoff, protecting soil fertility. On the other hand, green manures involve growing specific plant species usually belonging to the legume family that are incorporated into the soil, enhancing it with organic matter, nitrogen and other vital elements. They slowly release nutrients as they decompose, creating a nutrient-rich ecosystem. Integrating cover crops and green manure crops into the agricultural system

provides a comprehensive approach to soil management. These methods contribute to increased soil fertility and resilience to environmental stresses by improving soil structure and organic matter content. Improved water retention capacity of soils enriched with green manures and cover crops decreases irrigation needs, mitigates water scarcity issues and promotes water efficiency in agriculture. By harnessing the benefits of these activities, farmers can create resilient soils capable of sustaining productivity while reducing environmental impacts.

Keywords: Cover crops, ecosystem, green manures, legume, soil health

Appraisal of groundwater quality and its correlation with soil properties in Haryana

Kavita Boora^{1*}, Kautilya Chaudhary¹ and Ram Prakash¹

¹*Department of Soil Science, CCS Haryana Agricultural University, Hisar 125004, India*

**Corresponding author email: kavitaBoora96@gmail.com*

Abstract

The purpose of the study was to assess the geographic mapping of groundwater quality and its impact on soil properties in Uklana block of the Hisar district, Haryana. Eight typical soil sites were selected, examined and analyzed based on several irrigation water categories, after obtaining a total of 34 groundwater samples from farmers' fields. According to the AICRP (1989) criteria for classifying groundwater quality, majority of the samples were classified into saline (82.35%) followed by good (14.71%) and alkali (2.94%) categories. The lowest value of pH (6.70) was recorded in village Kallar bhaini, while the lowest EC (1.40 dS m⁻¹) was found in village Litani. The lowest SAR [4.52 (mmol l⁻¹)^{1/2}] in village Litani and RSC (0.00 me l⁻¹) observed in many villages of the block, whereas, the maximum value of pH (8.90) in village Bhari akbarpur, EC (9.50 dS m⁻¹) in village Daulatpur, SAR (24.03 (mmol l⁻¹)^{1/2}) in village Prabhuwala and RSC (4.40 me l⁻¹) in village Dhansu of the block. The mean cationic and anionic composition was obtained in order Na⁺ > Mg⁺² > Ca⁺² > K⁺ and Cl⁻¹ > SO₄⁻² > HCO₃⁻ > CO₃⁻² respectively. The collected soil samples were examined for the parameters EC_e, pH, soluble cations, anions and ESP in the soil saturation extract based on the type of irrigation water used. The investigation arrived at the conclusion that geographic assisted mapping was a more effective method for precise resource classification and usage in the block.

Keywords: Groundwater quality, Geographic mapping, Cation, Uklana block

Soil and Water Conservation for a Sustainable Agricultural System

A.V. Barad¹

¹*Ph.D Scholar, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India 362001*

**Corresponding Email: anjalibarad23@gmail.com*

Abstract

This study explores the imperative of implementing robust soil and water conservation measures to establish a sustainable agricultural system. In the intricate web of agricultural ecosystems, the interdependence of soil and water is pivotal, with soil structure, moisture content and nutrient retention influencing crop yield and quality. The global agricultural landscape is confronted with escalating challenges arising from climate change, population growth and resource depletion. These challenges render agriculture increasingly vulnerable to water scarcity and soil degradation, necessitating a transformative shift towards conservation-oriented approaches. To address this, the study evaluates a range of conservation techniques such as conservation tillage, cover cropping, agroforestry and precision irrigation. These measures emerge as essential tools for preserving soil structure, minimizing erosion and optimizing water usage. Synthesizing empirical evidence from diverse agroecosystems, the study demonstrates the efficacy of these techniques in enhancing soil fertility, water retention and overall

agricultural resilience. In addition to their environmental benefits, the economic and social dimensions of soil and water conservation are scrutinized. Conservation practices are shown to offer economic advantages through reduced input costs, enhanced crop yields and improved land-use efficiency. Moreover, the study highlights their role in securing livelihoods, particularly for small-scale farmers, thereby addressing social dimensions. However, the widespread adoption of conservation practices is not without challenges, as technical, economic and institutional barriers exist. The study delves into these obstacles, providing insights into the formulation of policies that incentivize conservation practices and promote sustainable agriculture. In conclusion, the research emphasizes the urgent need to integrate soil and water conservation into the core of agricultural practices. Through a comprehensive analysis of the interconnected dynamics of soil and water, coupled with the evaluation of proven conservation techniques, the study advocates for a holistic and adaptive approach. Embracing sustainable practices is posited as essential for the global agricultural community to navigate impending challenges, ensuring food security, ecological resilience and the long-term viability of agricultural systems.

Keywords: Sustainable Agriculture, Soil and Water Conservation, Conservation Techniques, Agricultural Resilience, Global Food Security

Water harvesting on amphi-phobic biomimetic material inspired by beetle

Prikxit^{1*}, N.K. Sankhyan², S.K. Sandal³ and Divya Jyoti⁴

Department of Soil Science, CSKHPKV Palampur (H.P.) 176062

Corresponding author email: prikitchauhan22291@gmail.com

Abstract

Water is a limited resource and its efficient utilization plays a critical role in growth and production functions of crops. Agriculture accounts for 70 per cent of global freshwater withdrawals, the majority of which is used for irrigation and is crucial for agricultural production to meet crop water requirements. Some arid regions in Africa, Latin America, and Asia have a severe shortage of freshwater resources for daily production and use. The current study entitled “Water harvesting on amphi-phobic biomimetic material inspired by beetle” was done by analyzing the secondary data. Aerodynamic theory was used to analyze and optimize the curvature structures of the imitation beetle back surfaces. In order to address the water crisis, a mock beetle back surface was created via 3D printing, which also allowed for surface hydrophilicity and curvature analysis. A variety of beetle back constructions have been constructed, and the three-dimensional convex curve of the back has been tuned. The findings demonstrate that the water collection on the super-impregnated surface is significantly larger than that on a regular hydrophobic surface if the surface has the appropriate curvature structure and hydrophobic density. This review is helpful in advancing the development of water collecting, transport, and separation technologies that are ecologically friendly.

Keywords: Amphi-phobic, Biomimetic, Aerodynamic, Hydrophilicity

Nano Fertilizers – A Novel Approach to Increase Nutrient Use Efficiency

Shivani Kumari^{*}, Manish Chauhan, Sandeep Kumar, Manjeet Singh

Department of Horticulture, School of Agriculture, Abhilashi University, Chail Chowk, Mandi – 175028 (Himachal Pradesh)

Corresponding author email: shivanikumarimsc008@gmail.com

Abstract

The emerging field of nanotechnology has a greater role in crop production with a strong promise to affect the current status of fertilizers with environmental safety, ecological sustainability, and economic stability. Nano-materials are the materials with a single unit between one and a hundred nm in size in a minimum of one

dimension. Nano fertilizers are important tools in agriculture to improve crop growth, yield and quality parameters with increased nutrient use efficiency, reduced wastage of fertilizers and cost of cultivation. These are specially crafted materials consisting of tiny particles housing a combination of macro- and micronutrients, which are carefully released into the plant rhizosphere, ensuring controlled delivery. Nano fertilizers are applied to soil or leaves. Nano-fertilizers are slowly released fertilizers and appropriate alternatives to conventional fertilizers for gradual and controlled supply of nutrients in the soil. Nano fertilizers are very effective for precise nutrient management in precision agriculture by matching the crop growth stage for nutrients and may provide nutrients throughout the crop growth period. Due to their small size and target specificity, they increase the use of efficiency of the fertilizer, which are applied in nanoparticle form. It may reduce ill effects due to overuse of conventional fertilizers. In recent lab scale investigations, it has been reported that nano-fertilizers can improve crop productivity by enhancing the rate of seed germination, seedling growth, photosynthetic activity, nitrogen metabolism, and carbohydrate and protein synthesis. As the nano fertilizers are getting very famous in farmers but some of them are also hesitating to adopt the use of nano fertilizers due to the lack of proper knowledge.

Key words: Nano fertilizers, Nano particles, Nanotechnology, Precision agriculture

Efficacy of nano- vis-à-vis prilled urea on plant growth attributes, nitrogen uptake, and apparent soil nitrogen balance in rice crop.

Suman¹, Debashis Chakraborty^{1*}, Achchhelal Yadav¹, P.K. Upadhyay²

¹ *Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi*

² *Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi*

* *Corresponding author email: debashisiari@gmail.com*

Abstract

The world's population is expected to grow by 2-3 billion by 2050, leading to a 70% increase in demand for agriculture. This means that there will be a rise in cereal production and global fertilizer-N demand. Rice, a crucial crop in feeding over half of the world's population, needs to have its nutrient utilization optimized, particularly with regards to nitrogen fertilizers. A new government-approved N-fertilizer source called 'IFFCO nano urea' has been developed to address this issue. A research study entitled "Efficacy of nano- vis-à-vis prilled urea on plant biophysical attributes and nitrogen uptake in rice" was conducted to monitor plant biophysical processes, N uptake, and apparent N balance in basmati rice (var. Pusa Basmati- 1692) at IARI farm during *kharif* season (2022) [both field and pot grown rice]. The experiment consisted of three treatments viz., T1 [recommended dose of N, P and K-soil application], T2 [75% of N-soil application + foliar sprays at active tillering and flowering stage of 2% prilled urea solution] and T3 [75% of N + foliar spray at active tillering and flowering stage of nano- formulation @ 4ml L⁻¹]. Nitrogen fertilizers, whether applied to soil or through soil + foliar methods, had little impact on plant and root growth. Several yield attributes viz., panicle and flag leaf length, number of total and filled grains were higher with nano urea; however, the yield was comparable to soil application of urea-N. Soil application of urea resulted in higher total N-uptake, although grain N in rice was similar among treatments. Total residue N in soil and apparent N balance was comparable among the treatments; however, NH₄-N of residue N was higher, and NO₃-N was lower in the soil under the foliar application of 25% N. Thus, One-season results indicated 25% N substitution in RDN can be achieved through foliar application of nano urea during critical growth stages without reduction in yields, but with lower total N uptake, indicating more research is necessary to recommend on the effective substitution of conventional soil application of N by nano urea foliar spray to the rice crop to achieve environmental sustainability.

Keywords: Rice, foliar application, nano urea and soil nitrogen balance

Effect of natural farming, organic, inorganic and integrated nutrient management on quality of fodder oat (*Avena sativa* L.)

Shobit¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

A field experiment entitled “Effect of natural farming, organic and inorganic sources of nutrients on quality of fodder oat (*Avena sativa* L.)” was conducted at Research Farm of School of agriculture, Abhilashi university, Mandi (HP) during *Rabi* 2021-2022. The experiment was laid out in randomized block design with three replications, comprising of six nutrient management treatments *i.e.* T₁ – absolute control, T₂ – natural farming nutrient management (*Beejamrit* + *Jeevamrit* + mulching), T₃ – organic nutrient management (FYM @10 t/ha + *Jeevamrit*), T₄ – farmer’s practice (FYM @ 2.5 t/ha + 25% recommended dose of fertilizers), T₅ – integrated nutrient management (FYM @ 5 t/ha + 50% recommended dose of fertilizers) and T₆ – inorganic nutrient management (100% recommended dose of fertilizers). Results of the study revealed that inorganic nutrient management and integrated nutrient management behaving alike resulted in significantly higher crude protein content and crude protein yield than treatments comprised of farmer’s practice, organic and natural farming nutrient management.

Keywords: natural farming, organic, inorganic, oat

Effect of nitrogen levels and cutting management on quality of fodder oat (*Avena sativa* L.)

Ayush Prasher¹, Priyanka Kumari², Ravinder³

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), ³ Assistant Professor (Soil Science)

¹²³School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

A field experiment entitled “Effect of nitrogen levels and cutting management on fodder oat (*Avena sativa* L.)” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Rabi* 2021-2022. The experiment was laid out in randomized block design with three replications, consisting of ten treatment combinations of two cutting management *i.e.* C₁ (Single cut at 50% flowering) and C₂ (Double cut at 60 DAS and 50% flowering) and five nitrogen levels *i.e.* N₁ – 0 kg N/ha, N₂ – 50 kg N/ha, N₃ – 75 kg N/ha, N₄ – 100 kg N/ha and N₅ – 125 kg N/ha. Results of study revealed that among cutting management, double cut at 60 days after sowing and 50 per cent flowering resulted in significantly numerically higher values of crude protein content and crude protein yield than single cut at 50 per cent flowering. Similarly, crude protein content and crude protein yield increased with increasing nitrogen levels with highest value recorded with application of 125 kg N/ha. Application of 125 and 100 kg N/ha remaining at par with each other resulted in significantly higher crude protein content and crude protein yield.

Keywords: fodder oat, crude protein yield, cutting management, nitrogen levels

Effect of sowing methods and row spacing on yield of fodder sorghum and pearl millet hybrids

¹Arun Verma and ²Priyanka Kumari

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: rockstararunvermaak@gmail.com

Abstract

The field experiment entitled “Effect of sowing methods and row spacing on yield of fodder sorghum and pearl millet hybrids” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications, comprising of nine treatments of all possible combinations of two sowing methods and two row spacing of sorghum and pearl millet *i.e.* T₁ - broadcast sowing of sorghum alone, T₂ - line sowing of sorghum alone in 30 cm apart rows, T₃ - line sowing of sorghum alone in 45 cm apart rows, T₄ - broadcast sowing of pearl millet alone, T₅ - line sowing of pearl millet alone in 30 cm apart rows, T₆ - line sowing of pearl millet alone in 45 cm apart rows, T₇ - broadcast sowing of blended seeds (sorghum + pearl millet), T₈ - line sowing of blended seeds in 30 cm apart rows (sorghum + pearl millet) and T₉ - line sowing of blended seeds in 45 cm apart rows (sorghum + pearl millet). The results of study revealed that line sowing of blended seeds of sorghum and pearl millet in 30 cm apart rows and line sowing of sole pearl millet in 30 cm apart rows behaving alike resulted in significantly higher total green fodder yield at first and second cuts over other treatment combinations of sowing methods and row spacing.

Keywords: sorghum, pearl millet, sowing methods, line sowing, broadcast sowing

Effect of sowing dates and varying seed rates on yield of wheat

Pallvi¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: pallvinaik23@gmail.com

Abstract

A field experiment entitled “Effect of sowing dates and varying seed rates on yield of wheat” was conducted at the Research Farm of the School of Agriculture, Abhilashi University, Mandi (H.P.) during *Rabi* 2021-22. Field experiment comprising of three sowing dates *viz.* 9th November, 29th November and 19th December and three seed rates *viz.* 100 kg/ha, 110 kg/ha and 125 kg/ha was conducted in split plot design with three replications. The results of study revealed that significantly higher grain and straw yields of wheat was obtained with 9th November sowing, which was statistically at par with 29th November sowing grain and straw yields. Significantly the lowest grain and straw yields were obtained from crop sown on 19th December. Seed rate of 125 kg/ha resulted in significantly higher grain and straw yields over 110 and 100 kg/ha seed rates. The effect of 110 kg/ha seed rate was found comparable with both the seed rates of 125 and 100 kg/ha.

Keywords: sowing date, seed rate, yield, wheat

Citrus *limonoid glucosyltransferase* (CrLGT) gene characterization from kinnow mandarin and its overexpression

Ekta Patel¹, Piyali Das¹, Somak Hazra¹, Prashant Mohanpuria¹

¹School of Agricultural Biotechnology, Punjab Agricultural University, Ludhiana

Corresponding author email: ektu.p421@gmail.com

Abstract

Kinnow mandarin (*Citrus reticulata* Blanco) stands as a significant fruit crop in north-western India, renowned for its commercial value. The fruits and juices extracted from citrus are an excellent source of health-promoting phytochemicals, particularly citrus limonoids. Despite of the problem of delayed bitterness, citrus limonoids holds promise for human health because of their demonstrated anticancerous properties. The citrus *limonoid glucosyltransferase* (CrLGT) gene encoding for limonoid glucosyltransferase enzyme, is pivotal in mediating the conversion of bitter limonoid aglycones into their non-bitter glucoside forms, thereby serving as the natural debittering mechanism. *In silico* characterization of the CrLGT gene (Accession no: KP306791) isolated from commercial cultivar of citrus i.e. Kinnow mandarin demonstrated 99% identity with *Citrus limettoides* (EU531463.1), *Citrus unshiu* (AB033758.1), *Citrus sinensis* (EU531465.1) and *Citrus paradisi* (EU531464.1) using BLASTn tool. The nucleotide sequence of CrLGT gene was converted into protein sequence using ExPasy translate tool that also revealed 94-99% similarity with related citrus species. Additionally, secondary structure prediction was carried out using Phyre² web server that exhibited 37% of α -helices and 7% of β -sheets confirming the modelled 3D structure of CrLGT protein. The MEME suite tool recognized the presence of plant secondary product glycosyltransferase box near to the N-terminal region of the CrLGT gene. The expression analysis of CrLGT gene was analysed in BL21-DE3 strain of *E.coli* at 37°C with 0.7mM IPTG whereas, in RG2 strain at 25°C with 0.5mM IPTG concentrations. In order to assess the potential of citrus limonoids such as limonin, limonin glucopyranoside, and obacunone, as precursors for anticancer drugs, in silico screening of cancer targets was carried out using Autodock v1.5.6. The three dimensional structures of cancer targets used for study were HER3, HER4, FGFR1, GSTP1, MMP3, EGFR, CDC42, CDHF12, GRK5, MAPK14, DAPK3 and ABL1-gene. Hence, the attempt concluded satisfactory cancer targets and predicted the list of complexes that needs further validation at in vivo level for the anticancer potential.

Role of artificial seed in crop improvement

Priyanka¹, Ravi Sharma^{2*}, Ritika Singh², Priyanka Uppal¹

¹M.Sc. Scholar, Department of Genetics and Plant Breeding, School of Agriculture, Abhilashi University, Mandi (H.P), India-175028

²Assistant Professor, Department of Genetics and Plant Breeding, School of Agriculture, Abhilashi University, Mandi (H.P), India-175028

Corresponding author email: ravii7777@gmail.com

Abstract

An enhanced method of producing artificial seeds is regarded as a significant means of mass propagation of elite plant genotypes and a beneficial alternative technology of propagation in many commercially important crops. Artificial seeds is "encapsulated somatic embryos." It is byproduct of somatic cells, they can be widely propagated clonally. In addition to somatic embryos, other explants include axillary buds, shoot tips and any other micro propagules that, when sown as seeds and grown in-vitro or in-vivo, can develop into plants. Artificial seed delivery helps with both ex-vitro adaptation and scaling up in-vitro culture. Since synthetic seed manufacture offers numerous practical benefits on a commercial scale for the cultivation of a wide range of agricultural crops, it has expanded the possibilities of in-vitro plant propagation techniques. The development of artificial seed technology presents fresh opportunities for a viable approach to enhancing a variety of economically important plant species, such as vegetable and fruit crops. Not a lot of soil is needed for the manufacturing of synthetic seeds. Certain characteristics of fruit crops, such as small seeds, diminished endosperm, low germination rates, heterozygosity and seed lessness in certain kinds, are obstacles to successful seed propagation. Modern synthetic seed production techniques are considered to be a useful substitute for producing a wide variety of commercial crops and advantageous for widely propagating limited plant genotypes.

Keywords: Artificial seed, somatic embryo's, in-vitro, propagation.

Crop diversification for enhancing farmers income in Himachal Pradesh

Priyanka Kumari¹ and Ravinder Kumar²

¹Assistant Professor (Agronomy), ²Assistant Professor (Soil Science),
School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028
Corresponding author email: kumaripriyanka786@gmail.com

Abstract

Himachal Pradesh is a small hill state located in the western Himalayas. State where about 93 per cent of the population depends directly on agriculture. The major rain-fed cropping systems are maize-wheat, rice-wheat, and intercropped pulses and oilseeds in maize and wheat. Rice-wheat and vegetable based crop sequences are dominant under irrigated conditions. The agro-climatic conditions in the state are congenial for the production of cash crops like seed potato, off-season vegetables and ginger. Like whole country, Himachal too has almost reached a plateau in so far as cultivable land is concerned. Hence, the emphasis has to be on increasing productivity levels through diversification of high value crops. Crop diversification refers to the addition of new crops or cropping systems to agricultural production on a particular farm taking into account the different returns from value-added crops with complementary marketing opportunities. Diversification of agriculture refers to the shift from the regional dominance of one crop to regional production of number of crops to meet ever increasing demand for cereals, pulses, vegetables, fruits, oilseeds, fibers, fodder and grasses, fuel, etc. It shows a lot of promise in alleviating the second generation problems such as lowering of water table, soil degradation, nutrient imbalance, soil salinity, resurgence of weeds, insect-pests and diseases, environmental pollution, decline in farm profit and change in climate through fulfilling basic needs, withstanding weather aberration, controlling price fluctuation, ensuring balanced food supply, reducing pesticides and fertilizers loads and creating employment generation.

Impact of green synthesis nanoparticles on crop production

¹Anuj Chaudhary, ²Navdeep Sharma

¹Teaching Assistant (Agronomy) School of Agriculture, Abhilashi University, Chail-Chowk, Teh. Chachyot, Distt. Mandi (H.P.) -175045, India

²Assistant Professor (Physics), School of Basic Sciences, Abhilashi University, Chail-Chowk, Teh. Chachyot, Distt. Mandi (H.P.) -175045, India

Corresponding author email: anujatt244@gmail.com

Abstract

Green nanotechnology is a new division of nanotechnology with low environmental impacts associated with substantial economic and social benefits. Biosynthesis of nanoparticles (NPs) using living cells and plants are a successful and novel method in bio nanotechnology. Chemical and physical approaches are used to produce NPs; but, biological approaches are favoured owing to their eco-friendly, clean healthy, cost-effective, simple, and efficient high productivity and purity sources. NPs have various uses for medical, pharmaceutical, and agricultural applications. The application of nanotechnology, especially green technology offers considerable promise in alleviating these problems. Nanotechnology has led to changes and advances in many technologies and has the potential to transform various fields of the agricultural sector, including biosensors, pesticides, fertilizers, food packaging and other areas of the agricultural industry. Green synthesis, as part of bio-inspired protocols, provides reliable and sustainable methods for the biosynthesis of nanoparticles by a wide range of microorganisms rather than current synthetic processes. Therefore, this field is developing rapidly and new methods in this field are constantly being invented to improve the properties of nanoparticles. In this review, we consider the latest advances and innovations in the production of metal nanoparticles using green synthesis by different groups of plants and microorganisms and the application of these nanoparticles in various agricultural sectors to achieve food security, improve crop production and reduce the use of pesticides. In addition, the mechanism of synthesis of metal nanoparticles by different microorganisms and their advantages and

disadvantages compared to other common methods are presented. Improvement in seed germination, nutrient uptake, enhanced production of photosynthetic pigments and other secondary metabolites have been observed upon treating with green synthesized nanoparticles. So far, the effects on seed germination, photosynthesis, yield and product quality.

Keywords: Green Synthesis, NPs, Crop production

Influence of Sowing Techniques and Herbicidal Treatments on the Morpho-physiological Parameters: Plant Height and Dry Matter Accumulation in Maize (*Zea mays* L.)

Sahil Chauhan¹, Mohit Naik² and US Walia³

¹M.Sc. Student, Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab 144411

²Ph.D. (Scholar), Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, H.P.-176 062

³Professor, Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab 144411

Corresponding author email: chauhansahil00266@gmail.com

Abstract

This study systematically evaluated the combined impact of sowing methods and weed management practices on two critical agronomic parameters, namely plant height and plant dry matter accumulation. Employing a split-plot design, sowing methods were assigned to the main plots, and weed management treatments were applied to subplots. Data collection occurred at 30 days after sowing (DAS), 60 DAS, and at harvest. In the main plot analysis, three sowing methods—flat sowing (M₁), ridge sowing (M₂), and furrow sowing (M₃)—were scrutinized for their influence on plant height and dry matter accumulation. Ridge sowing (M₂) consistently resulted in taller plants at 60 DAS and harvest, reaching 65.6 cm and 149.1 cm, respectively. Correspondingly, the dry matter accumulation mirrored this trend, emphasizing the interdependence of plant height and biomass production. Subplot investigations focused on weed management strategies, including varying concentrations of Atrazine and a combination of Atrazine and Pendimethalin. Among these treatments, the combination of Atrazine (1 kg ha⁻¹) and Pendimethalin (0.75 kg ha⁻¹) (T₃) demonstrated superior results, with significantly increased plant height and dry matter accumulation at all growth stages. Conversely, the control treatment (T₄) without weed management exhibited lower plant height and dry matter accumulation, underscoring the importance of effective weed control in optimizing crop performance. Statistical analyses indicated significant differences among weed management treatments, highlighting the efficacy of the Atrazine + Pendimethalin combination. Interaction effects between sowing methods and weed management were evident, particularly in plant height at 60 DAS, indicating that the combined influence of these factors is crucial at specific developmental stages. The presence of significant interaction effects underscores the need for a holistic approach in agricultural management practices.

Organic farming versus conventional Farming impact on environment, yield, soil property and human health

Bavita Kumari

Department of Plant Pathology, Abhilashi University (Chail chowk Mandi)

Corresponding author email: bavitat41@gmail.com

Abstract

Conventional farming includes a large amount of chemical fertilizer and pesticide use to increase the yields per hectare. Chemical and synthetic fertilizers and pesticides are not applied in the organic farming system to reduce their adverse environmental impacts. Instead, plant residues or livestock manure are used to enhance soil fertility. The primary goal of both conventional and organic farming is plant production. However, in organic farming, all cultivation procedures aim to protect the environment while also maintaining high crop quality, whereas in conventional agriculture the ultimate end is high yield, i.e. maximum economic efficiency. In order to achieve the intended goal in conventional agriculture, repeated high doses of artificial fertilizer and chemical crop protection materials are often used. These may then degrade the soil environment, contaminate the groundwater and negatively affect microorganisms. Organic farming is one of the fastest growing sectors of world agriculture. Although it represents only 1% of world agricultural area, organic is one of the most recognized food labels and most people in developed countries consume some amount of organic food today. This interpretation of organic as “chemical-free” farming. The recognition of the negative impact this system of production has on the health of the soil and farmers. However, environmental results based on carbon emissions reduction show that organic system is found to be more effective in mitigating climate change. Organic farming can be a very competitive alternative to conventional farming, when it comes to healthy food production. Organic farming reduces pollution conserve water, reduce soil erosion. Since these farms are without pesticides, they are safer for people who harvest the food. Organic farming is more humane than conventional farming. Organic farming uses fewer fossil fuels and leaves the environment less contaminated by pesticides and herbicides. The intake of organic food may lower the incidence of allergic illness and obesity. The largest source of human pesticide exposure comes from residues in conventional fruits and vegetables.

Correlation and path coefficient analysis for fruit yield and component traits in bacterial wilt tolerant genotypes of bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.)

Anuradha^{1*} and Sonia Sood²

¹Project Associate-I, CSIR-IHBT, Palampur and ²Professor, Department of Vegetable Science and Floriculture, CSKHPKV, Palampur-176062, India

*Corresponding author email: as677053@gmail.com

Abstract

Understanding the direction and magnitude of the correlation between fruit yield and its attributing traits in bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.) is a prerequisite for the identification of such characters whose selection would prove beneficial in any breeding programme. The correlation coefficient analysis measures the mutual relationship between various characters and it determines the component traits on which selection can be relied upon the effect of improvement. The correlation coefficient analysis was studied in 43 genotypes in bell pepper for different characters viz., days to 50 per cent flowering, days to first picking, plant height (cm), primary branches per plant, harvest duration (days), fruit length (cm), fruit width (cm), pericarp thickness (mm), lobes per fruit, average fruit weight (g), marketable fruits per plant, marketable fruit yield per plant (g), capsanthin content (ASTA units), TSS (oBrix) and ascorbic acid content (mg/100g) under Randomized Complete Block Design with three replications during summer-rainy season. Significant and positive correlation of marketable fruit yield per plant, both at genotypic and phenotypic levels was recorded with marketable fruits per plant, harvest duration, average fruit weight and fruit width while significant and negative correlations were observed with days to 50 per cent flowering and days to first picking. The data pertaining to phenotypic and genotypic path revealed that marketable fruits per plant had maximum positive direct effect on marketable fruit yield per plant followed by average fruit weight. Similarly, marketable fruit yield was also increased by positive indirect effects of harvest duration and fruit width. Thus, direct selection for the above traits will be helpful in improving marketable fruit yield of bell pepper and ultimately farmers' income.

Keywords: Bell pepper genotypes, correlation coefficient, path analysis

Assessing the Impact of Cadmium and Lead Toxicity on Germination Percentage, Plant Height and Internodal Spacing in Chickpea (*Cicer arietinum*)

Mohit Naik¹, Sahil Chauhan² and M.C. Rana³

¹Ph.D. (Scholar), Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, H.P.-176 062

²M.Sc. Student, Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab 144411

³Professor, Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, H.P.- 176 062

Corresponding author email: mcrana2014@gmail.com

Abstract

This study investigated the impact of varying concentrations of cadmium (Cd) and lead (Pb) on the germination percentage, plant height at 60 and 90 days after sowing (DAS), as well as internodal spacing at 60 and 90 DAS in chickpea (*Cicer arietinum*). The experiment comprised nine treatments (T₀ to T₈) representing different levels of Cd and Pb exposure. The germination percentage exhibited noteworthy variations among treatments. T₃ recorded the highest germination percentage at 23.00%, while T₅ exhibited the lowest at 16.67%. These findings suggest a differential response of chickpea germination to Cd and Pb concentrations. Plant height measurements at 60 and 90 DAS revealed distinctive trends across treatments. T₆ displayed the tallest plants at both time points, reaching 27.06 cm and 31.20 cm, respectively. Conversely, T₇ had the shortest plants in 60 DAS (19.53 cm) and 90 DAS (24.16 cm). These results indicate that Cd and Pb concentrations influence the growth trajectory of chickpea, with variations in plant height at different stages of development. Internodal spacing was also affected by Cd and Pb exposure. Notably, T₆ exhibited the widest internodal spacing at both 60 DAS (1.23 cm) and 90 DAS (1.56 cm), suggesting a potential influence on the structural development of the plants. Conversely, T₇ displayed the narrowest internodal spacing at 60 DAS (1.10 cm), emphasizing the role of Cd and Pb in altering plant architecture.

Theme 10: Diverse Agro-Allied Sectors

Carotenoids: Nature's Vibrant Pigments and Health Guardians

Raveena Rani, Priyanka and Veenu Sangwan

Research scholar, Dept. of Foods and Nutrition, CCSHAU, Hisar, Haryana, 125004

Corresponding author email: raveenajyani123@gmail.com

Abstract

Carotenoids, a group of natural pigments found in plants, algae, and some bacteria, have garnered considerable attention for their diverse roles in human health. In addition to being highly pigmented, carotenoids are strong antioxidants that provide defense against oxidative stress and chronic illnesses. Carotenoids are classified according to the systems of conjugated double bonds that give them their color and antioxidant properties. They are widely found in fruits, vegetables, and other plant-based diets; bell peppers, tomatoes, carrots, and spinach are among the prominent sources. Carotenoids are essential for photosynthesis and photo protection, in addition to giving diverse plant tissues their vibrant colors. Their antioxidant qualities also aid in lessening the negative impacts of free radicals, which lowers the chance of oxidative damage and linked illnesses like cancer, heart problems, and age-related macular degeneration. Higher intakes of carotenoids have been consistently associated with decreased occurrences of chronic illnesses, according to epidemiological research. Among the most well-researched carotenoids are beta-carotene, lycopene, lutein, and zeaxanthin, each of which has distinct health advantages. For instance, lutein and zeaxanthin are concentrated in the macula of the eye, where they aid

in preventing macular degeneration, while beta-carotene is a precursor of vitamin A, which is necessary for vision, immunity, and skin health. Carotenoids' bioavailability varies according on food matrix, processing techniques, and physiological factors specific to each individual. Including a variety of fruits and vegetables in regular meals improves the absorption of carotenoids. Dietary guidelines suggest eating a variety of vibrant fruit to guarantee that you are getting enough carotenoids and other phytochemicals for good health. With significant biological implications, carotenoids are an intriguing class of phytochemicals. They are essential antioxidants that also help prevent chronic diseases, in addition to being natural pigments. Choosing foods high in carotenoid content for your diet is an easy yet effective way to improve your general health and wellbeing.

Keywords: carotenoids, phytochemicals, antioxidants, health benefits, bioavailability

To study on biology of Oleander hawk moth (*Daphnis nerii*) under ambient condition

Vinod Kumar

Assistant Entomologist, Department of Seed Science and Technology ANDUA&T, Ayodhya, U. P. India

Abstract

The order Lepidoptera comprises Butterflies and Moths. According to a recent study, 1,57,424 Lepidopteran species have been reported globally. The primary objective of this study is to establish the interaction between *Daphnis nerii* (Linnaeus, 1758) and *Alstonia scholaris* (L.) R.Br. During survey, the 5th instar larvae were collected, and after emergence, adult were identified as *Daphnis nerii* (Linnaeus, 1758). Interestingly, it was found to be a new pest feeding on *Alstonia scholaris* (L.) R.Br. with adult longevity of 9 days. This plant is found near the agricultural fields and other open spaces along the roadsides in India. Description (Adult) Head green, rufous in front; a grey band on vertex. Thorax green, collar outlined in grey; a triangular grey patch on vertex. Abdomen paler green, with oblique lines at the side; paired dark green lateral blotches on penultimate and a single dorsal blotch on ultimate segment. Antennae filiform, slightly hooked at terminal position (thread like). Labial palpi greenish; turned upwards. Two mid-tibial spurs, one short and one long. Four hind tibial spurs, one from each pair short and other long.

Keywords: Lepidoptera, Moth, Biology

Efficacy of essential oils and plant extracts in controlling *Varroa destructor* in *Apis mellifera* Linnaeus colonies in Tarai regions

Akanksha Ruhela¹ and Pramod mall²

¹Ph.D Scholar, Dept. of Entomology, College of Agriculture, Govind Ballabh Pant University of Agriculture & Technology Pantnagar

²Prof & Head, Dept. of Entomology, College of Agriculture, Govind Ballabh Pant University of Agriculture & Technology Pantnagar

Abstract

Bees are part of the biodiversity on which we all depend for our survival. They provide high-quality food honey, royal jelly and pollen and other products such as beeswax, propolis and honeybee venom. The importance of *Apis mellifera* L. is greatly appreciated not only for their various products with nutritional and medicinal uses but also because of their important role as pollinators. People have used bees and bee-related products for medicinal purposes for thousands of years. Bee products have antioxidant, antimicrobial, anti-inflammatory, and anticancer properties. However, several biological stresses pose a threat to this pollinating insect. Among these, the ectoparasitic mite *Varroa destructor* is currently the most significant concern. In this paper, we offer an updated analysis of the use of some essential oils, powders, and plant extracts to fight against *V. destructor*. Some aromatic plants have been used for essential oil, some for making powders and some plant extracts have been used to test their varroacidal efficacy in the field conditions. We have used clove oil, cinnamon oil,

peppermint oil, citronella oil, lemon grass oil and some powder like sugar powder, thyme powder and neem seed powder as well as some plant extract as camphor extract and thyme plant abstract to check their varrocidal activity in selected bees' colony. The objective of this study is to develop an ecofriendly module to control varroa mites as well as provide overall health to bee colonies.

Genetic variability analysis in stone and kernel traits of wild apricot (*Prunus armeniaca* L.) trees in Himachal Pradesh, India

Anchal* and Anita Kumari

Department of Tree Improvement and Genetic Resources, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP), India 173 230

Corresponding author email: anchkaushal99@gmail.com

Abstract

Wild apricot is an important stone fruit found in temperate regions around the world. The current study aimed to evaluate the genetic variability of stone-kernel traits of seventy-three candidate wild apricot trees chosen from three regions of Himachal Pradesh. The results revealed that the Panjhor/Digwali site in Sirmour had the highest mean value for stone and kernel length. The kernel thickness was found to have a high heritability coupled with a moderate genetic gain, encouraging the use of variability in advanced breeding strategies. The stone and kernel length were found to be highly, positively, and significantly correlated traits, implying that improvement in one character will improve another character. The cluster analysis divided all of the investigated sites into two major clusters. The study will further help to select the best performing wild apricot trees for future selection of plus trees and other improvement programs.

Keywords: candidate trees, cluster, genetic variability, stone, wild apricot

Performance of half sib progenies for morphometric and fodder traits of *Grewia optiva* Drummond

Shikha Bhagta, Jai Pal Sharma, Reena Kumari and Sarita Devi

College of Horticulture and Forestry, Thunag-175048, Mandi (H.P.)

Corresponding author email: bhagtashikha@gmail.com

Abstract

Grewia optiva, commonly known as 'Beul' and very popular agroforestry tree which is grown in low and mid-hills regions in the western and central Himalayas on account of its utility as fodder, fuel and fiber. With the increase in demand for fodder, there is a need to develop clones of genetically superior trees. Therefore, evaluating locally adopted beul families for commercial cultivation is a priority area of research in improving the fodder quality. A seedling seed orchard of *Grewia optiva* Drummond has been established in July 2000, which consists of 60 families each under three replications at spacing of 2mx2m. These different families have been sourced from various districts of Himachal Pradesh. For the present study, only 40 families were selected and evaluated for various morphometric and fodder quality parameters. The analysis of variance indicated highly significant differences among the families for all the morphometric traits and fodder quality traits studied, which revealed the existence of a good deal of variability in the seedling seed orchard of *Grewia optiva*.

Key words: Agroforestry; Half sib; family; morphometric

Development and Evaluation of Climate - Resilient Clones of Willows (*Salix* species)

JP Sharma¹, Tushal², Shikha Bhagta¹, Sapna Thakur³

¹College of Horticulture and Forestry, Thunag (Mandi) HP 175 048, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan (HP) India PIN- 173230

²Department of Tree Improvement and Genetic Resources, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) India PIN- 173230

³Department of Forestry and Natural Resources, Punjab Agriculture University, Ludhiana, India, PIN 141 004
Corresponding author email: jaiuhfrajgarh@rediffmail.com

Abstract

There are about 31 species of *Salix* in India, but most of them are not suitable for industrial use due to poor bole and wood characteristics. The *Salix* improvement programme was initiated in the Department of Tree Improvement and Genetic Resources, UHF Nauni, in the year 2002-03 with the introduction of superior clones of *Salix* species/hybrids from foreign countries. The clones were screened in the nursery and selected were evaluated in the field conditions. The hybridization programme was carried out from the year 2010 to 2012. The reproductive biology of various clones was studied and new hybrids were developed. The hybrids were screened in pots, nursery and field conditions on the basis of morphological traits. The selected newly developed hybrids along with the parent clones were planted at different agroclimatic regions in Himachal Pradesh, India to find out the genotype x environment interaction and to screen the best stable clones and the site-specific clones. The growth of clones at Lana Palar (Sirmour), Thunag (Mandi) and Nauni (Solan) was evaluated after two years using Eberhart and Russel, Additive Main Effect and Multiplicative Interaction (AMMI) and GGE models for genotype x environment and stability parameters. Using the regression model, clones UHFS068, UHFS112 and UHFS062 were found stable for plant height, diameter at breast height and volume index respectively. The clones J799 and Kashmiri were the most stable and better performing on the basis of GGE and MTSI. The clone UHFS114 was suitable for rich environments and clone J795 performed similar in all environments. Therefore, this study identified the stable clones that can be recommended for the commercial plantation of willow in different geographical regions of Himachal Pradesh.

Kew words: Agroclimatic, AMMI, clone, Genotype x environment, GGE

Nitrogen Management in Agriculture: A Comparative Analysis of Organic and Inorganic Sources

Sahil Sethi¹, Dr. Jay Nath Patel² and Dharmvir¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University, Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: sethisahil321@gmail.com

Abstract

Efficient nitrogen management is pivotal for sustainable agriculture, ensuring optimal crop yields while minimizing environmental impacts. This study investigates the contrasting impacts of organic and inorganic nitrogen sources on soil health, plant growth and overall agricultural sustainability. Through a comprehensive review of existing literature and field experiments, we assess the advantages and challenges associated with each nitrogen source. Organic nitrogen sources, such as compost, manure and cover crops, contribute to soil fertility by enhancing microbial activity and improving soil structure. These sources release nitrogen slowly, reducing the risk of leaching and promoting long-term nutrient availability. However, challenges such as variable nutrient content and decomposition rates must be addressed to optimize their effectiveness. Inorganic nitrogen fertilizers, including urea and ammonium nitrate, provide readily available nitrogen to plants, ensuring rapid growth and high yields. However, improper application can lead to nitrogen losses through leaching and atmospheric emissions, causing environmental concerns such as water pollution and greenhouse gas emissions.

This study aims to provide a balanced perspective on nitrogen management, considering the ecological and economic implications of both organic and inorganic sources. By understanding the nuances of nitrogen dynamics in different agricultural systems, farmers can make informed decisions to optimize nutrient use efficiency, reduce environmental impacts and foster sustainable agricultural practices.

Keywords: Nitrogen, Organic sources, Inorganic sources, Soil health and sustainable agriculture

Integrated weed management in Wheat crop

¹Adarsh, Dr. Mohd. Shah Alam² and Sandeep¹

M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)

Corresponding author email: adarshchaudhary650@gmail.com

Abstract

Wheat is generally infested with diverse kind of weed flora including broad and narrow leaf weeds. It results in 20–40% average reduction in grain yield (Kumar et al. 2010). Weeds are a major impediment to crop production through their ability to compete for resources and their impact on product quality. Selective herbicides are very effective in controlling weeds in crop, however, continuous use of same herbicide or herbicide having similar mode of action results in weed flora shifts and evolution of resistance in weeds (Yadav et al. 2016). In India, presence of weeds in general reduces crop yields by 31.5 and 22.7% in winter season and 36.5% in summer and kharif season and in some cases can cause complete devastation of the crop (Anonymous, 2007). An integrated weed management approach to land management combines the use of complementary weed control methods such as grazing, herbicide application, land fallowing, and biological control. Management strategies must be developed to prevent selection and spread of herbicide resistant populations. For control of multiple herbicide resistant *P. minor* populations (resistant to isoproturon, clodinafop and sulfosulfuron) pendimethalin, trifluralin, pyroxasulfone, metribuzin and terbutryn are effective. Also, the multiple herbicide resistant populations showed sensitivity to glyphosate and paraquat. However, for efficient weed management, the non-chemical weed management tactics should be adopted in conjunction with chemicals (like herbicide mixture and rotation, optimum spray time, dose and methods). Some of the nonchemical agronomic strategies like tillage, sowing time, sowing methods, competitive crop cultivars, higher crop density, closer spacing, irrigation, fertilization, crop rotation and sanitation practices (weed-free crop seeds and manure) can be adjusted and adopted in such a manner that they provide the competitive edge to the crop over weeds.

Impact of weed management methods on yield and economics of transplanted rice

Manish Kumar¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: manishemo28@gmail.com

Abstract

A field experiment was conducted at the Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022 to study the impact of weed management methods on yield and economics of transplanted rice. The experiment was laid out in randomized block design with three replications, consisting of eight weed management treatments *viz.* T₁ - weed free (hand weeding at 25, 45 and 55 DAT), T₂ - two hand weeding at 25 and 45 DAT, T₃ - butachlor @1.5 kg a.i./ha at 1-3 DAT + byspribac sodium @25 g a.i./ha, T₄ - pendimethalin @ 1 kg a.i./ha at 1-3 DAT + byspribac sodium @25 g a.i./ha, T₅ - butachlor @1.5 kg a.i./ha at 1-3 DAT + one hand weeding at 25 DAT, T₆ - pendimethalin @ 1 kg a.i./ha at 1-3 DAT + one hand weeding at 25 DAT, T₇ - byspribac sodium @25 g a.i./ha and T₈ - weedy check. Results of the study revealed that two

hand weeding, butachlor @1.5 kg a.i./ha at 1-3 DAT + bysribac sodium @25 g a.i./ha and pendimethalin @ 1 kg a.i./ha at 1-3 DAT + bysribac sodium @25 g a.i./ha remaining at par with each other were found superior treatments next to weed free in recording lower total weed dry weight, higher rice grain yield, net returns and net returns per rupee invested over other treatments.

Keywords: weed management, transplanted rice, herbicide, economics

Effect of integrated nutrient management on yield and economics of soybean

¹Ashish Kapoor¹ and ²Priyanka Kumari

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: ak6004644@gmail.com

Abstract

The field experiment entitled “Effect of integrated nutrient management on yield and economics of soybean” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications, comprising of nine treatments *i.e.* T₁ – 100% recommended dose of fertilizers, T₂ – 100% recommended dose of fertilizers + FYM @10 t/ha, T₃ – 100% recommended dose of fertilizers + FYM @10 t/ha + biofertilizers, T₄ – 75% recommended dose of fertilizers, T₅ – 75% recommended dose of fertilizers + FYM @10 t/ha, T₆ – 75% recommended dose of fertilizers + FYM @10 t/ha + biofertilizers, T₇ – 50% recommended dose of fertilizers, T₈ – 50% recommended dose fertilizers + FYM @10 t/ha and T₉ – 50% recommended dose of fertilizers + FYM @10 t/ha + biofertilizers. Results of study revealed that treatments comprised of application of 100 per cent recommended dose of fertilizers with FYM @10 t/ha + biofertilizers or with FYM @10 t/ha resulted in significantly higher soybean seed yield compared to other treatments combinations. Application of 100 per cent recommended dose of fertilizers proved most profitable with highest net returns (Rs. 43025/ha) and net returns per rupees invested (1.21).

Keywords: soybean, integrated nutrient management, biofertilizers, fertilizers

Effect of weed management practices on yield and economics of maize (*Zea mays* L.)

Hemlata¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: hemlata175027@gmail.com

Abstract

A field experiment entitled “Effect of weed management practices on yield and economics of maize (*Zea mays* L.)” was conducted at the Research Farm of the School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications, consisting of nine weed management treatments *i.e.* weed free (hand weeding at 25, 45 and 65 DAS) (T₁), soybean intercropping + one hand weeding at 25 DAS (T₂), two hand weeding at 25 and 45 DAS (T₃), atrazine @1.25 kg a.i./ha (PE) + one hand weeding at 25 DAS (T₄), atrazine @1.25 kg a.i./ha (PE) + 2,4-D @1 kg a.i./ha (PoE) at 25 DAS (T₅), one hand weeding at 25 DAS (T₆), soybean intercropping (T₇), mulching (T₈) and weedy check (T₉). Results of the study revealed that non-chemical weed management treatments comprised of weed free (hand weeding at 25, 45 and 65 DAS), two hand weeding (25 and 45 DAS) and soybean intercropping + one hand weeding (25 DAS) being at par with each other resulted in significantly lower total weed dry weight and higher maize equivalent yield than rest of the chemical and non-chemical weed management treatments. Pre

emergence application of atrazine @1.25 kg a.i./ha supplemented with one hand weeding (25 DAS) was the next best treatment. Significantly higher net returns (₹ 112763/ha) and net returns per rupee invested (3.14) were obtained from soybean intercropping + one hand weeding treatment as compared to all other treatments.

Keywords: intercropping, maize, mulching, non-chemical

Weed management practices in wheat crop

Aditya¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

Wheat (*Triticum aestivum* L.) is a versatile crop, growing across a range of agro-ecological zones gets infested with variety of weeds and subjected to heavy weed competition during the crop period. Practice of using heavy inputs and intensive cultivation has led to heavy weed infestation lowering grain yield and quality deterioration of created products. Indiscriminate use of herbicides for weed control has resulted in serious ecological and environment problems. So there is strong need to discover the alternative weed management options. Non chemical methods of weed management like hand weeding, use of mulch and different intercropping combinations of crops and legume components can be effective for weed management. No doubt physical and cultural methods are useful but it will not be possible and economical to stick only to the single weed control strategy. Integrated weed management approach involving physical (hand weeding), cultural (intercropping, mulching) and chemical (use of herbicides) methods in wheat is very important to provide effective and acceptable weed control for realizing high production.

Key words: Intercropping, mulching, weed management, wheat

Effect of nitrogen levels, organic manure and biofertilizers inoculation on yield and economics of sorghum and pearl millet hybrids

Ankita Walia¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ² Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Abstract

The field experiment entitled “Effect of nitrogen levels, organic manure and biofertilizers inoculation on yield and economics of sorghum and pearl millet hybrids” was conducted at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during *Kharif* 2022. The experiment was laid out in randomized block design with three replications, comprising of nine treatments *i.e.* T₁ – 100% recommended dose of nitrogen, T₂ – 100% recommended dose of nitrogen + FYM @10 t/ha, T₃ – 100% recommended dose of nitrogen + FYM @10 t/ha + biofertilizers, T₄ – 75% recommended dose of nitrogen, T₅ – 75% recommended dose of nitrogen + FYM @10 t/ha, T₆ – 75% recommended dose of nitrogen + FYM @10 t/ha + biofertilizers, T₇ – 50% recommended dose of nitrogen, T₈ – 50% recommended dose nitrogen + FYM @10 t/ha and T₉ – 50% recommended dose of nitrogen + FYM @10 t/ha + biofertilizers. Results of study revealed that treatments comprised of application of 100 per cent recommended dose of nitrogen with FYM @10 t/ha + biofertilizers or with FYM @10 t/ha resulted in significantly higher total green fodder yield compared to other treatments combinations. Application of 100 per cent recommended dose of nitrogen proved most profitable with highest net returns (Rs. 53628/ha) and net returns per rupees invested (1.56).

Key words: biofertilizers, nitrogen levels, sorghum, pearl millet

Effect of weed management practices on yield and economics of wheat (*Triticum aestivum* L.)

Priyanka Bhardwaj¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: piyapb51393@gmail.com

Abstract

A field experiment was carried out at Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during Rabi 2021-2022 to study the effect of weed management practices on yield and economics of wheat (*Triticum aestivum* L.). The experiment was laid out in randomized block design with three replications, consisting of eight weed management treatments viz. T₁ - weedy check, T₂ - weed free (hand weeding at 40, 70 and 100 DAS), T₃ - one hand weeding at 40 DAS, T₄ - two hand weeding at 40 and 70 DAS, T₅ - clodinafop propargyl 60 g a.i. ha⁻¹ at 35 DAS, T₆ - clodinafop propargyl 60 g a.i. ha⁻¹ at 33 DAS *fb* metsulfuron methyl 4 g a.i. ha⁻¹ at 35 DAS, T₇ - sulfosulfuron 25 g a.i. ha⁻¹ at 35 DAS and T₈ - sulfosulfuron 25 g a.i. ha⁻¹ + metsulfuron methyl 4 g a.i. ha⁻¹ at 30 DAS. The results of the study revealed that among weed management treatments, weed free and two hand weeding (at 40 and 70 DAS) remaining at par with each other resulted in significantly lower total weed dry weight, higher wheat grain yield, net returns and net returns per rupee invested over other treatments. Herbicides combination treatments i.e. clodinafop propargyl 60 g a.i./ha at 33 DAS *fb* metsulfuron methyl 4 g a.i. ha⁻¹ at 35 DAS and sulfosulfuron 25 g a.i. ha⁻¹ + metsulfuron methyl 4 g a.i. ha⁻¹ at 30 DAS found comparable with two hand weeding and significantly superior to rest of the treatment in terms of weed control, yield and economic returns.

Keywords: weed management, hand weeding, herbicides

Influence of weed control methods on yield and economics of wheat (*Triticum aestivum* L.)

Abhishek¹ and Priyanka Kumari²

¹M.Sc. Agriculture, ²Assistant Professor (Agronomy), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: anaroid20@gmail.com

Abstract

A field experiment was conducted at the Research Farm of School of Agriculture, Abhilashi University, Mandi (H.P.) during Rabi 2021-2022 to study the influence of weed control methods on yield and economics of wheat (*Triticum aestivum* L.). The experiment was laid out in randomized block design with three replications, consisting of eight weed management treatments viz. T₁ - weedy check, T₂ - weed free (hand weeding at 40, 70 and 100 DAS), T₃ - one hand weeding at 40 DAS, T₄ - two hand weeding at 40 and 70 DAS, T₅ - clodinafop propargyl 60 g a.i. ha⁻¹ at 35 DAS, T₆ - clodinafop propargyl 60 g a.i. ha⁻¹ at 33 DAS *fb* 2,4-D sodium salt 1.0 kg a.i. ha⁻¹ at 36 DAS, T₇ - isoproturon 1.0 kg a.i. ha⁻¹ at 30 DAS and T₈ - isoproturon 1.0 kg a.i. ha⁻¹ + 2,4-D sodium salt 0.5 kg a.i. ha⁻¹ at 30 DAS. Results of the study revealed that two hand weeding, isoproturon 1.0 kg a.i. ha⁻¹ + 2,4-D sodium salt 0.5 kg a.i. ha⁻¹ and clodinafop propargyl 60 g a.i. ha⁻¹ *fb* 2,4-D sodium salt 1.0 kg a.i. ha⁻¹ remaining at par with each other were found superior treatments next to weed free in recording lower total weed dry weight, higher wheat grain yield, net returns and net returns per rupee invested over other treatments.

Keywords: weed management, wheat, herbicide, economics

***In-vitro* Evaluation of Fungicides against Brown Spot (*Bipolaris oryzae*) Disease of Rice**

¹Neeraj Bhardwaj and ²Anupam Kumar

¹M.Sc. Agriculture, ² Assistant Professor (Plant Pathology), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: thakurneeraj2706@gmail.com

Abstract

Rice (*Oryza sativa*), is the most important cereal crop grown in India which is served as a staple food for half of the world population. It is an important cereal crop of India, affected by the various fungal, bacterial and viral diseases, Brown spot of rice caused by *Bipolaris oryzae* (*Cochliobolus*) has become a major constraint to rice production. Brown spot disease of rice is characterized by distinct symptoms on the leaves. The primary symptoms include small, oval to spindle-shaped lesions with dark brown centers and lighter brown or yellowish halos surrounding them. These lesions typically appear on the upper leaves but can also affect lower leaves. Three fungicides namely; *Carbendazium*, *Propiconozal* and *Tricyclazole* were evaluated at 100,150 and 250 ppm and data were recorded after 24, 48 and 72 hours of incubation. After 24- and 48-hours no. of treatment showed any evidence of mycelium growth. The maximum *per cent* growth inhibition were recorded in T₆ and T₉ (100 %) followed by T₈ (75.00 %), T₇ (50.00 %), T₃ (33.37 %) respectively, however minimum growth inhibition was occurred in T₁ (8.37 %) at 24 hours. The maximum *per cent* growth inhibition were recorded in T₆ (100%) followed by T₉ (63.98 %), T₃ (62.00 %), T₈ (54.02 %) respectively, however minimum growth inhibition was occurred in T₁ (39.37 %) at 48 hours. The maximum *per cent* growth inhibition were recorded in T₆ (79.69 %). followed by T₉ (70.16 %), T₃ (65.63 %), respectively, however minimum growth inhibition was occurred in T₁ (46.88 %) at 72 hours.

Keywords: Rice, *H. oryzae*, disease, fungicides and growth inhibition

To study the isolation and purification of sheath blight (*Rhizoctonia solani*) disease of rice

Prabhat Kumar¹, Anupam Kumar², Sahil Chaudhary¹ and Preeti Thakur¹

¹M.Sc. Agriculture (Plant Pathology), ²Assistant Professor (Plant Pathology), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (HP) 175028

Corresponding author email: chauhanpk788@gmail.com

Abstract

Rice (*Oryza sativa*) is one of the major food crops of the world and is the staple food for more than half of the world's population. It is an important cereal crop of India, affected by various fungal, bacterial and viral diseases. Sheath blight of rice caused by *Rhizoctonia solani* has become a major constraint to rice production. The pathogen spreads both vertically and horizontally and the horizontal spread has estimated up to 20 cm/day under field conditions. Naturally infected sheath blight plants samples were collected from the field for isolation and purification of the fungus in the laboratory. With the help of a sterilized scalpel blade, small portions of both healthy and diseased tissues were sliced into 0.5-1 cm under aseptic condition. The fragments were then aseptically transferred to petri plates filled with Potato Dextrose Agar (PDA) medium with the help of sterilized forceps. Then they were incubated at a temperature of 26±2°C in BOD incubator. For purification, approximately 15-20 ml of Potato Dextrose Agar (PDA) medium were added to each petri dish after a pinch of streptomycin (1 %) was added to prevent unwelcome bacterial contamination. A small amount of mycelia growth was transplanted to solidified PDA on a petri dish from a recently isolated culture. The dishes were incubated in a BOD incubator at 26±2° C. The finally purified culture was used for further studies of cultural characteristic of *R. solani*. The purified cultures of *R. solani* were characterized morphologically, revealing typical features such as hyphal branching at right angles and characteristic sclerotia coloration. The hyphal

width ranged from 4.55 μm to 7.75 μm , and sclerotia exhibited colour changes from light brown to dark brown as the culture aged.

Keywords: *Rhizoctonia solani*, pathogen, purification and streptomycin

Research Trends on Animal Health in the Era of Artificial Intelligence

¹Dr. Ajay Patial, ¹Dr. Peer Rayees Aziz, ¹Dr. Kirti Jamwal, ¹Dr. Ananya Sharma

¹Assistant Professor, School of Veterinary Sciences, Abhilashi University, Chail Chowk, Mandi, Himachal Pradesh, 175028

Corresponding author email: ajaypatial09@gmail.com

Abstract

Artificial Intelligence encompasses a large range of theories and technologies used to solve problems of high complexity. It crosses many disciplines including mechanistic modeling, software engineering, data science and statistics. Introduced in the 1950's many Artificial Intelligence methods have been developed or extended recently with the improvement of computer performance. Recent developments have been fuelled by the interfaces created between Artificial Intelligence and other disciplines, such as bio-medicine, as well as massive data from different fields, particularly those associated with healthcare. Artificial Intelligence addresses three challenges that also make sense in animal health: (1) understanding a situation and its dynamics, e.g., epidemic spread; (2) the perception of the environment, which corresponds in animal health to the detection of patterns (e.g., repeated sequence of observations), forms (e.g., of a protein) and signals (e.g., increased mortality compared to a baseline) at different scales; (3) computer – based decision making, or, more realistically, human decision support (e.g., expert systems, diagnostic support, resource allocation). To answer these challenges, a wide range of concepts and methods are developed in Artificial Intelligence. This includes machine learning, a widely known Artificial Intelligence method nowadays. Part of the scientific challenges faces in animal health can be approached from a new perspective by using some of these Artificial Intelligence methods to analyse the ever increasing data collected on animals, pathogens and their environment. Animal health research benefits from advances in machine and deep learning methods, e.g., in predictive epidemiology, individual based precision medicine, and to study host pathogen interactions. These methods contribute to disease diagnosis and individual case detection, to more reliable predictions and reduced errors, to speed up decisions and improved accuracy in risk analysis and to better targeting interventions in animal health.

Livelihoods and Livestock: An Analysis of Mandi district's Animal Husbandry

Brij Vanita¹, Ankaj Thakur², Pankaj Sood¹ and Rajesh Rajput²

¹Krishi Vigyan Kendra, Mandi

²DGCN COVAS, CSKHPKV, Palampur

Abstract

Animal husbandry holds a pivotal role in sustaining rural communities, bolstering food security, and fostering economic stability. Within Mandi district, farmers predominantly adhere to traditional animal husbandry methods, focusing mainly on cattle rearing. This study aims to document the prevailing animal rearing techniques practiced by farmers in Mandi district, Himachal Pradesh, India. Through a semi-structured questionnaire, 200 respondents from various blocks within the district were interviewed regarding prevailing animal rearing practices in the district. Findings revealed that 51.1% of respondents housed their animals in *kaccha* sheds, while 18.4% utilized a loose housing system for cattle. Further, 72.3% of the respondents positioned animal sheds near their residences, with 45.1% providing concrete mangers. The majority (70.6%) of the respondents employed individual feeding systems, while only 22.3% were incorporating silage into their animals' diet. Notably, 54.6% of the respondents acknowledged a lack of feeding criteria. Maintenance of animal

health was primarily through routine vaccination (78.3%), deworming (69.8%), access to veterinary services (62.3%), and widespread use of artificial insemination (91%). Understanding these prevalent animal husbandry practices in Mandi district offers critical insights for policymakers, researchers, and development practitioners, for designing of targeted interventions to support sustainable livestock production, enhance farmers' livelihoods, and fortify food security within the region.

Morphological basis for identification of *Swertia chirata*: A traditional herb

Aruna Mehta*, Ravinder Raina, Neena Kumari and Kumari Bandna

College of Horticulture & Forestry, Thunag, Mandi (HP)-175084, India

**Corresponding authoremail: arunauh2521@gmail.com*

Abstract

Swertia chirayita (Gentianaceae), a popular medicinal herb indigenous to the temperate Himalayas is used in traditional medicine to treat numerous ailments such as liver disorders, malaria, and diabetes. The herb is credited with tonic, febrifugal, laxative, stomachic, anthelmintic, anti-inflammatory and anti-diarrhoeal properties. Ever-increasing demand for its raw material nationally and globally is cause of major concern as most of its raw material is wild collected only. Due to ruthless and indiscriminate collection, natural populations of this species have become rare unable to sustain its commercial demand. Therefore, *Swertia chirayita* is being frequently adulterated with other species of *Swertia* which are more readily available. Presently almost all the similar looking species of *Swertia* are marketed as ‘chirata’ without any rationale which is affecting the potency of the drug. Hence, it is necessary to establish the correct identity of *Swertia chirayita*. Studies focused on evaluating *Swertia chirayita* along with its four common adulterants (*S. alata*, *S. cordata*, *S. angustifolia* and *S. purpurascens*) based on comparing their morphohistological characteristics to replicate differences that can be used to check adulteration in this important plant based drug.

Keywords: *Swertia*, crude drug, authentication, adulterants, floral morphology

The Local Medicinal Plant Knowledge in Temperate Regions of Himachal Pradesh

Neena Kumari, Aruna Mehta and Kashish Walia

Dr. YS Parmar University of Horticulture and Forestry, College of Horticulture and Forestry, Thunag, Mandi, Himachal Pradesh (175048)

Corresponding author email: neenak.kashyap@gmail.com

Abstract

Indian Himalaya is a treasure trove of numerous medicinal plants. It possesses about 17,000 species of higher plants described in India, 7500 are known for their medicinal uses. Medicinal plants have been a vital source of both curative and preventive medical therapy preparations for human beings. However, with the passage of time, synthetic medicines gradually started replacing natural medicines irrespective of the fact that former have some side effects as well. On the other hand, natural products extracted from medicinal plants are less expensive than the synthetic drugs and majority peoples in rural areas have blind faith on them. The natural products provide an important foundation as potential lead compounds for the development of new and more effective drugs through structural modification. So, considering the importance of medicinal plants in today's world, the paper is an attempt to bring all the necessary information related to the medicinal plants especially in context to traditional knowledge treasures carried by people on one podium. This documented knowledge of phyto-medicines, as in the traditional system of medicine may be helpful to overcome the problems of low success rate and decrease the cost, and time of natural product development.

Keywords: Indian Himalaya, Medicinal plants, Natural products, Synthetic medicine, Traditional knowledge

Isolation and purification of proteins from *Tinospora cordifolia* against *Pseudomonas aeruginosa*

Parul¹, Dr. Sneha Sharma¹ and Dr. Vivek Sharma²

¹Department of Biotechnology, Dr. Y.S Parmar university of Horticulture and Forestry, Nauni

²College of Horticulture and Forestry Neri, Hamirpur 177001 (HP), India

Corresponding author email: negiparul580@gmail.com

Abstract

Tinospora cordifolia is a deciduous shrub. It is a well-recognized for its medicinal properties in Indian Ayurveda system. It is one of the most versatile shrub commonly known as “giloy”. The plant gained attention due to its various biological activities such as anti-diabetic, anti-microbial, anti- allergic, anti-oxidant and anti-cancer activities. The plant parts contains various chemical constituents such as alkaloids, steroids, glycosides and polysaccharides. The study was undertaken for isolation and purification of antibacterial protein of *Tinospora cordifolia* collected from Hamirpur district (Neri), Himachal Pradesh. Analysis was done by stem ethanolic, methanolic, extract of samples taken from Neri village. It was found that methanol act as better solvent for extraction of proteins. Ammonium sulphate precipitation of methanolic crude extract showed that 60-70% precipitation was found best for precipitation of proteins. Further, 60-70% precipitates was subject for dialysis followed by ion exchange chromatography. The fractions obtained after ion exchange chromatography was assayed by antibacterial activity against test organism. The active fractions were pooled together and carried out for SDS-PAGE. The total protein content present in methanolic crude extract was 2.056 mg/ml. The ammonium sulphate precipitation showed 10.833±0.928 mm zone of inhibition and after purification the antibacterial activity increased to 15±0.289 mm. The partial characterization of proteins revealed that the antibacterial proteins was stable at optimal pH 8, heat stable at 40 °C temperature and stable at low salt concentration. For future aspects, the stem extract and protein can be further exploited for its other properties such as its sequencing.

Keywords: *Tinospora cordifolia*, ammonium sulphate precipitation, protein, dialysis

Impact of Agricultural Practices on Environment

Richa Thakur

PG Scholar (1st Year) Department of Kaya Chikitsa, Abhilashi Ayurvedic Medica College & Research Institute Chailchowk Mandi

Abstract

It is well known that about one third of the world's land surface is under agriculture. Environment has a direct influence on existence and sustainability of agriculture as it depends upon the use of natural resources. Undoubtedly, agriculture has a greater environmental impact on Earth than any other single human activity, Conventional agricultural farming practices will not provide the food and fibre needed by burgeoning population in the future. In general, the question arises, can we develop and adopt the agriculture farming practices that can produce the food needed to feed an increasing population and simultaneously sustain our environment on in long term systems of term basis. Under most agricultural production at this time, it is not a question of if, but rather when, virtually all of the natural habitat on the planet will become degraded to the point that it is no longer productive and then abandoned for future generations to find ways to rehabilitate and repair Farmers are beginning to invent, adapt and adopt a wide range of new technologies and approaches but most of them are not environment friendly. Hence, this paper reviews the linkage between environment and agriculture and the resultant impact of agriculture on environment.

Influence of Agriculture on Child Nutrition through Child Feeding Practices in India

Sukriti Awasthi

PG Scholar, Department of Kaumarbhritya (Bal-Rog), Abhilashi Ayurvedic College & Research Institute

Abstract

Child feeding practices play a crucial role in ensuring proper nutrition and development. Agriculture is intricately linked to these practices, influencing food availability, accessibility, and diversity. Sustainable agricultural practices contribute to a varied and nutritious food supply, essential for a child's well-being. Diversified farming systems enhance the range of foods accessible to communities, fostering a balanced diet for children. Moreover, agricultural interventions, such as biofortification, can enhance the nutritional content of staple crops, addressing specific nutrient deficiencies. Farmers knowledge and practices influence the nutritional quality of food produced, impacting child feeding positively. Additionally, agricultural policies and programs play a vital role in ensuring food security and supporting vulnerable populations. Investments in small-scale agriculture can empower local communities, improving their ability to provide nourishing foods for children. By promoting sustainable farming techniques and ensuring equitable access to resources, agriculture becomes a cornerstone in shaping healthy child feeding practices and overall community well-being. The interconnectedness of agriculture and child nutrition underscores the importance of holistic approaches for addressing global health challenges.

Contribution of Non-Timber Forest Products (NTFPs) in tribal economy of Kinnaur district of Himachal Pradesh

Akanksha Klate^{1*}, Shilpa², Ajit Sharma³ and Sandeep Kumari⁴

Department of Social Sciences, College of Forestry, Dr. YSP UHF, Nauni, Solan (H.P) 173230

**Corresponding author email: akankshaklate.7@gmail.com*

Abstract

Non-Timber Forest Products (NTFPs) play an important role in the household economy of tribals. Tribals living in and around the forest collect forest products in regular basis for their livelihoods. The study conducted in Kinnaur district of Himachal Pradesh during the year 2020-2021 analysed that *Chilgoza*, *Kalajeera*, *dhoop*, *karoo* and *kuth* were the five NTFP species that were mostly collected by tribal households. The dependency of tribal people was more on the *Chilgoza* specie. The cost of collection and net return obtained from *Chilgoza* was Rs.36829.14 and Rs. 585974.09 per quintal respectively that was highest as compared to other selected NTFPs. The Lorenz curve and Gini Concentration Ratio (GCR) was used to evaluate the concentration of selected NTFPs quantity collected among the tribal people. Logit model were used to identify key factors that influence the collection of NTFPs. The socio economic factors namely; income, gender, age and experience were found affecting the NTFP collection. Out of these four variables three variables viz., NTFPs income, gender and age behaviours of the selected households were found to be significantly affecting the NTFP collection. Garret Ranking and Chi square method was used to find out the problem existing in collection and marketing of NTFPs. The chi-square value was found significant at $p < 0.05$ indicating that not all of the problems have affected tribal people equally except where natural regeneration is preferred over the artificial regeneration.

Keywords: Non-Timber Forest Products (NTFPs), Gini Concentration Ratio (GCR), Lorenz Curve, Garret Ranking, Logit Model

Artificial Intelligence (AI) in Fish Nutrition: The Future of Aquaculture

Patekar Prakash ^{1*}, Jebarson Solomon ¹, Swapnil Narsale ¹, and K.N. Mohanta ^{*2}

¹ Ph.D. Scholar, ICAR-Central Institute of Fisheries Education (CIFE), Mumbai, 400061

² Principal Scientist & Head, Division of Fish Nutrition, Biochemistry and Physiology, ICAR-CIFE, Mumbai, 400061

*Corresponding author email: patekarprakash476@gmail.com

Abstract

The ever-increasing global demand for nutritionally balanced food necessitates innovative cultural techniques and sustainable production systems to enhance the fish production/unit area. Artificial Intelligence (AI) has emerged as one of the most advanced and promising tools for rapidly transforming many agriculture production systems, including aquaculture and its application in fish nutrition holds immense potential for transforming traditional aquaculture practices into eco-friendly and precision aquaculture. AI integration in fish nutrition is a multidisciplinary approach that involves data analysis, machine learning and precision feeding. By applying AI algorithms, we can gather real-time data on water quality, fish behaviour and growth patterns, facilitating dynamic adjustments in feeding schedules and formulation. This precise feeding reduces feed waste and minimizes the environmental impact of excess nutrients in aquatic ecosystems. AI algorithms continuously adapt to changing conditions, resulting in healthy and faster-growing fish, ultimately increasing aquaculture production. AI-powered sensors and cameras are installed to monitor fish health, reducing the risk of disease outbreaks and enabling timely intervention. AI can be used to optimize the formulation of fish feeds to ensure that they are nutritionally balanced and cost-effective. This can be done by considering factors such as the availability of different feed resources and their nutrient composition, the nutrient requirement of fish, feed and feeding management, and the environmental impact of the feed. Furthermore, AI can predict fish growth by considering the fish diet, feeding behaviour and consumption pattern of fish, water quality, and environmental conditions. This information can be judiciously used to optimize fish production and improve profitability. The use of AI in fish nutrition is still in its nascent stage, but it has enough potential to transform the industry. By improving the quality and efficiency of fish feeds, AI can help to make aquaculture more eco-friendly, sustainable and profitable. The potential applications of AI in fish nutrition are vast, and AI technology will likely play an increasingly important role in this field as it progressively develops and is used in modern aquaculture practices.

Keywords: Aquaculture, Artificial Intelligence (AI), Fish Nutrition, Sustainable Development

Integrated Farming System (IFS)

Abhishek Sanspal¹, Jay Nath Patel², Punit¹

¹M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

²Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, H.P.

Corresponding author email: abhisanspal6829@gmail.com

Abstract

ISAP (Indian Society of Agribusiness Professionals) implemented Integrated Farming Systems (IFS), a method that uses livelihood diversification and resource management to maintain revenue streams. A mixed farming system or IFS, consists of two or more distinct, logically independent segments related to animals and crops. The IFS strategy aims to achieve several goals, including poverty reduction, food security, farmer security and sustainability. The Integrated Farming Systems (IFS) model consists of modernising farming to increase productivity through efficient recycling of agricultural waste for useful purposes, making the best use of local resources, establishing community-led local systems for organic farming, conserving water and creating a sensible combination of revenue-generating ventures like fisheries, dairy, poultry, goat rearing and vermicomposting among others. IFS components are also recognised for their ability to control weeds and are a

crucial part of integrated pest management. In the Ortenau district of Baden-Württemberg, Germany, near Lautenbach, the Federal Republic of Germany (F.R.G.) gave rise to the integrated farming system in 1978. A third or intermediate approach between organic and conventional farming is what is known as integrated farming systems or IFS. Rather than using a prescriptive approach, the key to IFS is a set of guidelines and protocols that need to be adhered to. The three main pillars of an integrated farming system are crops, livestock and fisheries. Though actual adoption rates of integrated farming are low and unequally distributed among farmers, the IFS is practicable in terms of socio-economic imperatives. Thus, farmers should be appropriately informed about the usage and management of IFS in order to grow a nation.

Keywords: IFS, conventional farming, ISAP, integrated farming

Legal and Judicial Perspective of Contractual Employment in India with Special Reference to Teachers: An In-depth Analysis

¹Sujata Lather and ²Lt. Col. Dr. Anil Balhera

¹Ph.D. Research Scholar, BPSMV Khanpur Kalan, Sonapat, Haryana, 131305

²Assistant Professor, BPSMV Khanpur Kalan, Sonapat, Haryana, 131305

Corresponding author email: sujatalather09@gmail.com

Abstract

This research paper critically examines the legal and judicial aspects surrounding contractual employment in India, focusing specifically on the teaching profession. The paper delves into the statutory framework governing contractual employment and analyzes relevant judicial precedents that have shaped the landscape of teacher contracts. The traditional paradigm of permanent employment for teachers is gradually being replaced by contractual employment, driven by economic factors, evolving educational dynamics, and administrative needs. Beyond individual experiences, the impact of contractual employment on the quality of education, professional growth, and job security of teachers is explored. By exploring key legislations and landmark cases, the research aims to provide insights into the unique challenges and opportunities faced by teachers engaged in contractual employment in India. In legal disputes, contract teachers must turn to remedies provided by the Constitution and various UGC guidelines pertaining to their employment. States have significantly restricted the filling of vacant positions in universities and colleges, leading to a surge in court cases involving contract teachers.

Key words: Judicial, Contractual Employment, Precedent, Professional Growth

Time Span in Adjudication of Anti-Defection Petition By Speaker: A Need To Revisit

¹Vanika and ²Lt. Col. Dr. Anil Balhera

¹Ph.D. Research Scholar, BPSMV Khanpur Kalan, Sonapat, Haryana, 131305

²Assistant Professor, BPSMV Khanpur Kalan, Sonapat, Haryana, 131305

Corresponding author email: vanikachahal@gmail.com

Abstract

The assessment of anti-defection petitions by the Speaker of the House has sparked considerable controversy and scrutiny. Criticism has been levelled at the Speaker's discretionary and undemocratic authority, often perceived as favouring the ruling party's interests. However, to uphold legislative stability, it is argued that the Speaker, being in a neutral position, is best suited to handle defection cases impartially. This study delves into the existing framework for adjudicating anti-defection petitions and suggests several reforms to enhance transparency, fairness, and efficiency in the process. It scrutinizes recommendations put forth by various committees regarding the Speaker's adjudicative powers and provides an overview of Schedule X of the Indian

Constitution, along with discussions on the Speaker's role and instances of defection. Furthermore, the research identifies numerous factors contributing to delays in adjudicating anti-defection petitions. It concludes by proposing multiple strategies to streamline the adjudication process and offers a roadmap for implementation. The study contends that the current system for handling anti-defection petitions is flawed and necessitates reform. The suggested reforms aim to render the process more equitable, transparent, and prompt, thereby ensuring that the Speaker exercises their authority responsibly and impartially.

Keywords: Adjudication, Anti-defection, Time-span, Constitution

Development of Protein and Energy Rich Ready-To-Eat Snack: A Sustainable and Scientific Approach to Healthier Snacking

Shrishti Singh and Dr. Neetu Dobhal

Department of Food Science and Nutrition, College of Home Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand (263145), India

Corresponding author email: shrishtisingh324@gmail.com

Abstract

Moringa oleifera leaves possess nutritional diversification and has the potential to combat PEM, yet it is underutilized and its incorporation in meals is limited. Therefore, keeping this into consideration, blanched and unblanched moringa leaf powders (UMLP and BMLP) were developed and analysed for physico-chemical and nutritional parameters. Ready-to-eat snack i.e. 'sev' was developed with incorporation of UMLP and BMLP (15, 20 and 25%) in barnyard millet flour in different proportions (75, 70 and 65%). Results of sensory evaluation showed that ready-to-eat snack i.e., 'sev' prepared with 20% incorporation of blanched moringa leaf powder in 70 % of barnyard millet flour most acceptable among all the 6 formulations. Nutritional analysis of 'sev' showed that the most acceptable 'sev' was found to be better in most of the nutritional parameters. Shelf-life study showed that moringa leaf flour and most acceptable 'sev' were safe for consumption till 15 and 45 days of storage. On the basis of findings of present study, it can be concluded that that incorporating steam blanched moringa leaf powder (up to 20 percent) into a ready-to-eat snack like 'sev' could be a valuable addition to the diets of undernourished children. This approach might help address the issue of Protein-Energy Malnutrition (PEM) due to the snack's considerable protein content and its *in-vitro* protein digestibility.

Keywords: *Moringa oleifera*, PEM, UMLP and BMLP, Sensory evaluation, *in-vitro* protein digestibility

Survival Dynamics of *Xanthomonas axonopodis* pv. *phaseoli* in Infected Seed and Plant Debris in Himachal Pradesh

¹Sakshi Suchita and ²Sandeep Kansal

¹*Ph.D. Scholar, Department of Plant Pathology, Punjab Agricultural University, Ludhiana, Punjab. 141004*

²*Principal Scientist, Department of Plant Pathology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan. 173230*

Corresponding author email: sakshi-2115008@pau.edu

Abstract

Common bean (*Phaseolus vulgaris* L.) is one of the most important vegetable crop belonging to the family Fabaceae/Leguminosae. Successful and economic cultivation of beans is affected by the attack of various diseases caused by fungal, bacterial and viral pathogens. Among the various bean diseases, common bacterial blight (CBB) caused by *Xanthomonas axonopodis* pv. *phaseoli* is one of the most devastating disease causing

high yield losses all over the world. Since few management strategies have been developed because little is known about pathogen survival, the study was conducted in Dr. Y.S Parmar University of Horticulture and Forestry Nauni, Solan during the year 2020-2021. The pathogen can survive on plant debris, soil, and seed; however, infected bean seed and debris are the most effective means of survival. The survivability was studied in infected plant debris as well as infected seed at an interval of every 2 months. The duration of the study was 12 months and it was observed that the recovery of the pathogen was 13.00 cfu/ml (10^8) after 2 months and it decreased significantly to 0.55 cfu/ml (10^8) after 12 months. Whereas, in case of infected plant debris the recovery was observed under three different depths of burial (0cm, 10cm, 15cm). It was observed that the viability of the pathogen decreased significantly with the increasing depth of burial of the infected debris and there was no recovery beyond 6 months of storage at increasing (10cm and 15cm) depth of burial.

***In-vitro* evaluation of natural products against *Colletotrichum gloeosporioides* causing anthracnose in Citrus**

Deepika¹, Kumud Jarial¹ and R.S. Jarial²

Department of Plant Pathology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni

College of Horticulture and Forestry Neri, Hamirpur-177001 (HP), INDIA

Corresponding author email: ds1559691@gmail.com

ABSTRACT

Citrus anthracnose caused by *Colletotrichum* species causes serious threat to crop production that results in nearly 30-50 per cent post-harvest losses, hampers both quality and quantity of the produce. In present investigation, four different natural products viz., cow urine, buffalo urine, goat urine and 10, 20 and 30 days old sour butter milk at four different concentrations viz., 2.5, 5.0, 7.5 and 10 per cent were evaluated *in-vitro* by poisoned food technique against *Colletotrichum gloeosporioides* causing anthracnose in Citrus. Buffalo urine was found most effective where maximum mycelial growth inhibition (69.24%) and minimum diametric growth (57.48 mm) was recorded. Whereas, minimum growth inhibition was recorded in 10 days old sour buttermilk (41.10%).

Keywords: *Colletotrichum*, Natural products, Citrus and Anthracnose

Theme 11: Technological Advancements and Knowledge Transfer:

Enhancing Agricultural Productivity Through Technology Transfer in Rural Farming Communities

Meenu and Dr. Manju Dahiya

Research Scholar and Associate Director

Dept. of Extension Education and Communication Management, CCS HAU, Hisar, Haryana, 125004

Corresponding author email: meenuladoiya19@gmail.com

Abstract

The enhancement of agricultural productivity, sustainability, and socio-economic development is contingent upon the transfer of technology to rural farmers. Lack of technical know-how, insufficient infrastructure, and financial limitations are some of the reasons why rural farmers frequently struggle with restricted access to contemporary agricultural technologies. A comprehensive strategy that takes into account the unique demands of rural communities is needed to close this technology divide. A key role in distributing knowledge, offering training, and establishing the capacity required for effective technology adoption is played by extension services and farmer education initiatives. By giving farmers access to up-to-date information, information and communication technologies (ICTs) are essential in promoting the transfer of technology. With the aid of ICTs,

farmers may integrate precision agriculture technologies to maximise resource utilisation, make well-informed decisions, and adjust to shifting environmental conditions. To build a climate that is supportive of technology transfer, however, stakeholders from the private sector, NGOs, and government agencies must work together. Building capacity is cited as a crucial element of successful technology transfer, highlighting the significance of equipping farmers with the know-how and abilities required to adopt new technologies. Programmes that exchange knowledge between farmers are emphasised as a vital means of facilitating the sharing of real-world experiences and practical insights within the community. Adoption of technology solutions is more likely when they are customised to fit in with regional customs and habits. Engaging farmers in the co-development and adaptation of technologies is encouraged in order to guarantee the applicability and durability of technological interventions. By tackling issues related to infrastructure, education, and socio-cultural aspects, we can close the gap in agricultural knowledge and enable rural communities to adopt technology for more productive, sustainable farming methods, enhanced general well-being, and strengthened productivity.

Keywords: Technology, ICT, Participatory approach, Sustainability

Dynamics of India's Seafood Exports Business and Their Contribution to the Blue Economy: A Quantitative Analysis

N. Karthik^{*1}, P. Seenivasan² and Anzil Rikesh³

¹*M.F.Sc., Division of Fisheries Resource Management, SKUAST-Kashmir, 190025*

²*Ph.D. Research Scholar, Department of Fisheries Economics, ICAR-CIFE, Mumbai, Maharashtra – 400 061*

³*B.F.Sc student, COF, DIFST, Kanniyakumari, Tamilnadu – 629 193*

**Corresponding author email: karthiknarayanan329@gmail.com*

Abstract

This study analyzes India's seafood export industry, leveraging its extensive coastline, vast Exclusive Economic Zone, and rich marine resources. Despite its modest scale, Indian seafood products are globally embraced, contributing significantly to foreign exchange. Aquaculture, driven by increasing global demand, is a key sector. India exports to 123 countries, with the USA and China as major importers. A comprehensive analysis spanning 1995 to 2022 reveals India's remarkable seafood exports, reaching 21,892,302 metric tonnes (MT) valued at USD 95,356 million. Additionally, a compound annual growth rate analysis shows that from 1995 to 2022, Indian seafood exports grew at a 6% annual rate. Furthermore, the USD value of Indian seafood exports rose by 9%. The pinnacle of this export activity was observed in 2022-23, with 1,735,286 MT valued at USD 8,094.31 million. The export hub predominantly thrives at Pipavav port, witnessing a trade volume of 4,168,104 MT, encompassing 1,735,286 MT valued at USD 9,004 million. Notably, Kochi port exhibits seafood exports totaling 3,434,485 MT, valued at USD 13,558 million. Frozen shrimp spearheaded the exports during the 1995-23 fiscal years, comprising 7,731,248 MT valued at USD 61,946 million, followed by frozen fish with 6,617,082 MT valued at USD 11,163 million. Southeast Asian countries received a notable share of these exports, amounting to approximately 5,568,551 MT valued at INR 104,611 crore (USD 16,820 million), with China receiving 4,159,418 MT worth approximately INR 67,513 crore (USD 10,776 million). An in-depth analysis of the collected data underlines the escalating seafood export value, driven by increasing demand and favorable price realization in both domestic and international markets. These factors collectively motivate exporters to actively engage and expand their presence in the thriving seafood export sector.

Keywords: Seafood exports, Blue economy, Foreign exchange earnings, Aquaculture, Market dynamics.

Organic farming: Its impact on soil health and food grain

Kamini Thakur¹, Dr. Mohd. Shah Alam² and Divya Chaudhary¹

¹*M.Sc. Research Scholar, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)*

²*Assistant Professor, Agronomy, School of Agriculture, Abhilashi University Mandi, (H.P.)*

Corresponding author email: kaminithakur522@gmail.com

Abstract

Organic farming can be defined as an agricultural process that uses biological fertilisers and pest control acquired from animal or plant waste. Organic farming was developed as a response to the environmental harm caused by the use of chemical pesticides and synthetic fertilizers in conventional agriculture, and it has numerous ecological benefits. Organic farming practices such as crop rotations, inter-cropping, symbiotic associations, cover crops, organic fertilizers and minimum tillage are central to organic practices. These practices encourage soil fauna and flora, improving soil formation and structure and creating more stable systems. Soils rich in organic matter hold more air and water and produce higher yields than soils low in organic matter. They also supply a steady release of nutrients to plants, inhibit erosion, and host a robust population of beneficial microorganisms. Organic farming systems utilize carbon-based amendments, diverse crop rotations, and cover crops to build soil fertility. These practices increase biologically available soil organic matter and beneficial soil microbe and invertebrate activities, improve soil physical properties, reduce disease potential, and increase plant health. Vidanapathirana et al. (2023) reported the use of pesticides and fertilizers in modern agriculture causes a negative impact on the environment. This occurs mainly with an increase in toxic residue through the food chain and animal feed, triggering numerous health problems. With such adverse implications, the farming community is becoming increasingly aware of alternative agriculture systems such as organic farming. The key issues emerging in organic farming include yield reduction in conversion to organic farming, lack of raw materials for organic fertilizer production, lack of awareness of technical skills among farmers, soil fertility enhancement, certification constraints, and marketing and policy support. Asha et al. (2023) reported that the concentration of soil organic matter often serves as a foundational attribute that controls many soil properties. In organically managed systems where no synthetic fertilizers are allowed, soil microbial biomass is important to supply plant nutrients by mineralization processes and to avoid nutrient leaching. The soil organic matter is affected by land use practices, soil depth and climatic conditions under organic farming. Chhonkar et al. (2002) study that the increase crop production and boosting the soil quality and long-term manipulation of soil properties can be achieved by organic farming. Many studies have reported that organically produced agricultural products are better than as compared to products produced by conventional methods.

Nutraceuticals and health benefits of cereal grains and pulses

Priyanka Uppal¹, Alok Kumar^{2*}, Ritika Singh², Priyanka¹

¹M.Sc. Scholar, Department of Genetics and Plant breeding, School of Agriculture, Abhilashi University, Mandi (H.P), India-175028

²Assistant Professor, Department of Genetics and Plant Breeding, School of Agriculture, Abhilashi University, Mandi (H.P), India-175028

Corresponding author email: priyankauppal0300@gmail.com

Abstract

It is commonly known that our dietary habits have a significant impact on our health and happiness. Cereal grains and pulses are the most important staple foods and good source of protein, fibre, complex carbohydrates, resistant starch, folate, potassium, selenium, and zinc, as well as a variety of other vitamins and minerals. A numerous studies have shown that regular consumption of whole grains and pulses has protective effects against a number of chronic diseases, such as obesity, type 2 diabetes (T2D), cardiovascular disease (CVD), cancer and improving digestion and lowering blood pressure or cholesterol. These compounds go beyond meeting a person's fundamental nutritional needs by additionally acting as antioxidants, antidiabetics, antihypertension, antihyperlipidemic/anti-cholesterol, antibacterial, and anticancer agents, all without causing any negative side effects. Recommended Dietary Allowances (RDA) for pulse are 60g and 55g daily for adult males and females, respectively. Pulses are accessible to the average person at a rate of 42g per day. According to the Indian Council of Medical Research (ICMR), 40g of pulses is recommended daily intake for balanced diet for an average sedentary man. High protein and high fibres rich pulses consumption reducing the risk of many

diseases. Consuming pulses also lowers blood pressure, platelet activity, inflammation, and improves serum lipid profiles, among other cardiovascular disease risk factors. For example, peanut (*Arachis hypogaea*) and soybean (*Glycine max*) pulses are low in fat and high in protein and fibre. Chickpeas (*Cicer arietinum*) have a low GI and helps to control blood sugar, manage weight, and support heart and gut health.

Keywords: Recommended dietary allowances, obesity, type 2 diabetes, cardiovascular disease

Strategies for Agricultural Extension to Enhance the Farmers' Knowledge

Mahiwal Singh Sisodiya & Aditya Vikram Nirala

Department of Agricultural Extension Education, Kerala Agricultural University, Vellanikkara, Thrissure (Kerala) – 680656

Abstract

One of the biggest institutions for the distribution of knowledge and information is the public agricultural extension system. A system-based, multidisciplinary, holistic strategy is required in light of the stagnation of agricultural production over the past 15 years. This approach should not only produce environmentally sound technology for various applications but also make it easier for them to be used at the grassroots level. The extension method functions similarly to a system's ideology, informing, energizing, and directing elements such as the program, resources, leadership, structure, and connections. Numerous extension strategies have been implemented with success in the past, yielding positive outcomes and increasing farmers' awareness of newly developed agricultural technologies. Some of these are already in place and working in tandem with recently created extension strategies; they won't need much change in the future to boost the nation's agricultural potential. For this reason, everyone participating in agricultural extension and advisory services is concerned about using cutting edge extension techniques to expand coverage. Currently, farmer cooperatives and government partnerships with non-governmental organizations (NGOs) are operating well using participatory methods. In the future, efficient means of disseminating agricultural information to the grassroots level may include social media, agricultural education, local panchayats, and offline ICT introduction. Large-scale adoption of the cost recovery and sharing cropping approaches is recommended.

Keywords: Extension, Farmers, Awareness

Factor affecting the possession of soil health card by the beneficiary and non- beneficiary farmers in district mandi of Himachal Pradesh

Lalit kumar¹ and Sonia Rani²

¹Msc. Agriculture, ²Assistant Professor (Agricultural Extension Education and Communication), School of Agriculture

Abhilashi University, Chail Chowk, Mandi (HP) 175028

Corresponding author email: labuyadavkatariya@gmail.com

Abstract

“Earth needs to be nurtured with mother’s care because earth gives us everything for sustaining life.” So, any kind of torture on it is a sin. To protect soil health and for sustainable agriculture, the Government of India launched Soil Health Cards (SHC) Scheme in February 2015. To find out the impact of Soil Health Card, the present study entitled “Impact Study on Soil Health Card in District Mandi of Himachal Pradesh”. The multistage sampling design was employed. In first stage 2 blocks were selected randomly. In 2nd stage 2 panchayat were selected purposely from each blocks having maximum number of Soil Health Card holders. In this way 80 farmers out of these beneficiaries and non-beneficiaries were selected randomly. Results showed that majority Further 80 per cent of the beneficiary respondents had perception for the factor Waiting period of sample is too

long 100 per cent in non-beneficiary farmers perceived the complex procedure, 70 per cent beneficiary respondents had lack of guidance about soil health card and 100 per cent delay in issuing soil health cards factor affecting non-beneficiary farmers. It was also found that majority of the beneficiary farmers 85 per cent had the factor affecting the possession of soil health card was ‘physical (To improve soil health)’. Correlation coefficient results revealed that farmers having higher education, land holding, mass media exposure and extension contact possessed higher level of awareness of Soil Health Card Scheme. Similarly, the findings of the regression analysis reported that age, education, training attended and extension contact were the major factors affecting the awareness level of the farmers accounted for about 73 per cent variation in the awareness level of the respondents.

Key words: SHC, Awareness, Beneficiaries, Non-beneficiaries, Farmers

Impact of Kisan Credit Card Scheme in District Mandi of Himachal Pradesh

Meenakshi Devi¹ and Sonia Rani²

¹M.Sc. Agriculture, ²Assistant Professor (Extension Education), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: chauhanmeenakshi542@gmail.com

Abstract

The government of India has been launching several schemes for the rural and urban area of the country. But the evaluation or assessment of these schemes is crucial to know the impact among the beneficiaries. To find out the impact of Kisan Credit Card, the present study entitled “Impact of Kisan Credit Card Scheme in District Mandi of Himachal Pradesh” was undertaken. Based on the feasibility, non equivalent static group comparison design was applied for the study. The multistage sampling design was employed. In first stage 2 blocks were selected randomly. Result shows that impact of the KCC on the bases of recommended scientific practices was high in case of beneficiaries respondents as compare to non-beneficiaries. Impact of KCC for availing the credit from institutional sources in case of timely credit, low interest rate, benefits of crop insurance, access to financial transaction, benefits of early repayment of loan, resolving nature of credit availability, flexibility of cash credit availability, was 100 per cent in case of beneficiaries respondents.

Key words: Kisan Credit Card, beneficiaries, non-beneficiaries

Protected cultivation of vegetable crop

Himanshu Sharma*, Sandeep Kumar, Manish Chauhan, Shubham Verma

Department of Horticulture, School of Agriculture, Abhilashi University, Mandi, Himachal Pradesh - 175028

Corresponding author email: himanshusharma98051@gmail.com

Abstract

A new technology called protected cultivation is being used to grow perishable commodities like vegetables, flowers, and other high-value crops. Protected structures offered great potential for increased productivity and production in modern agriculture. Produce is also considerably more plentiful and of higher quality than produce from open fields. Protected cultivation structures are used to protect crops from adverse weather conditions and for off-season cultivation. The selection of protected cultivation structures mainly emphasizes minimizing the crop water requirement, i.e., reducing evapotranspiration and creating maximum hindrance against rainfall and insect infestation. Vegetables provide all the nutrients ingredients viz., vitamins, minerals, protein and properties that are essential for balanced diet. High value vegetable crops like, tomato, cherry tomato, bell pepper, parthenocarpic cucumber and brinjal are suitable for protected cultivation. Controlled

environment agriculture requires far more capital investment per unit area than field agriculture. The main components of greenhouse like structure, covering/glazing and temperature control systems need proper design for healthy growth of plants. Off-season cultivation of cucurbits, leafy vegetables, beans etc. under low plastic tunnels is one of the most profitable technologies under northern plains of India. Walk-in tunnels are also suitable and effective to raise off-season nursery due to their low initial cost. Insect proof net houses can be used for virus free cultivation of tomato, chilli, sweet pepper and other vegetables mainly during the rainy season. Therefore, protected structures-based farming (protected cultivation) technology is superior to open field cultivation/conditions in terms of improving agricultural yield, soil fertility, profitability, and sustainability, among other factors.

Keywords: Protected cultivation, Off season, Soil fertility, Vegetables

Examining the Knowledge Level of Rural Women on Post-Harvest Technologies and Value-Added Products

Bharti*, Dr. Rajesh Dahiya **

* *Ph.D. Student, Department of Extension Education and Communication Management, I.C. College of Community Science. CCS Haryana Agricultural University*

** *Assistant Professor, Department of Extension Education and Communication Management, I.C. College of Community Science. CCS Haryana Agricultural University*

Corresponding author email: bhartibugalia1396@gmail.com

Abstract

Post-harvest intervention is necessary to protect the food from spoilage. Post-harvest intervention including different techniques at every stage of food processing like harvesting, cleaning, drying, storage, packaging, transportation, cooling all these stages need different techniques to reduce losses. A strong and dynamic food processing sector plays an important role in the overall economic growth of a country. To make feasibility in horticultural enterprise, value addition is essential. Training is the most important input for bringing desirable changes in human behavior in terms of knowledge & skill. Knowledge of these technologies at household level as well as enterprise can enhance food security as well as livelihood security. The study was conducted under RKVY project implemented at Fatehabad & Hisar districts of Haryana. A sample of 120 rural women from 4 villages 2 each from these districts were selected randomly. Intervention was provided to each (30 each). Knowledge level of respondents was measured on four parameters. In experimental group, all the respondents found in high & medium categories of knowledge irrespective of training aspects. In high level it ranged between 60.00 percent in nutritional importance of vegetables to 86.67 percent in mixed vegetable pickle respectively. knowledge level of control group was found in low category irrespective of all aspects of training. However, it ranged between 70.00 percent in moongdal ladoo to 93.33 percent in precautions before, during & after storage. This conclude training impacted positively over women.

Keywords: Adoption, Intervention, Food security, Post-harvest technologies

Effect of Ultrasonication on coating properties and shelf life of fresh cut onion

*** Neha Rawat¹, Satish Kumar Sharma² and Charu Bisht³**

1Department of Food Science and Technology, G.B Pant University of Agriculture and Technology, Uttarakhand, India

**Corresponding author email: rawatneha1225@gmail.com*

Abstract

Plant tissues face considerable stress from mechanical damage, especially during cutting and handling, leading to changes in color, texture, and flavor due to enzyme and substrate disruption. These challenges complicate the

production of fresh-cut onions. Edible coatings offer a promising solution by forming a protective barrier against moisture loss, oxidation, and microbial growth, while preserving product quality. In this research, chitosan was investigated as an edible coating for fresh-cut onions at varying concentrations (ranging from 0.5% to 1.5%). Other variables taken into consideration were dipping time (5 min to 15 min), ultrasonication power (50 Watt to 250 Watt) and ultrasonication time (15 min to 45 min). Various coating properties such as thickness and viscosity were examined, alongside its effect on shelf life assessed through texture analysis, weight loss, and microbial activity. Findings suggest that this approach can extend the shelf life of fresh-cut onions to around 15 days when refrigerated, and up to 2 days at room temperature.

Keywords: Fresh cut onion, post- harvest life, shelf life, fresh cut

Hydroponics farming in Vegetable Production

Priyanka Devi*, Manish Chauhan, Sandeep Kumar, Neha

Department of Horticulture, School of Agriculture, Abhilashi University Mandi – 175028 (Himachal Pradesh)

Corresponding author email: pd283264@gmail.com

Abstract

“Hydroponics” is the science of growing plants without soil. India currently needs food security, which means that everyone must have physical and financial access to wholesome food in order to meet their dietary needs. Lack of water for agriculture results in lower food production, which in turn causes widespread poverty and malnutrition throughout our nation. In order to conserve water and increase food availability and production, agriculture must thus embrace this technology, as hydroponic gardening produces high-quality food and manages resources efficiently, it is currently becoming more and more popular worldwide. These days, soil-based agriculture faces a number of difficulties, including indiscriminate use of chemicals and pesticides that are reducing the fertility of the land, urbanization, natural disasters, and climate change. In hydroponic various structures viz. wick, ebb and flow, drip, deep water culture and Nutrient Film Technique (NFT) system are used to grow different crops like tomato, cucumber, pepper and leafy greens etc. Several benefits of this technique include water conservation, less growing time of crops than conventional crop growing in soil, round the year production, minimum disease and pest infestation and conventional crop growing in soil, round the year production, minimum disease and pest infestation elimination of several intercultural operations like weeding, spraying, watering etc. Since hydroponics can grow short-duration crops like vegetables year-round in small places with little labour, it can be highly helpful for the poor and landless as well as in areas with limited soil and water resources.

Keywords: Hydroponics, Nutrient Film Technique (NFT), Vegetables, Water conservation.

Vertical farming: The future of agriculture

Neha*, Sandeep Kumar, Manish Chauhan, Abhishek

Department of Horticulture, School of Agriculture, Abhilashi University Mandi – 175028.

Corresponding author email: chaudharyneha309@gmail.com

Abstract

“Vertical Farming” is an agricultural method through which crops are grown in vertical stacked layers. The necessity for vertical farming is highlighted by the growing issues of food security, urbanization, a lack of farmland, and increased greenhouse gas emissions from food miles. An increasing global population will be able to feed themselves in the future with the help of vertical farming, an eco-friendly, energy-saving and a promising alternative to conventional farming. Currently, vertical farming is becoming increasingly popular around the world due to its ability to efficiently manage resources and produce high-quality food. In areas where soil and water resources are limited, vertical farming could indeed play a significant role in the production of crops and vegetables. Vertical farming can produce food in a climate-resilient manner, potentially emitting zero

pesticides and fertilizers, and with lower land and water use than conventional agriculture. Vertical farming system currently produce a limited range of crops including fruits, vegetables and herbs, but successful implementation of vertical farming as part of mainstream agriculture will require improvements in profitability, energy efficiency, public policy and consumer acceptance. Tomatoes, cucumbers, mushrooms strawberries, beans, pea, bell peppers, etc. The vertical farm idea seems to have a bright future with recent technologies like hydroponics, aeroponics, and aquaponics. Modern agricultural practices have changed as a result of high-tech systems, which maximize productivity while requiring less upkeep, making them perfect for urban farming. The development of low-cost, simple-to-operate methods involving less labours and lower overall setup and operational costs are critical for the successful implementation of vertical farming technologies. During pandemics like COVID-19, vertical farming has emerged as a viable option for producing a wide variety of food crops to meet the nutritional needs of the growing global population.

Keywords: Energy efficient, Hydroponics, Urbanization, Vertical farming.

Assessing the Feasibility and Benefits of Self-Propelled Paddy Harvesters in Hilly regions of India

Sheikh Aadil Mushtaq*, Sanjay Khar, Sushil Sharma and J.P. Singh

Division of Farm Machinery and Power Engineering, Faculty of Agricultural Engineering, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Corresponding author email: sheikhaadil110@gmail.com*

Abstract

Crop harvesting is one of the most important agricultural operations but the major issue is the availability of labour and high cost during the harvest season. The efficient harvesting of the crop is essential for achieving superior quality and increased production to meet the increasing demands of the world. The Self-propelled paddy harvesters have been proved as one of alternate to significantly enhance the efficiency of rice harvesting processes. It has been reported that the adoption of self-propelled paddy harvesters has led to increased efficiency in harvesting operations, reducing labour requirements and harvesting time compared to traditional methods. Moreover, self-propelled paddy harvesters contribute to sustainability efforts in agriculture by reducing fuel consumption, minimizing soil compaction and lowering greenhouse gas emissions compared to conventional harvesting methods. The present study was carried to assess the feasibility of the self-propelled paddy harvester in the hilly regions and highlights the challenges and opportunities associated with the adoption of self-propelled paddy harvesters, including initial investment costs, maintenance requirements, and the need for skilled operators. The study reported that the self-propelled paddy harvester results in reduction in labour cost and increase the efficiency of harvesting however this must be carried out using self-propelled harvester as large tractor-based harvester have large turning head which becomes one of the biggest hindrances in the hilly regions of India. In conclusion self-propelled paddy harvesters represent a significant advancement in agricultural technology, offering farmers increased productivity, reduced environmental impact, and improved economic returns specifically in hilly region of India

Keywords: Paddy, Labour, Self-propelled harvester

Agrotourism - The Rural Retreats

Jayasudha J^{1*}, R. M. Naik², K. L. Chaudhary³

**Ph. D. Research Scholar (Agricultural Extension & Communication), N. M. College of Agriculture, NAU, Navsari*

²Principal & Dean, N. M. College of Agriculture, NAU, Navsari

³Assistant Professor, Dept. of. Agricultural Extension & Communication, N. M. College of Agriculture, NAU, Navsari

Corresponding author email: sudhajaganathan97@gmail.com

Abstract

Agrotourism refers to a wide range of services, facilities, and events offered by farmers and rural people to attract tourists to their region and enhance their income. Anything that links visitors to the history, natural resources, or culinary traditions unique to the agricultural sector or a particular portion of the nation's rural areas is referred to as agrotourism by travelers. Agrotourism is a more pleasant approach to learn about the customs of traditional farming, which brings us closer to the natural world and is crucial to maintaining a sustainable way of life on planet. Indian cities are currently dealing with issues of environmental degradation and overcrowding. It is now well accepted that agrotourism can provide us with a break from the frenetic lifestyle of cities. It plays a pivotal role in generating a significant and supplementary income for the population of rural areas, leading to regional and rural development. With its variety of rural customs, festivals, natural surroundings, and agricultural products, India has tremendous potential for the development of agrotourism. Agrotourism center is one of the best alternatives to reduce the problem of employment generation and also for the purpose of enjoyment, education and active involvement in the activities of the farm in rural areas. It is one of the best ways to generate extra income using same piece of land. It helps to raise socio-economic condition of rural people. The benefits of development in both the primary sector of agriculture and the service sector of tourism were combined to create a synergy that further boosted the entrepreneurship in rural areas and improved the environment.

Keywords: Agrotourism, Entrepreneurship, Rural areas, Development, Agriculture

Factors that Influence Farmer's Behaviour Towards Risk Taking: An Empirical Study in Himachal Pradesh

Nandita Sharma*, Aman Sharma, Komal Sharma, Kapil Kathuria

School of Agriculture, Abhilashi University, Chail Chowk, Mandi (HP)- 175028

**Corresponding author email: nanditasharma1612@gmail.com*

Abstract

The research was carried out with the aim to find out the behaviour of farmers towards risk and the factors that influence the farmers behaviour. The present study was conducted in Himachal Pradesh and multistage sampling technique was used to collect the data from 450 farmers. Literature review was done to generate a representative pool of factors influencing risk taking. The literature continues to confirm that risk taking is a key success factor for any type and size of business, especially for agricultural businesses in emerging economies. The research investigates the relationship between the demographic characteristics of farmers with respect to the risk taking. Based on literature review a questionnaire was designed that was used to collect the data. The relevant information about the study was collected through a pre-structured schedule for a personal interview with the farmers. The study also aimed at understanding the efficacy of including demographic variables as a risk- takers measurement parameter in developing such a scale. A 5- point Likert scale was used to capture the data on the statements pertaining to risk taking. The type of data obtained through the questionnaire was quantitative. To check the internal consistency of the questionnaire Cronbach's alpha reliability test has been conducted, the study finalized the instrument to 6 items yielding the factor i.e., risk taking. Farmer's behaviour towards risk was analysed using quadratic utility functions, while the factors that influence farmer's behaviour towards risk were analysed using logistic regression, Farming experience, social participation, land area and income significantly influence farmer's behaviour towards risk; while age, education gender, family size and family type did not significantly influence farmer's behaviour towards risk.

Keywords: Risk takers, land area, logistic regression, quadratic utility

An Exploratory Study for Conceptualization of Rural Entrepreneurship: Major Challenges and Opportunities in India

Taruna*, Nandita Sharma, Komal Sharma, Ankita

School of Agriculture, Abhilashi University, Chail Chowk, Mandi (HP)- 175028

**Corresponding author email: tarunathakur2495@gmail.com*

Abstract

This paper is an attempt to understand the major problems and challenges for rural entrepreneurship, by reviewing published literature. It also tries to focus on the major problems faced by entrepreneurs especially in the field of marketing of products, other primary amenities like water supply, transport facilities and financial amenities. According to 2011 census 68.84% people are living in rural areas of India and the share of agriculture sector in GDP has declined to 18.20% resulting in low farm/ rural incomes. To increase the farmers' income, we have to increase farmer participation in off- farm economic activities within the village itself as land holdings being small sizes limit the possibility of increasing on-farm incomes. An ideal solution lies in enhancing livelihood opportunities back home, by establishing rural enterprises, instead of migration to urban areas where urban infrastructure is already stretched. The off-farm business opportunities in all agrarian societies arise from the local talent, culture, traditions, handicrafts, farm based and non-farm based local resources, etc. Rural entrepreneurship in rural or semi-rural regions could enable local economic growth while building local talent and capacity. This requires relevant and adequate training as well as building capacities to help create micro and small enterprises. In the era of globalized competition, entrepreneurship development in the rural context is a challenge. Further, these rural entrepreneurs are suffering with various problems like fear of risk, lack of finance, illiteracy and competition from the urban entrepreneurs. Thus, developing entrepreneurship in rural areas is an answer to the issues of low farm incomes, migration etc. as it promotes economic and social development in rural areas provided the challenges faced by rural enterprises are overcome. It is recommended that vocational education with a component of entrepreneurship be emphasized at senior secondary level in rural areas. Local role models and mentors need to be located and used in fostering a culture of enterprise and entrepreneurship in rural areas.

Keywords: Entrepreneurship, Rural Enterprises, Local Talent, Vocational Education.

Sustainable Initiatives in Agribusiness Entrepreneurship

Aparna Gogoi

Research Scholar, Department of Business Administration, Tezpur University, Tezpur-Assam 784028, India

Corresponding author email: gogoiaparna20@gmail.com

Abstract

The purpose of this study is to understand the Sustainable practices in rural agribusiness entrepreneurship. Sustainable Agribusiness encompass various strategies such as organic farming, water conservation, and renewable energy utilization. Organic farming practices, including the use of natural fertilizers and pest control methods, contribute to environmental conservation by reducing the reliance on synthetic chemicals and promoting soil health. Water conservation practices, such as drip irrigation and rainwater harvesting, help in efficient water management, reducing water wastage, and ensuring sustainable agricultural production. The adoption of renewable energy sources, such as solar panels and biogas systems, in rural agribusiness entrepreneurship reduces reliance on fossil fuels, mitigates greenhouse gas emissions, and promotes sustainable energy use.

The research aims to investigate various challenges and barriers in adopting and implementing sustainable practices in rural agribusiness entrepreneurs. Limited access to financial resources and lack of awareness about sustainable practices are common challenges faced by rural agribusiness entrepreneurs. Inadequate infrastructure, such as lack of proper irrigation systems and storage facilities, also hinders the adoption of

sustainable practices in rural agribusiness. The research involves mainly secondary data. The results of the analysis can contribute to the existing knowledge on absence of supportive government policies and regulations, as well as limited technical knowledge and skills, pose significant barriers to the implementation of sustainable practices in rural agribusiness entrepreneurship. The sustainable initiatives in agribusiness entrepreneurship play a crucial role in preserving the environment, conserving resources, and ensuring long-term sustainability in the agricultural sector.

Keywords: Sustainable, Agribusiness

Post-Harvest Management of Vegetable

Mohit Sharma¹ and Sandeep Kumar²

¹M.Sc. Agri. Horti (Vegetable Science), ²Assistant Professor (Horticulture), School of Agriculture, Abhilashi University, Chail-Chowk, Mandi (H.P.) 175028

Corresponding author email: sharmamohit57559@gmail.com

Abstract

India is the second largest producer of vegetables in the world after China. Post-harvest losses of vegetables are higher than other crops due to their perishable nature. Broccoli, cauliflower and leafy vegetables have the maximum post-harvest losses in vegetables. It is difficult to increase a 10% yield but it is easy to reduce a 10%. Post-harvest losses are estimated to be as maximum as 15-30% in onions, potato 15-20% and a minimum of 1-3%, and beans 7-12% in garlic. Reasons for Post-harvest losses such as Physiological loss causing the decline in quality, Fibre development, Greening in storage (Potato), insects and rodents etc. Pre-harvest factor includes Environmental factor (temperature and humidity), mineral nutrition (toxicity of N and deficiency of K), irrigation etc. The harvesting factor includes time and stage of harvesting. Post-harvesting factors are grading, packing, waxing, transportation, cold storage, Grading, Processing etc. The processing is to minimise microbial spoilage and natural physiological deterioration of the plant cells. Generally, the techniques include blanching, dehydrating, canning, freezing, fermentation and pickling and irradiation. The different processed products of different vegetables such as ketchup from tomato, French fries, potato chips from potatoes, pepper spray from chilli, pickle and powder, tomato sauce, ketchup and juice from tomato. The advantages of post-harvest management are to maintain the quality of fresh vegetables, reduce postharvest losses, and reduce poverty and food insecurity. Post-harvest loss of vegetables can be considerably minimised whereas self-life can be greatly increased by careful manipulation of these factors. During processing, the main objective is to preserve and addition of colour, flavour, texture, and nutrition to improve the nutritional value and prolong the shelf life of perishable vegetable produce.

Keywords: Deterioration, Fermentation, Nutrition, Perishable, Vegetables

A study on socio-economic status of farmers practicing natural farming in Himachal Pradesh

Ankita*, Komal Sharma, Nandita Sharma, Taruna

School of Agriculture, Abhilashi University, Chail Chowk, Mandi (HP) – 175028

Corresponding author email: jaswalankita545@gmail.com

Abstract

The present study was conducted in district Kangra and Solan of Himachal Pradesh. Two blocks from each district namely Kangra and Indora blocks from district Kangra and Solan and Kandaghat blocks from district Solan were randomly selected and a sample of 120 farmers practicing natural farming was selected for the study. The study revealed that 72 per cent of farmers were small farmers and 28 per cent of farmers belonged to large

farm category. The average family size comprised of 5 members where the percentage of males was found to be 51 per cent. The average number of females per thousand of males was 954. Male literacy rate was higher (96 %) than female literacy rate (93 %). Agriculture was the main occupation of respondents. The average proportion of active workers was worked out to be 69 per cent. Indigenous cows’ population was higher than other livestock. About 61 per cent of the total land holding was cultivated area with cropping intensity of 198 per cent. Maximum income was generated from agriculture (40 %) followed by government services (18 %) and private service (11 %).

Keywords: Natural Farming, Cultivation, Farming system

Integrated crop management practices for offseason garden Pea in high hill wet temperate region of north-western Himalaya

Shakuntla Rahi¹, Pankaj Sood², Akhilesh Sharma³, Desh Raj Chaudhary⁴, Ranjana Thakur⁵ Brij Vanita⁶ and Arti Mahajan⁷

PES (Vegetable Science) ¹ Professor and Head (KVK) ² Professor (Vegetable Breeding) ³ Prof. & Head (Department of Vegetable science and floriculture) ⁴, SRF⁵, SMS (Veterinary & Animal Science) ⁶ and MSc (Vegetable Science)⁷

CSKHPKV, Krishi Vigyan Kendra, Sundernagar-Mandi (HP)-175019

Corresponding author email: shakuntlarahi@rediffmail.com

Abstract

Off-season vegetable cultivation is a boon to resource poor hill farmers of north-western (NW) Himalayas because of climatic advantage and remunerative returns in the market being off-season. Majority of hill farmers in Himachal Pradesh have marginal and small land holdings with consequently poor socio-economic status. Maize, wheat, black gram, kidney bean and potato are main field crops of the region; though off-season vegetable production is also gaining ground on large scale especially Mandi district that too in wet-temperate high hill region (Rahi et al., 2013). It is an important off-season and nutritious vegetable crop of Himachal Pradesh in general and in wet-temperate region of Mandi district in particular.

In Himachal Pradesh, garden pea is cultivated in 30% of the total area under vegetable crops grown in the state and ranks first in acreage. It is grown in an area of 26.00 thousand ha with an annual production 3.28 Lakh MT and average productivity of 12.60 t ha⁻¹ (DOA, 2021). With emergence of urban middle class market having specific kitchen needs and health consciousness, there is growing demand for off-season garden pea in changing food preference domain. With a steady increase in acreage and production over the year, it has occupied the position of the most leading cash crop especially in the high hill wet temperate region where the green pods are available during the months of April to June and the fresh produce finds a ready market in the plains bringing lucrative returns to the growers. It plays an important role in agrarian economy of Himachal Pradesh because of congenial environment and high yielding potential. Due to economic profitability of garden Pea, hill farmers are cultivating off-season pea on large scale during summer (April-July). However, the yields are very low due to non adoption of high yielding cultivars integrated crop management practices particularly under rainfed situations. This all has resulted in less remunerative returns which are still threatening the livelihood security of small and marginal hill farmers. Thus, in order to disseminate the technology effectively, there is a dire need to educate and upgrade the farmers to boost their productivity and profitability to follow such oriented farm entrepreneurship and income enhancement venture in NW Himalayas

Methodology

In order to scale up the off-season pea cultivation in north western Himalayas and to solve above problems, KVK Mandi conducted 20 front line demonstrations on high yielding and rust resistant cultivar Him Palam Matar-1 and their management practices and GS-10 as farmers practices in two potential blocks (Karsog block of Chauridhar, Khadra, Seri Bangloo and Seraj block of Chhatri, Gunash and Shikaberi villages) of Mandi district, Himachal Pradesh during Kharif 2020 and 2021 with the objectives of improved technology dissemination through FLDs' over farmers' practices under rainfed situation in high hill wet temperate region of the state. A total of 10 garden pea growing farmers were randomly selected for front-line demonstrations (FLD's) on integrated crop management (ICM) in off-season garden pea variety Him Palam matar-1 in an area of 0.80 ha demonstration plots (n=10). All the farm inputs required for off-season pea cultivation were applied as per the SAU recommendations and all ICM practices including pest and disease management were performed under close supervision of KVK Scientists following FLD guidelines of Ministry of Agriculture, Govt. of India. The yield data was determined by using standard procedure, B:C ratio was computed using marketable yield and cost incurred towards crop management at the prevailing market price.

Results

The results of FLD,^s (pooled data of *Kharif* 2021 and 2022) have revealed that fresh pod yield of garden pea Him Palam Matar -1 (147.42 qt/ha) was substantially higher (49.38 %) under improved practices over farmers' practices. GS-10 fetching gross, net returns to the tune of Rs. 147420 & Rs.1, 01,688/ha and B: C ratio (2.23:1), respectively. Whereas Gs -10 registered lowest productivity (98.67qt/ha), gross and net returns to the tune of Rs. 98670 & Rs. 61642), respectively during both years of study. An impact analysis revealed that about 90% of the participating and surrounding farmers of 'On farm' study area with the performance of improved ICM practices and have sincerely adopted this ICM technology due to its higher yield, attractive colour, rust resistance and more demand in the market during summer as offseason.

Conclusion

With the KVK interventions and sound technical backup of line departments, the adoption of offseason garden pea following this ICM technology was estimated in about 1125 ha alone in Mandi district of Himachal Pradesh during the year 2021& 2022. Although some impacts were quite impressive by and large; but these remained specific to Karsog & Seraj valley of Mandi district in Himachal Pradesh, thus, benefitting only a cross section of the hill farmers. Since, KVK alone cannot reach all the unreached with its skeleton staff. Thus, a full proof mechanism to rope-in the state extension functionaries to carry the technology to farmers' door in remote villages is necessary. Overall, participation of State Department of Agriculture, innovative farmers and sound technical backup by KVK-Mandi has made this integrated crop management technology one of the most remunerative and sustainable practice in the region which proved as a promising agro-technology for hill farmers of north-western Himalayas.

References:

1. Anonymous. 2021. Area and production of vegetables in Himachal Pradesh. Directorate of Agriculture (HP), Shimla-5, Himachal Pradesh
2. Rahi, S., Thakur, S.K. and Choudhary, A. K. 2013. Off-season pea cultivation: An income enhancement venture in Mandi district of Himachal Pradesh. In Proc: National Seminar on Indian Agriculture: Present Situation, Challenges, Remedies and Road Map held at CSK HPKV, Palampur, India. CSK HPKV Publication, ISBN No. 978-81-85430-23-2: 47-48

Determining the genetic parameters of grain protein content and yield traits in rice (*Oryza sativa* L.) Grains

G. Kiruba¹, S. Geetha^{1*}, R. Saraswathi¹, R. Santhi², D. Uma³ and R. Pushpa⁴

¹ Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore-641003, India.

² Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore-641003, India

³ Department of Biochemistry, TNAU, Coimbatore-641003, India

⁴ Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu, India

*Corresponding author email: geethagovind1@gmail.com

Rice (*Oryza sativa* L.) serves as the staple food for a significant portion of the global population. The protein content of rice grains is a critical determinant of its nutritional value. The relationship between enhancing grain protein content (GPC) and climate-resilient agriculture lies in the intersection of agricultural practices that promote both nutritional quality and adaptation to climate change. By focusing on strategies to increase protein levels in grains while also implementing practices that build resilience to climate variability and extremes, farmers can develop more sustainable and robust agricultural systems. Among the array of breeding approaches, Griffing's full diallel analysis by Hayman (1954) and Jinks (1954), which incorporates reciprocal crosses, stands out for its particular ability to ascertain the presence of maternal effects. The statistical analysis of diallel crosses provides a comprehensive understanding of the heritability of diverse polygenic traits, including grain protein

content. Many researchers examining the heritability mechanisms of grain protein content, elucidate its genetic architecture and identified various types of gene action influencing its expression. Some authors reported that heritability of GPC was determined by additive effects with incomplete dominance, whereas others emphasize dominance. The variability in gene action largely extends on the specific parental forms studied, environmental conditions and their interplay. With this information, the objective of current study aims to determine the gene action and genetic parameters associated with grain protein content and yield attributing traits.

METHODOLOGY

The study was conducted at Department of Rice, TNAU, Coimbatore, during the *Rabi* season of 2021. It involved genetically diverse six parental lines with varying grain protein content: high category (>10%) IG74 and *Gandhasala*; medium category (8-10%) CO52; and low category (<8%) CRDhan315, TKM13 and *Vellai chithiraikar*, chosen for hybridization using a 6 × 6 full diallel method, resulting in 30 hybrids. These hybrids, along with parents, were replicated twice in a randomized block design, with observations recorded on yield and yield attributing traits following the Standard Evaluation System (IRRI, Philippines). Each hybrid consisted of 3 rows and 12 plants per row, spaced at 30 cm × 30 cm, with single seedling per hill in each replication. Standard agronomic practices were followed throughout the crop growth period. The grain protein was estimated using Near Infra-Red Spectroscopy (NIR ZEUTECH spectra Analyzer™). The collected data from F₁ hybrids and parents were analyzed using Method I (F₁ hybrids + F₁ reciprocals and parents) and Model I (fixed effect) of Griffing (1956) and Hayman's diallel analysis to elucidate the gene action governing protein inheritance. Hayman's diallel analysis and Vr-Wr graph were generated using the "Diallel Analysis R" package in R software version 4.2.0.

RESULTS

Analysis of variance for all the traits including protein content showed significant differences among genotypes which includes parents and hybrids, revealing the genetic variability among them. Estimation of genetic parameters (Table 1) showed that significant amount of D, H₁ and H₂ for grain protein and yield characters indicating the existence simultaneous effect of both additive and non-additive gene action. However additive variance is predominant for grain protein content, plant height and fifty percent flowering over dominance variance. The additive effect in protein content also reflected by average degree of dominance (H₁/D)^{1/2} by which the value of (H₁/D)^{1/2} for grain protein content was between 0-1 depicts occurrence of partial dominance and the value is significant and greater than one for yield traits which depicts over dominance is involved in yield traits. The results showed the value of H₂/4H₁ for grain protein and other yield traits lower than 0.25 which indicates, the unequal distribution of positive and negative genes in the parental lines, which are in line with Chaudhari *et al.* (2022). A proportion of dominant genes to recessive genes Kd/Kr and positive F value were more than 1 for grain protein content specifies more dominant genes in the parent. The values of h² /H₂ for grain protein content and majority of the traits studied were found smaller than one indicated that the single group of genes control these traits. The protein content, single plant yield and panicle length possess moderate heritability. Moderate heritability for protein content represents a fixable, additive heritable variation. While compared to recessive genes, the dominant single group of gene with moderate heritability play vital role for grain protein content and selection response would be rapid for this trait so that progressive generations of repeated and pedigree selection accompanying with conventional selection are recommended for improving these traits (Sharma *et al.*, 2022).

The Vr/Vr graph (Fig.1) displayed that the regression line, intercepted the Vr axis well above the origin for protein content representing the occurrence of additive with incomplete or partial dominance in inheritance of protein content. The average degree of dominance for this trait is 0.51 which is confirming partial dominance. While the regression line cutting the Vr axis below the point of origin for the remaining traits implying the existence of over dominance for inheritance of these characters. Also, the average degree of dominance for yield related traits is more than 1 which is confirming over dominance.

CONCLUSION

The findings of present study revealed that inheritance of protein was governed by additive effects with partial-dominance. As the protein content was influenced by both additive and dominance gene action, the selection

may be postponed to later generations and care should be taken to fix the male and female parents due to the influence of maternal cytoplasm.

REFERENCES

Chaudhari, G. R., Patel, D. A., Kalola, A. D., & Kumar, S. 2022. Graphical and Numerical Analysis of the Components of Gene Effect on the Quality Traits of Bread Wheat (*Triticum aestivum* L.) under Varying Environmental Conditions. *Agriculture*, 12(12), 2055.

Sharma, N., Mittal, R. K., & Sood, V. K. 2022. Genetic Component and Vr-Wr Graphical Analysis in Blackgram [*Vigna mungo* (L.) Hepper]. *Legume Research-An International Journal*, 45(12), 1490-1495.

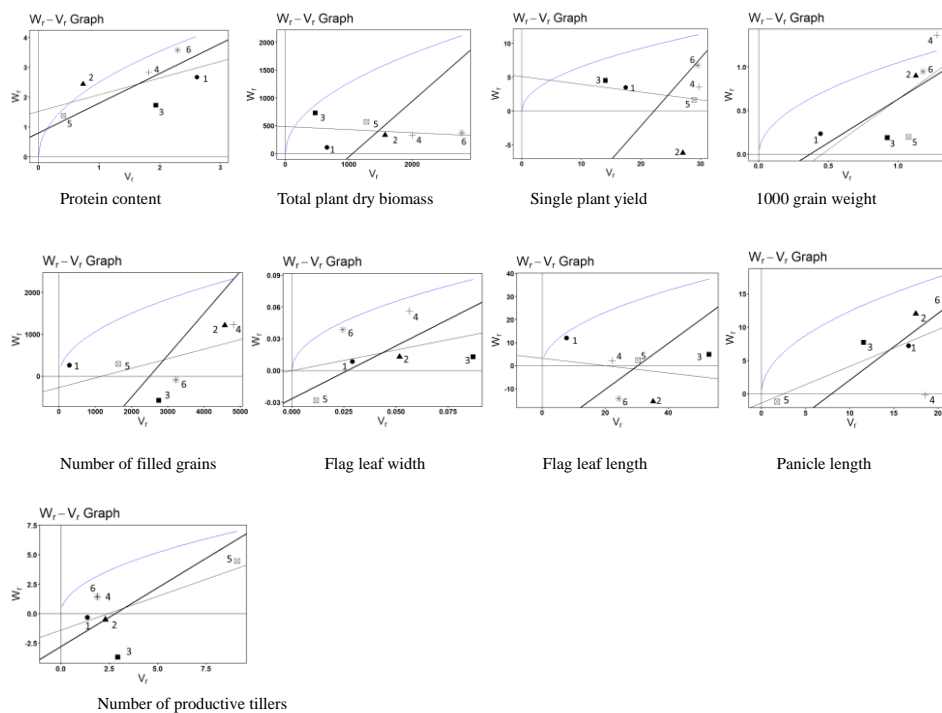


Fig. 1. Vr – Wr graph for grain yield and protein quality in rice (1. IG74, 2. CO52, 3. TKM13, 4. CRDhan315, 5. *Vellai chithiraikar*, 6. *Gandhasala*).

Table 1. Genetic variance components and related statistics for 11 traits in a 6×6 diallel cross

	DDF	PH	NPT	PL	FLL	FLW	NFG	TGW	SPY	TPDB	PC
D	52.55**	779.58**	4.13	14.31**	23.82**	0.07**	1037.93	0.93**	2.03	1598.11**	6.21**
F	-30.60	15.36	5.23	-4.96	29.50	0.05*	-1114.65	-0.55	-6.00	535.59	2.77**
H ₁	43.22**	137.19	14.23	25.73**	70.87**	0.09**	5463.05*	1.91**	42.72**	2046.12*	1.59**
H ₂	25.23**	112.76	12.01	24.71**	49.45**	0.06**	3717.12	1.77**	40.65**	1674.59*	1.21**
h ²	10.77*	7.10	8.65	28.38**	17.58	-0.01	3409.45*	3.78**	109.05**	280.55	0.17
E	1.29	14.01	1.24	0.97	2.85	0.01**	87.55	0.17**	2.26*	16.99	0.05
H ₁ /D ^{1/2}	0.91	0.42	1.86	1.34	1.73	1.13	2.29	1.43	4.59	1.13	0.51
H ₂ /4H ₁	0.15	0.21	0.21	0.24	0.17	0.18	0.17	0.23	0.24	0.21	0.19
Kd/Kr	0.51	1.05	2.04	0.77	2.12	1.96	0.62	0.66	0.51	1.35	2.58
h ² /H ₂	0.43	0.06	0.72	1.15	0.36	-0.10	0.92	2.13	2.68	0.17	0.14
h ² ns	1.92	0.90	0.06	0.89	0.16	0.25	1.11	1.14	0.55	0.43	0.38

* Significant at 5% level, ** Significant at 1% level. DFF=Days to 50% flowering, PH=plant height, NPT=number of productive tillers, PL=panicle length, FLL=flag leaf length, FLW=flag leaf width, NFG=number of filled grains per panicle, TGW=1000 grain weight, SPY=single plant yield, TPDB=total plant dry biomass, PC=protein content. D= Additive variance, H₁, H₂ and h²= Dominance variance, F= product of additive and dominant alleles, E= Environmental variance, H₁/D^{1/2}= Mean degree of dominance, H₂/4H₁= Proportion of genes with positive and negative effects, Kd/Kr= Proportion of dominant and recessive genes, h²/H₂= number of gene groups, h²ns= Heritability in narrow sense.

Adapting Floriculture to Urban India: Navigating Climate and Pollution Changes

Akhil Rana^a, Sukhjinder Singh^{a*}, Deepika Sharma^a and Bhavya Bhargav^b

^aBusiness Development and Marketing Unit, Council of Scientific and Industrial Research - Institute of Himalayan Bioresource Technology, Palampur - 176 061 (Himachal Pradesh) India

^bAgrotechnology Division, Council of Scientific and Industrial Research - Institute of Himalayan Bioresource Technology, Palampur - 176 061 (Himachal Pradesh) India

**Corresponding author email: sukhjinder@ihbt.res.in*

Abstract

Urban areas are looking for landscaping methods that are both aesthetically pleasing and environmentally beneficial as a result of increasing urbanization. Indian gardening customs date back thousands of years and have gained popularity since the Mughal Empire. Urban horticulture is encouraged by several causes, including the need for effective space utilization, aesthetically beautiful, oxygen-rich air, temperature control, increased wellness, reduced background noise, reduced stress, and an increase in biodiversity. All sorts of agricultural production have been continuously impacted by global warming. Due to space limitations, decorative plants have been highly sought after for interior decorating of homes and offices. The biggest contributor to pollution in cities has been the growing population, which necessitates planning and management in urban areas. Many different plants have phytoremediation abilities that are useful in the fight against pollution. Urban settings are seeing the emergence of vertical farming, aquaponics, and aeroponics as viable and sustainable choices. Urban areas in India will see a significant amount of these new techniques in the ensuing decades.

Keywords: Landscaping techniques, Biodiversity, Phytoremediation, Vertical gardening, Urban gardening

Introduction

In India, gardening possesses a thousand-year cultural heritage and attributed to cultural, religious, and beauty, which sparked the growth of a thriving floricultural tradition. It's the capacity to create profitable independent businesses among marginalized and tiny agricultural enterprises. As economic conditions have improved and people's awareness of the need to exist in an environmentally conscious way has grown, there has been an increase in appetite for flower farming products in both developed and developing nations across the globe. As a consequence, it has become a successful agricultural industry in India and around the world. Products from floriculture are frequently among the top agricultural exports from many nations. In recent decades, the landscape of floriculture has shifted significantly, particularly within the urban domains of the country. Urban areas, with their expanding populations and evolving environmental challenges, have become focal points for understanding the intricate interplay between floriculture, climate dynamics, and pollution (De, 2018).

In India, the primary sector of farming and its associated businesses is the field of floriculture. A total of about 282.38 ha that are have been planted for flower cultivation throughout the nation, generating 614.64 MT of cut flowers and 2198.83 MT of loose flowers in 2022 (NHB). The Indian government has designated floriculture as a sunrise industry and given it a 100% export-oriented status (Vahoniya et al, 2018). Since India, the flower business evolved because of the explosive growth of 20% annually of flower design in homes, offices, and ceremonial activities, including festivities. Although some flowers are produced outside in greenhouses or fields of crops, the majority of wildflowers and miniature plants are produced in plant-growing structures throughout tropical areas, which has led to the sector being

predominantly associated with greenhouses. The breeding of plants for decorative purposes along with the development of clippings in conservatory and urban implementation are both included in the definition of "floriculture." Its activities include flower and decorative plant cultivation, marketing, and arrangement (Gill et al., 2017).

The second-biggest flower and plant consumer sector in India by 2025, when the country's share of super-elite families is anticipated to grow five-fold, it will become the third-largest consumer market in the world. Indian consumers are now able to spend more on high-quality items thanks to their increased purchasing power and the increasing influence of social media platforms. India is currently thought to have the second-biggest customer base and the most rapidly developing retail market in the entire world. The biggest flower trading hub in South Asia will soon be India. Throughout anywhere in the globe, prospective importers of plants, seeds, bulbs, planting materials, greenhouse technology, implements supplies, and tools for gardening are very interested in tapping into this marketplace. Due to the country's rising flower consumer demand, certain exotic flowers have been brought into India by entrepreneurs for use in bouquets and interior design. Proteas, orchids, heliconias, and other significant flora have been transported and offered for sale in Indian markets. Flowers Export in 2023 serves as a forum for a combination of diverse companies from around the world, including specialists in the traditional blossoming stage and landscaping industries, large-scale consumers from the industry, florists, retailers like home centres, designers of homes, and internal shops (Flora Expo, 2023).

This introductory exploration delves into the multifaceted realm of floriculture within urban India, aiming to unravel the complexities of how this cherished practice adapts and transforms in response to the changing climate patterns and escalating pollution levels. As the nation grapples with rapid urbanization, the implications for floriculture are profound, necessitating a re-evaluation of traditional practices, the introduction of innovative techniques, and a keen understanding of environmental sensitivities.

This discourse seeks to uncover the current landscape of floriculture in India's urban centres, shedding light on the challenges posed by climatic shifts and pollution, while also examining the resilience and adaptive strategies employed by practitioners and horticulturists. By elucidating these critical dynamics, this manuscript aims to contribute to a deeper understanding of the evolving relationship between urban spaces, floriculture, and the imperative need for sustainable practices in the face of environmental change.

Floriculture Industry in India

Floriculture is a fascinating enterprise. Everybody has received a million joys from flowers, putting smiles on everyone's faces. The field of floriculture has developed into an interdisciplinary, high-tech zone focused on scientific superiority. Due to the diligent work of floriculture researchers, both physically and commercially, the industry has improved. The floriculture sector is quickly growing and rising. The floriculture industry is among the most lucrative in that case, and it has recently expanded to include India perhaps the rest of the world. Compared to most fields and even certain other gardens, flower gardening now acknowledges that it provides a greater probability of yield per area of production. Considering that India's flower gardening industry can serve the nation's as well as overseas blooming markets (Singh, 2011; De and Singh, 2016; Misra and Ghosh, 2016; Panigrahy et al., 2018; Geetha and Lissy, 2018; Datta, 2019)

India's floriculture business is expected to grow to 231.7 billion dollars by 2022. According to the IMARC Group, the market will grow to 460.6 billion dollars by 2028. According to the CAGR, a growth rate of 13.1% between 2023 and 2028. Flowers such as roses, marigolds, tuberose, carnations, orchids, tulips, and lilies are part of India's floral industry. Tamil Nadu, Madhya Pradesh, Karnataka, and Andhra Pradesh create more than half of the products. The National Horticulture Board (NHB) 2021-2022 reports, that 283 thousand hectares of floriculture were produced in India, yielding 2295 thousand tonnes of loose flowers and 833 hundred tonnes of cut flowers. Many states, including Tamil

Nadu (15.16%), Madhya Pradesh (13.66%), Karnataka (15.85%), and West Bengal (10.61%), cultivate flowers. In 2022–2023, India's total floriculture export revenue was Rs 707.81 crore. In India, there are about 300 units focused on exports (APEDA, 2023).

Urban Floriculture

The activity of cultivating flowers and ornamental plants in crowded areas such as cities, towns, and other urban areas is known as urban floriculture. Tamil Nadu, Andhra Pradesh, West Bengal, Maharashtra, Rajasthan, Delhi, & Haryana are the Indian states that practice urban floriculture. According to the AG Group Survey, in 2021, the Indian field of floriculture industry generated \$661 billion in revenue. Additionally, by 2024, the global market will be worth \$28.98 billion (AG Group, 2021). Urban floriculture is the growing and distributing of flowers, potted plants, and ornamental plants for a variety of purposes, such as beautification or landscaping (Annuals, Biennials and Herbaceous Perennials, Shrubs, Trees, Climbers and Creepers, Cacti and Succulents, Indoor Plants, Ornamental Palms and Bulbous Plants) and improving the aesthetic appeal of urban space. This is becoming a popular new trend in many urban areas, which attracts onlookers and enhances the allure of urban areas. In urban settings, floriculture serves multiple purposes beyond mere decoration. It encompasses the beautification of public spaces such as parks, gardens, roundabouts, and streetscapes, enhancing the visual appeal and psychological well-being of urban dwellers. Additionally, floriculture plays a pivotal role in various commercial endeavours, including the floral industry, landscaping services, and the production of ornamental plants for homes, offices, and events.

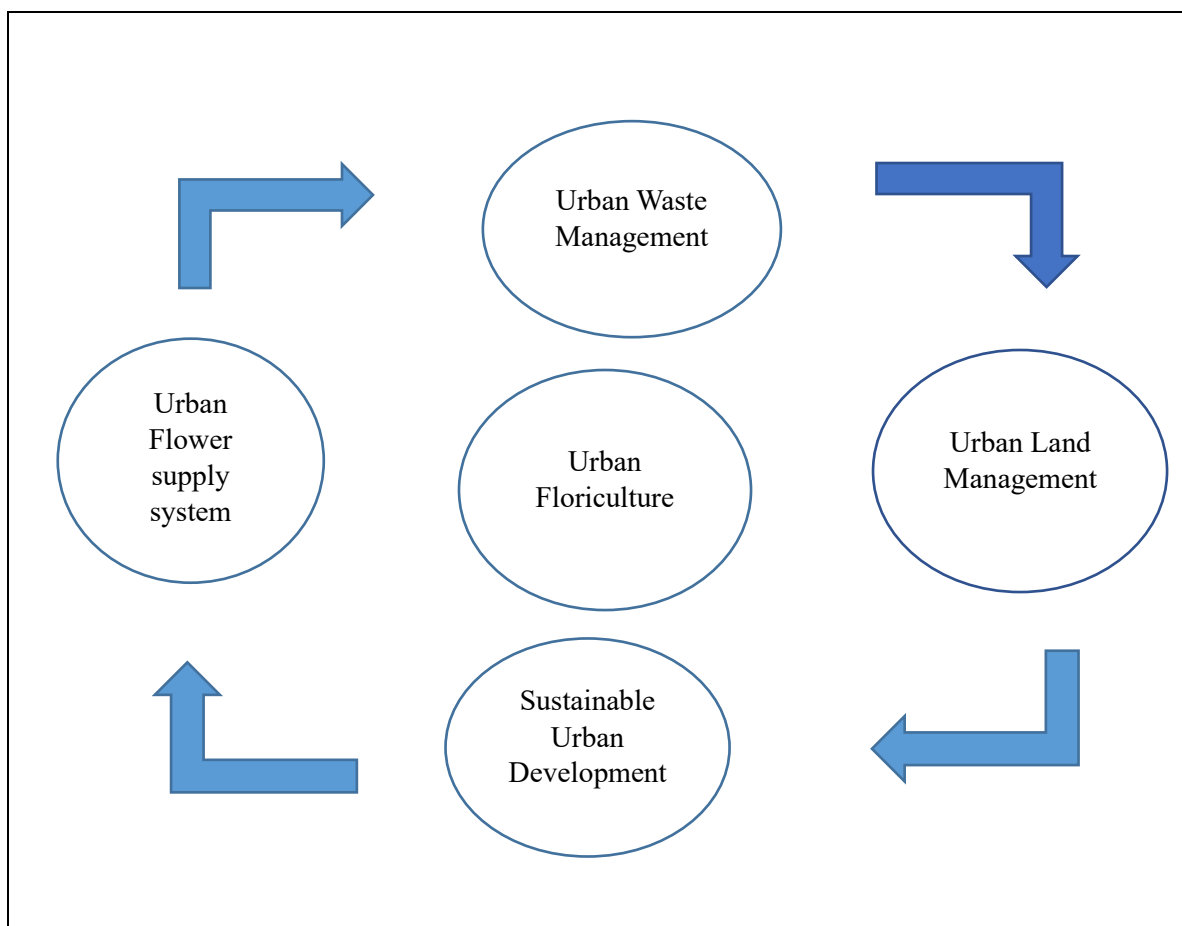
The field of ornamental horticulture is also known as urban floriculture. While floriculture concentrates on growing floral and beautiful plants, horticulture deals with the production of crops for the garden, fruits, and vegetables. Urban floriculture contributes significantly to the attractive, healthy, and lively urban environment in urban areas, improving the quality of life for urban residents and fostering a connection between people and nature (Anonymous, 2021). The popularity of numerous small and medium-sized pots for flowers and their access to marketplaces have given urban floriculture a boost (Fig. 1).

Figure 1: Urban Floriculture

Vertical Gardening

Vertical gardening is a practice that involves growing plants upward, usually on walls, fences, or other vertical structures, instead of horizontally on the ground. It's a creative and space-efficient method that allows for the cultivation of plants in areas with limited space, common in urban environments. Urban areas have a lot of potential throughout the fields of floral design along with indoor gardening. The latest trend in wall or ceiling decoration is horizontal planting. It is a productive technique to add charm and foliage to the area. The greatest option for vertical gardening is plant growth supported by a trellis. With the aid of climbing gardening nettings, and a tower of pots, along the garden's structure, people living in cities may cultivate fruits, and colorful flowers, as plants using vertical gardening. Developing plants in good health with simple harvesting and higher yields is possible with vertical gardening, which is also simple to maintain (Anonymous, 2024).

For India's metropolitan regions to become greener, vertical gardening offers an imaginative and beneficial option. The newest gardening position along with instruments to make cultivation possible in vertical environments is gardening from the above idea. There are numerous advantages to vertical gardening, including simple setup, simple accessibility, environmental beautification, efficient use of space, aesthetically pleasing, oxygen-rich air, maintained temperatures, minimized utilization of water, improved wellness, decreased background noise, decreased stress, consumed gases in the atmosphere,



as well as a boost in biodiversity (Anonymous, 2024).

The wall of greenery and healthy wall are other names for vertical planting. When municipal agencies and entrepreneurs began using vertical gardens to promote urban memories and identities within the institutionalized green markets numerous job and independent business opportunities, and fresh startups were generated in the marketplace (Patel et al., 2018). By boosting ecosystems, lowering the incidence of urban heat islands, and providing a home for invertebrates over gardening in cities, while opening up the potential to modern cultivation of flowers, vertical gardens significantly boost the standards of life in urban areas. An economically viable city model is built on this foundation. Thus, the relevance of financial benefits as the foundation for vertical garden methods increases. The architectural priorities of the ecologically conscious city approach are vertical garden techniques, ecological regularity, and green economy.

Landscape Gardening

Landscaping is the process of building and designing gardens with plants and flowers in urban environments, whereas landscape gardening is a way to beautify places with beautiful plants. It became crucial for living with and adapting to the effects of climate change. In many respects, landscaping is gardening—indoor gardening, outdoor gardening, commercial parks, terrace gardening, and veranda

gardening—which has given people jobs and made cities more attractive. The extending of indoor living to the outdoors through the use of bio-aesthetically attractive practices is known as landscaping. Ancient cultures have long valued gardens. There are numerous well-known gardens in metropolitan areas nowadays, including the Hanging Garden in Delhi, the Mughal Garden in Srinagar, the Rose Garden in Chandigarh, the Lodi Garden in Delhi, the Valley of Flowers in Chamoli, the Botanical Garden in Kolkata, and the Lal Bagh Garden in Bengaluru. India has recently experienced changes in the landscape and gardening. Landscaping has become a recognized sector in recent years (Sindhu, and Vanlalruati, 2018).

Today, pollution from motor vehicles, industry, smoke, dust, and other sources has increased daily in urban areas. Urbanization benefits greatly from landscaping and gardening. The well-being of kids is directly impacted by the lack of play spaces, access to colorful flowers, birds, and insects, and lack of oxygen in metropolitan settings. Children's play areas and greens are all made possible by flowers, plants, and theme park landscaping. After a long day of work, people can unwind, find peace of mind, and breathe clean air in beautiful parks, flowers, or gardens (TNAU Agritech Portal Horticulture, 2021).

Landscape wall

A landscape wall, also known as a retaining wall, serves several functions in landscaping. It's a structure built to hold back soil or create a defined area within a landscape. These walls can be made from various materials, including concrete blocks, natural stone, bricks, wood, or even engineered materials. The main purpose of landscape walls, which are often slanted rather than vertical, is to stabilize valleys or reduce noise. Such walls are constructed using a type of building material consisting of polymer or concrete with spaces for media to grow flowers and plants.

Phytoremediators Plants

Plants used in phytoremediation use a strategy to absorb contaminants from the soil and change hazardous elements into less toxic volatile forms. Due to their vast biomass and size, trees are perfect for the clean-up of heavy metals since they can withstand and absorb higher concentrations of pollutants. In an environmentally responsible manner, revegetating heavy metal-polluted soil with plants is possible through phytoremediation. Recognizing the mechanisms driving heavy metal accumulation and tolerance in plants is essential for increasing the efficacy of phytoremediation. Alfalfa, sunflower, corn, date palms, Indian mustard, water hyacinth, and even willow and poplar trees are examples of phytoremediators (Sadasivam, 2022).

While phytoremediation plants are used to clean up metal-polluted soils and waters using the portions of the plant that can be harvested, there is a risk of damage to the plants that are utilised in the process. The phytoremediation of heavy-metal contaminated salty land can also use ornamental plants that are well adapted to high salinity. Plants produced for ornamental purposes typically have sizes, shapes, or colours appropriate to the temperature, landscape, and desired gardening, such as flowers, leaves, fruits, or an aesthetically pleasing form. The numerous kinds of plants, from aquatic to natural, herbaceous to woody, and lower to higher level. Phytoremediation, while promising, has its limitations and may not be suitable for all types of contaminants or environmental conditions. Factors such as plant species selection, soil conditions, pollutant concentrations, and the extent of contamination play crucial roles in the success of phytoremediation projects. Additionally, it's essential to consider the proper disposal or containment of the contaminants extracted by these plants after the remediation process.

Classification of urban floriculture

Balcony and Terrace Gardening

Container gardening includes gardening on balconies and terraces. Because plants are grown in pots of different sizes and shapes. Terrace gardening is the practice of creating a garden on a building's roof or

terrace rather than on the ground. To benefit from the health advantages of greenery in constrained settings, numerous urban inhabitants, especially those who live in residences or high-rise buildings, have turned to balcony and terrace gardening. Most flowers are cultivated in pots and containers, including marigolds, roses, geraniums, and petunias. Terrace gardening offers numerous advantages, including access to fresh produce, a connection with nature in urban environments, and an opportunity for hobbyists to engage in gardening despite space limitations. It encourages self-sufficiency, promotes eco-friendly practices, and contributes to creating greener and more sustainable urban spaces.

Theme Garden

The primary goal of theme gardens is on a special location or exclusive use in the design of the garden. Gardens are created to enhance the surrounding area's aesthetics as well as the environment or to display colourful flowers. where each plant fits with a specific theme. They promote the topic's outdoor learning, exploration, plant, and design components. Vegetables, fruits, and culinary herbs are among the plants grown in the ecological park. The ornamental plants also include those in the Japanese Garden, Mediterranean Garden, Butterfly Garden, Art Garden, Herb Garden, Rose Garden, eco-park, Spiritual Garden, Sensory Garden, Sundial Garden, Tulip garden, Children Garden, Rock Garden, and Brindavan garden, among others.

Theme gardens are not only visually appealing but also educational and experiential. They provide opportunities to explore different cultures, ecosystems, or concepts while showcasing diverse plant species and design elements. The selection of plants, structures, and arrangements is key to creating an immersive and cohesive experience aligned with the chosen theme.

Roof Gardening

A roof area with plants or a landscape constructed atop a protected base is known as a roofing gardening system. In addition to controlling temperature and providing aesthetic value and nutrition, roof gardening also provides environmentally friendly, hydrological, and aesthetic advantages. As it is based on the concepts of energy, atmosphere, endurance, economics, and technology, it is a vital component in the current scenario. Roof gardening presents a creative and sustainable way to utilize otherwise unused spaces in urban environments (Bhat, and Paschapur, 2020). Beyond aesthetic enhancements, it promotes environmental sustainability, energy efficiency, and community engagement while providing opportunities for gardening and greenery in densely populated areas (Anonymous, 2024).

Window Box Gardening

Residents who don't have access to a yard or a roof to grow plants frequently use window boxes. Currently, there are several buildings, taller apartments and cottages are being built every day, and there is ample room for people to place decorative plants. Now that the issue had been resolved, window boxes were made. Window boxes are constructed of metal and wood, blocks, cellular PVC, fiberglass, and wood are common building materials. Because they are often used in multi-story apartments and high-use buildings, these window boxes are used by individuals in urban areas for gardening. Window box gardening is a versatile and accessible way to bring gardening to urban dwellers. It adds beauty to buildings, provides a connection to nature, and offers an enjoyable way to cultivate plants even in limited outdoor spaces (Anonymous, 2020).

Highway and Underpass Landscaping

Currently since connections, subway systems, and raised highways or paths have been built in towns and cities, including Delhi, Mumbai, Bangalore, Chandigarh, UP, Jaipur, Nagpur, Kolkata, etc. it is crucial or necessary to design landscape plants for reducing pollution and beautifying the building's surroundings or underpass. It aims to enhance the aesthetic appeal, safety, environmental quality, and functionality of these areas while considering the unique challenges posed by their proximity to transportation infrastructure. The basic objective is to have more transportation below the terrain than

above it. After all, this raises the proportion to green the environment, minimizes the negative effects of roads on cities and the environment, and creates more green space for enjoyment. They all undoubtedly link habitats and enhance water cycles, with the highway noise remaining below and being muffled. Key aspects and considerations of highway landscaping include visual enhancement, erosion control and soil stabilization, noise and pollution reduction, safety considerations, sustainability and ecology, maintenance practices and public engagement.

Highway landscaping not only contributes to the beautification of transportation corridors but also plays a role in environmental conservation, improving air quality, reducing erosion, and providing habitats for wildlife. Thoughtful planning and sustainable practices in highway landscaping can create visually appealing, functional, and ecologically beneficial green spaces along roads and highways.

Hanging Gardening

A hanging garden nowadays is a small urban farm, a decorative garden, or a sustainable landscape design for landscaping that is attached to or constructed on a wall. For plants, flowering decorative plants, and shrubs, there aren't many horizontal places available. The health of the people walking about the area is affected by factors like heat and dust pollution. To enhance the welcoming atmosphere of such areas, such as train platforms, hospitals, highway transportation hubs, etc., hanging gardens and periodic annuals can be planted. They make it possible for homes with little gardens to still have fresh, real flowers and plants.

Types of Urban Plants

Urban gardens require the kinds of plants that look good all year round, take up the least amount of area, and require little upkeep. Numerous plant species are suitable for urban settings like yellow *wood sorrel* (*Oxalis stricta* L.), *purslane* (*portulaca oleracea* L.), *chicory* (*cichorium intybus* L.), *plantain* (*plantago major/platago lanceolata* L.), *yarrow* (*achillea millefolium* L.), *goldenrod* (*solidago speciose* L.), *common milkweed* (*asclepias syriaca* L.), *mullein* (*verbascum thapsus* L.), *staghorn sumac* (*rhus hirta/rhus typhina* L.), *poison hemlock* (*conium maculatum* L.), *red clover* (*trifolium pratense* L.), *wild carrot* (*daucus carota* L.), *trachelospermum jasminoides* L., *euphorbia characias* subsp. *Wulfenii* L., *dicksonia Antarctica* L., *hydrangea quercifolia* B., *rainbow chard* (*beta vulgaris* subsp. *Cicla* var. *flavescens* L.), *dahlia bishop of llandaff* L., *topiary* (*buxus sempervirens* L.), *amelanchier lamarckii* F.G. Schored., and *geranium orion* L. are some of the common plants. Numerous additional types of attractive plants are ideal for urban settings and draw people there.

Smart Urban Farming Technology for Floriculture

The sophisticated, intelligent, and IT-connected components of protected cultivation and cultivating highly valuable horticultural crops in urban locations are referred to as "smart urban farming." High-value horticultural commodities like flowers, plants, vegetables, and herbs grown for several years or during off-seasons are now being produced thanks to smart urban farming technology. Numerous contemporary technologies are used in smart farming in cities, mostly for the effective control and management of expensive inputs including energy, water, seed, fertilizer, and other chemicals. Cultivating specialist plants also aids in pollution management, facilitates the provision of plentiful oxygen, and controls several dangerous gases. Growing horticulture crops that are secure and valuable for society, as well as our own community, is possible through urban farming. Large cities today have a thriving start-up scene for several Smart Urban Farming-related businesses (Floriculture Magazine, 2023).

Through the aid of advanced urban farming technologies, there is a tremendous opportunity for cultivating a variety of flowers throughout the year-long and making it profitable & sustainable. Future innovations for flower production include smart urban farming and vertical farming that utilize a soilless hydroponics system with mechanization and monitors. Protected cultivation, drip irrigation and fertilization, aeroponics and aquaponics, automation, sensors, controllers, etc. are some key elements of urban floriculture. Protected cultivation-based smart urban farming offers a number of benefits for producing and yielding horticulture crops and their growing material through effective land and resource usage.

Smart urban farming frequently makes use of several vital protected structures, including naturally ventilated greenhouses, climate control, insect-proof net houses, and rain shelters. All of these safe structures can be utilized to implement clever urban farming techniques based on ground or free-of-soil systems in any number of layers. According to the unique requirements of the module used for the cultivation of crops, the cultivation system can be simply adapted. Smart urban farming results in earnings and pulling young people into farming or business (Floriculture Magazine, 2023).

The Effect of Climate/Pollution Change

The environment impacts all agriculture, horticultural practices, soil, animals, and pests, either directly or indirectly. Day-by-day fluctuations in the global temperature have a direct impact on the atmosphere's concentration of greenhouse gases such as nitrous oxide (N₂O), carbon dioxide (CO₂), and methane (CH₄). It shows that drought, glacier melting, and sea level rise *have a direct impact on the climate* (De, 2018). The effects of global warming on the climate include changes to the photosynthetic process, reduced fertilization effectiveness, higher transpiration, which contribute to effects on the minerals found in the soils, and an increase in the number of pests. Drought, soil erosion, soil organic transformation, agricultural land use patterns, and reduced farming areas are all indirect effects of warming temperatures on the environment. India's temperatures continue to be climbing over the past three generations, which has resulted in higher rainfall.

According to NIC (National Intelligence Council) “India: The Impact of Climate Change to 2030” A Commissioned Research Report, glaciers are melting at a pace of between 10 and 15 meters annually each year due to changes in the climate and environmental factors. By 2030, the whole nation of India is projected to warm by 0.5°C, which is almost comparable to the warming of the twentieth century, and by the end of this century, the entire country is likely to warm by 2-4°C, with the highest increase over the northern part of the nation. Major metropolitan areas are projected to experience higher concentrations of tropospheric pollution such as ozone as well as additional types of pollutants in the atmosphere as a result of worldwide warming.

General Impact of Climate/Pollution

Agriculture climate impact: Crop productivity, and nutritional quality due to drought, heat waves, plant illnesses, shifts in the agricultural growing geographical area, and even diseases in warmer locations are just a few of the ways that the climate impacts farming.

Water Resources: Climate change reduces the quality of water, which impacts the effectiveness of water. This causes a lot of changes in the water supply, intensifies the drought, and raises the likelihood of flooding incidents. The elements found in water are impacted by pollution, and these minerals have an immediate effect on crops, plant life, and flowers as well as on the well-being of people.

Forest's Climate Impact: A variety of natural phenomena that affect the forests are impacted by climate change. By extracting and releasing significant amounts of carbon from the atmosphere, absorbed or reflected sunlight, contributing to cooling through evaporation of and generating particulates that produce clouds, forests have an impact on the climate. The loss of indigenous plants and animals and ecosystems, changes in the composition of forests, and transpiration out of forest plant life and grasses all have an impact on the atmosphere (De, 2018).

Impact of Climate Change on Floriculture

Climate change poses significant challenges to the floriculture industry, impacting various aspects of plant growth, production, distribution, and overall sustainability. Some key impacts include:

Seasonal Shifts: Changes in temperature, rainfall patterns, and extreme weather events affect the ideal growing conditions for flowers and ornamental plants. Shifts in temperature zones may alter traditional cultivation areas, impacting plant health and growth.

Pest and Disease Pressure: Climate change can influence the prevalence and behaviour of pests and diseases, potentially leading to new outbreaks or the emergence of invasive species. Warmer temperatures might create more favourable conditions for certain pests, challenging plant health and requiring adjustments in pest management strategies.

Water Availability: Changes in precipitation patterns and increased frequency of droughts can affect water availability for irrigation, impacting the growth and quality of floriculture crops. Water scarcity might necessitate more efficient irrigation practices or alternative water sources.

Quality and Quantity of Production: Climate variability can affect the quality and quantity of flower production. Extreme temperatures, unexpected frosts, or heatwaves can damage plants, reduce yields, or affect flower size, color and fragrance.

Shifting Demand and Consumer Preferences: Changes in climate can alter consumer preferences for certain flowers or impact the demand for specific varieties. Flowers that are more resilient to changing climate conditions may gain popularity over others.

Logistics and Distribution Challenges: Climate-related disruptions, such as extreme weather events or changes in transportation routes due to climate impacts, can affect the logistics and distribution of floriculture products, potentially leading to delays and increased costs.

Adaptation and Innovation: Climate change necessitates adaptation strategies within the floriculture industry. This includes the development of new cultivars better suited to changing conditions, adoption of sustainable practices, and investment in technologies to mitigate climate-related risks.

To mitigate the impact of climate change on floriculture, industry stakeholders are increasingly exploring resilient cultivation techniques, investing in research and development of climate-resilient plant varieties, adopting sustainable and resource-efficient practices, and promoting greater awareness and adaptation among growers. Collaboration between researchers, growers and policymakers is essential in developing strategies to address the multifaceted challenges posed by climate change in the floriculture sector.

Conclusion

In the following decades, our metropolitan environments will undergo substantial changes due to expanding populations and the depletion of natural resources. These will affect people's health, and it will be challenging for them to adapt to this changing atmosphere. To deal with the rising temperatures, eco-friendly, urban-adaptable practices will need to be developed. The consequences of climate change will cause crop patterns to vary in the coming years, hence it is critical that the most sustainable practises be adjusted. Phyto-remediated plants are used to reduce air pollution as a result of harmful compounds entering the atmosphere more and more as temperatures rise. It is possible to cool down metropolitan areas and make them more aesthetically acceptable and visually appealing.

The practice of urban floriculture has the ability to reduce urban pollutants while also enhancing the environment. Since the impact of temperature has prevented certain blooms from budding, flowers produced as a result of climate change have smaller sizes, inappropriate color progressions, and shorter development times. Technology has made it simpler for farms to protect and grow plants before, during, and after harvesting. Technology has raised farm income and attracted adults and young people to farming. Because of the increasing pollution people, no longer see as much greenery or colorful

flowers. Millions of people receive everyday happiness with flowers through urban floriculture, making everyone happy.

References

- Anonymous (2023). Green Bridges Garden Bridges Greenery. (accessed on 12th December, 2023) <https://greenrooftechnology.com/living-architecture/green-garden-bridg>
- Anonymous (2023). Urban Floriculture: why its to necessary to continue. (accessed on 02nd December, 2023) <https://www.eatmy.news/2021/06/urban-floriculture-why-is-it-necessary.html>
- Anonymous (2014). window box gardening. Green My life. (accessed on 10th December, 2023) <https://www.greenmylife.in/window-box-gardening/>
- Anonymous (2024). 15 Incredible Benefits of having a vertical garden at home. *Rinkesh. Conserver Energy Future*. accessed on 10th January, 2024) <https://www.conserve-energy-future.com/benefits-vertical-garden.php>
- Anonymous (2024). Add vertical gardening to your yard for space saving greenery. *Bettors Home and Gardens*. (accessed on 02nd January, 2024) <https://www.bhg.com/gardening/container/plans-ideas/vertical-gardening/>
- Datta, S. K. (2019). Present status of research on floriculture in India. *LS-An International Journal of Life Science*, 8(2), 71-93.
- De, L. C., & Singh, D. R. (2016). Floriculture industries, opportunities and challenges in Indian hills. *International Journal of Horticulture*, 6(13), 1-9.
- De, L. C. (2018). Impact of climate change on floriculture and landscape gardening. *International Journal of Agriculture Sciences*, 10(11), 6253-6256.
- Department of Floriculture and Landscaping (2021). Vertical Gardening. *TNAU Agritech Portal horticulture*. https://agritech.tnau.ac.in/horticulture/horti_Landscaping_vertical%20gardening.html
- Flora Expo (2023). India’s Largest Exhibition on Floriculture, Nursery & Greenhouse Technology. (accessed on 26th December, 2023).<https://www.floraexpo.com/aboutus.html>
- Gills, R., Sharma, J. P., Burman, R. R., Sharma, R. R., & Kar, A. (2017). Peri urban floriculture: A comparative study from NCR on production, value addition, marketing and constraints. *Indian Journal of Agricultural Sciences*, 87(4), 544-550.
- Geetha, R., & Lissy, N. S. (2018). Export of cut flowers from India. *International Journal of Pure and Applied Mathematics*, 119(18), 3835-3847.
- Group AG (2021). Trends in floriculture: India had high possibility to increase the economy. (accessed on 20th December, 2023) <https://aggrp.in/2021-trends-in-floriculture-india-has-high-possibility-to-increase-the-economy/>
- HP, S. (2011). Growing floriculture industry: opportunities for India. In *National Conference on Recent Trends and Future Prospects in Floriculture*, 5-8.
- National Intelligence Council (NIC) (2009). India: Impact of climate change to 2030. *Joint Global Change Research Institute; Battelle*, 1-48. https://www.dni.gov/files/documents/climate2030_india.pdf
- Hasan, M., Kumar, L., Paradkar, V., Gavhane, K.P., Sagar, A., Bhai, P., & Chawda, D. (2023). IoT and Sensor Operated Smart Urban Farming Technology for Floriculture Industry magazine “Floriculture Today”, 27(8), 38-40. <https://www.risenshine.in/downloads/Floriculture-Magazine-Jan-2023.pdf>
- Misra, D., & Ghosh, S. (2016). Growth and export status of Indian floriculture: *A review. Agricultural Reviews*, 37(1), 77-80.

Bhat, C., & Paschapur, A. Urban Agriculture: The Saviour of Rapid Urbanization. *Indian Farmer*, 27(08), 1-9.

Patel, M. A., Chawla, S. L., Shah, H. P., Patil, S., & Bhatt, D. (2018). Vertical gardening: A Novel concept of urban ornamental horticulture. *Navsari Agricultural University, Gujarat*.

Sindhu, S. S., & Vanlalruati (2018). Recent Advance in land scape gardening. In: *Advance in floriculture & Urban Horticulture: Recent Advances in Landscape Gardening*, Stupera Press, Delhi, 16-19.

Sadasivam, S. (2022). Role of Ornamental Plants in Phytoremediation—*An Overview*, 11(44), 478-488.

The Agricultural and processed food products export development authority (APEDA) (2023). Floriculture and seeds. https://apeda.gov.in/apedawebsite/six_head_product/floriculture.htm#:~:text=India's%20total%20export%20of%20floriculture,export%2Doriented%20units%20in%20India

Vahoniya, D., Panigrahy, S. R., Patel, D., & Patel, J. (2018). Status of floriculture in India: With special focus to marketing. *International Journal of Pure and Applied Biosciences*, 6(2), 1431-1438.

Organic farming: Concept and Importance in Indian Agriculture

Dr. Mohd Shah Alam¹, Yograj¹, Suraj Singh², Dr. Roop Kishor Pachauri³

¹Assistant Professor, Department of Agronomy, Abhilashi University, Chail chowk, Distt. Mandi, H.P 175028

²Assistant Professor, Department of Entomology, Shri Ram College Muzaffarnagar, U.P 251001

³Assistant Professor, Department of Agronomy, Chhatrapati Shahu Ji Maharaj University, Kanpur, U.P 208024

Abstract

The exercise of producing crops and raising animals naturally is known as Organic farming. In order to preserve soil fertility and ecological balance, it uses natural resources rather than artificial ones, which prevents pollution and environmental deterioration. In other terms, organic farming refers to a farming technique that forgoes the utilization of agrochemical like pesticides and artificial fertilizers in the cultivation and maintenance of crops. Additionally, the usage of GMOs is also prohibited. In command to keep productivity high and control pests, organic cultivation uses a fabrication system that depend on preventative measures, Ecological procedures, biodiversity, and mechanical procedures, and natural cycles. Compared to the typical traditional grower, organic cultivation typically has a higher tolerance for insect pressure and weed competition. Agricultural methods including seed rotation, green manure, organic waste management, insect control, mineral additions, etc. are based on ecologically friendly practices. Instead than employing inputs with negative impacts, organic farming relies on natural processes and biodiversity that are suited to local conditions to optimize the health of people, soil systems, and ecosystems. Organic farming blends science, creativity, and tradition to protect the environment and foster equitable interactions among all parties. The sale of crops labeled as organic or biological is highly regulated in most advanced markets. Organic cultivation has a low environmental impact and can be utilized to clean up and improve degraded agricultural land.

Keywords: Organic farming, GMOs, crop rotation, conventional farmer, green manure

1. Introduction

Organic cultivation has been excused in India for centuries. It is a sustainable farming method that aims to cultivate land and raise crops in a way that keeps the soil healthy and alive by using organic waste and other biological materials, along with beneficial microbes (biofertilizers) that release nutrients to crops. This method primarily relies on proper crop rotation and other natural methods to maintain or increase the biological activity of the soil, and it largely excludes the use of agrochemicals such as mineral fertilizers and chemical plant protection products. Organic farming helps to reduce environmental pollution with chemicals, maintains soil fertility, and preserves biodiversity while allowing for the production of high-quality food [25]. According to the IFOAM, organic agriculture is guided by four principles: health, ecology, fairness, and care. It is defined as "a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved" [16]. Compared to the conventional production system, the use of large amounts of agrochemicals and agricultural machinery, organic farming usually uses lower inputs and obtains lower crop yields. The environmental impacts of organic farming per unit of land are usually lower compared with the conventional production. However, with regards to the unit of product, the environmental impacts of organic farming may be greater [18, 27& 8].

Organic agriculture aims to improve soil fertility by using available resources effectively and avoiding the use of synthetic compounds, genetically modified organisms, and agrochemicals as food additives. The practices of organic farming are well-known for their excellent quality and added value. They are based on ecological cycles and strive to limit the environmental impact of the food industry, preserve the long-term sustainability of soil, and utilize fewer non-renewable resources [7]. The impact of organic farming on the ecosystem is less than that of conventional farming, according to the majority of studies comparing their effects on biodiversity [26]. Additionally, organic farming offers significant environmental benefits like preventing the use of toxic pesticides and their distribution across the ecosystem and down the trophic chain, as well as requiring less water [7].

1.1 Definition

1. **FAO** suggested that "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycle's synthetic off-farm inputs and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all".
2. As per the definition of the **United States Department of Agriculture (USDA)** study team on organic farming "Organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc.) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection".
3. According to the International Federation of Organic Agriculture Movements (**IFOAM, 2008**) "Organic Agriculture is a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved".

2. History of organic farming

The concept of organic farming dates back to before 1940 and was pioneered by Sir Albert Howard (1873-1947). Howard believed that in order to maintain soil fertility, it was crucial to recycle waste materials, including sewage sludge, onto agricultural land. F.H. King's book 'Farmers of Forty Centuries' supported Howard's ideas in this regard. The term 'organic' was first used by Walter Northbourne to describe Howard's agricultural system, which he characterized as "having a complex but necessary interrelationship of parts, similar to those in living things." Lady Eve Balfour also contributed to the popularization of organic farming with her book 'The Living Soil,' which contrasted organic and non-organic farming methods. [9]. Advocates such as J.I. Rodale and his son Robert played a key role in promoting organic farming approaches. They published Organic Gardening and Farming magazine and several books on organic farming during the 1940s and beyond. In the 1960s, Rachel Carson's book Silent Spring further increased public demand for organic food by revealing the extensive harm caused by pesticides to the ecosystem. [1]. In 1980, organic farming gained popularity and recognition after the USDA published the Report and Recommendations on Organic Farming. In 1990, the Federal Organic Foods Production Act was passed, which led to increased support for organic farming in the United States. Another significant milestone was achieved in 2002, when the USDA Certified Organic label was officially established. Given the organic movement's ongoing concerns about social, environmental, and philosophical issues, organic agriculture is likely to continue evolving in the future [9]. In the 1960s, Rachel Carson's book Silent Spring exposed the environmental harm caused by pesticides, which increased consumer demand for organic food. This demand has been steadily rising since the late 20th century, leading to significant growth in the organic industry. The industry's growth is attributed to increased environmental awareness and concerns about the potential health effects of eating genetically modified (GMO) crops and pesticide residues. In 2019, retail sales of organic food in Europe exceeded \$52 billion (€45 billion), while sales in the United States increased from \$20.39 billion in 2008 to \$47.9 billion in 2019 [1].

3. Why Organic Farming is needed:

Due to continuous use of synthetic agrochemical, it causes ill effect on soil crops as well as on human and animal health. Change in soil structure, pollution in our air and water, causing deficiencies of micro-nutrients in soil, breeding more virulent and resistant species of insects and diseases, chemicals cause cancers and genetic damage, hormones and antibiotics leave residues in foods, killing of useful insects, microorganisms and predators that naturally check excessive crop damage by insect pests etc., are some of the prime ill effects of inorganic farming. Through organic farming we secure the food as well as environment to avoid the application of chemical fertilizer. Thus only apply the organic residue to enhance the quantity & quality of the produce by organic farming and to prevent the soil erosion & maintain the soil fertility at long run.

3.1 Objectives of organic farming

Organic farming has the twin objective of the system sustainable and environmentally sensitive.

1. To produce a food of nutritional quality and sufficient quantity,
2. To maintain and increasing long term fertility status of the soil,
3. Maximize the utilization of renewable resources in local agricultural systems.
4. To give all livestock, condition of life that allows them to perform all aspect of innate behavior,
5. Minimize pollution from agricultural practices.
6. Consider the social and environmental consequences of farming systems.

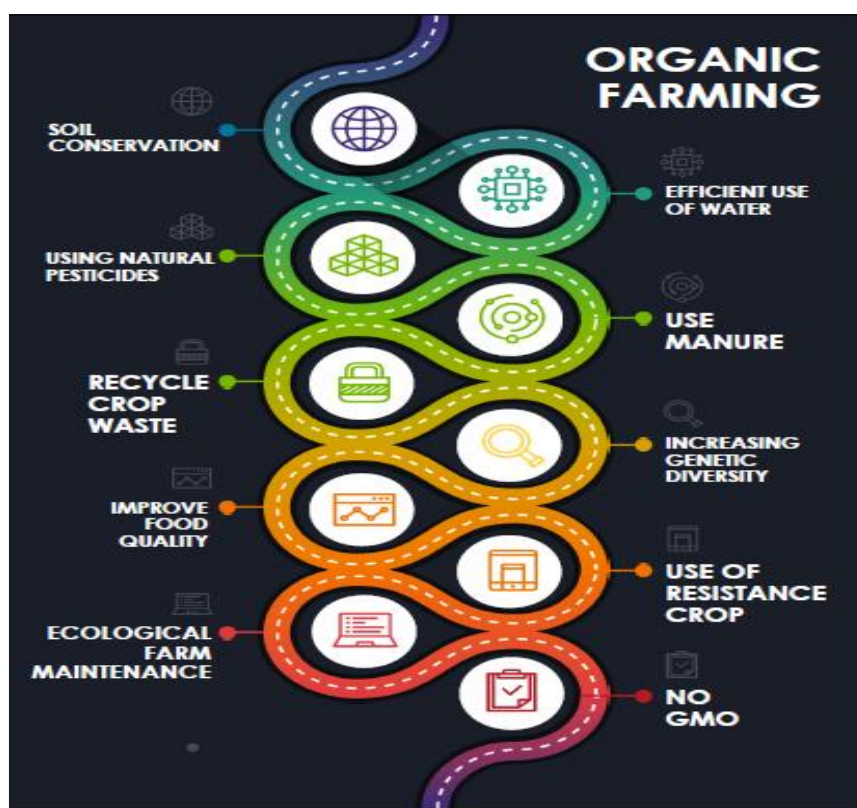


Fig. Roadmap of organic farming

3.2 Difference between organic and inorganic farming

Organic cultivation systems have long been compared with conventional farming systems in number of scientific studies and official reports [24]. One significant difference is the way that pest management tools, tactics, practices, and inputs are integrated into systems to prevent economically damaging pest losses [21, 22 & 13]. Organic growers use ecological principles and practices to build and sustain diverse communities of below- and above-ground organisms in ways that generally prevent economic losses from arthropod pests, plant pathogens, and weeds [2 & 6]. Combinations of cultural, physical, and mechanical practices are utilized to control weeds on organic farms, and herbicides are rarely used [15]. In contrast, conventional farmers generally rely predominantly and often exclusively on pesticides to manage pests, diseases, and weeds [14]. Historical organic farming technologies may be tailored by conventional agriculture to make it more sustainable and environmentally friendly.

Table: Fundamental differences between organic and conventional farming

Organic farming (OF)	Conventional farming (CF)
Synthetic fertilizers and insecticides are not allowed.	Synthetic fertilisers and pesticides are authorized.
Genetically modified organisms (GMOs) are not permitted.	GMOs can be employed.
Terrains have a higher capacity for holding water than CF.	Soils hold less water-holding capacity than organic farming.
Organic cultivation has more floral and faunal biodiversity than CF (intricate crop pattern).	
The agricultural terrain is characterized by heterogeneity (multicultural systems).	Conventional farming has less biodiversity than organic farming (commonly crop

	patterns).
diminishing the use of nonrenewable resources by recycling plant and animal waste into soils (on-farm inputs)	The agricultural landscape is distinguished by homogeneity (a mono-cultural system).
Organic cultivation is more sustainable than CF.	Depends mostly on nonrenewable resources (off-farm inputs).
International and national institutional groups such as Codex Alimentarius and IFOAM enforce strict regulations.	Conventional farming is less sustainable than OF.
Crop protection relies mostly on natural processes such as soil fertility, crop cycle, and biodiversity (more preventative).	Not severely controlled.

4. Principles of Organic Farming

The International Federation of Organic Agriculture Movements (IFOAM) defines the four major principles of organic farming as health, care, environment, and justice [10].

- ❖ **Principle of health:** Organic farming should safeguard and enhance the health of the land, plants, animals, humans, and the world as a whole. It aids in the maintenance of mental, physical, sustainable, and social health. For example, it provides pollution-free, chemical-free, and healthy food to humans.
- ❖ **Principle of Fairness:** Organic farming should be based on partnerships that provide justice in the shared environment and life chances. To be fair, production, distribution, and trading systems must be transparent and equal, with genuine environmental and social costs taken into consideration. Fairness is visible in the maintenance of fairness and equity in our common world, both among humans and other living species. Organic farming promotes quality of life and may eventually assist in reducing poverty.
- ❖ **Principle of Ecological Balance:** Organic cultivation should be founded on live ecological systems and cycles, working with, replicating, and sustaining them. Those who produce, process, trade, or use organic goods must safeguard and benefit the common environment, which includes landscapes, climate, habitats, biodiversity, air, and water. Organic agricultural systems must adhere to the natural ecological balances and biogeochemical cycles observed in nature.
- ❖ **Principle of Care:** Organic cultivation should be managed with prudence and responsibility to safeguard the health and well-being of present and future generations, as well as the environment [11]. Decisions should be made in a transparent and collaborative manner that reflects the values and needs of all parties involved. Furthermore, unlike current and conventional agricultural practices, organic farming does not use synthetic chemicals. It uses natural biological approaches to increase soil fertility, such as microbial activity, which improves plant nutrition. Most significantly, different cropping strategies in organic farming increase biodiversity, which promotes resilience, productivity, and a healthy farming system. On the contrary, the typical agricultural approach employs monocropping, which degrades soil fertility.

4.1 Major certified states

- India is entering in a new era of organic farming. As of March 2020, 2.78 million hectares, which is 2% of the 140.1 million hectares of net sown area in the country, were under organic farming, according to the Union Ministry of Agriculture and Farmers Welfare. A few states are leading the way in expanding the scope of organic cultivation. Madhya Pradesh tops the list of

states engaged in organic farming with 0.76 million hectares under organic farming, which is more than 27% of all organic farming land in India [4].

- To improve organic agricultural coverage, a few states have taken the lead, as the majority is concentrated in a few numbers of states. Madhya Pradesh leads the way in organic farming in India with 0.76 million hectares of land dedicated to organic agriculture, accounting for over 27% of the country's total organic agricultural land. The top three states, including Madhya Pradesh, Rajasthan, and Maharashtra, account for more than half of all organic cultivation. Furthermore, the top 10 states concentrate almost 80% of the land used for organic farming. [12].
- Currently, Sikkim is the only state in India that has been certified as fully organic. In most states, only a modest percentage of the net planted land is dedicated to organic farming. The top three states with the most land under organic cultivation are Madhya Pradesh, Rajasthan, and Maharashtra, and they have only 4.9%, 2.0%, and 1.6% of their net sown land dedicated to organic farming, respectively [12].
- Organic farming accounts for 10% or more of net planted area in some states, including Meghalaya, Mizoram, Uttarakhand, Goa, and Sikkim. Except for Goa, all of these states are hilly. Most other states devote < 10% of their net planted area to organic cultivation. UTs like as Delhi, Chandigarh, Dadra and Nagar Haveli, Lakshadweep, and Daman and Diu use organic farming for 10% or more of their net sown land, however their agricultural land is relatively modest [4].

Table 2: Organic sources in India

No.	State/Union Territory	Organic area	
		Total Organic area ('000,ha) in 2019*	Organic area in 2019 as % of net sown area of that state/Union Territory** (%)
1.	Madhya Pradesh	756	4.9
2.	Rajasthan	350	2.0
3.	Maharashtra	284	1.6
4.	Andhra Pradesh	144*	2.3
5.	Uttarakhand	128	18.2
6.	Odisha	118	2.6
7.	Karnataka	111	1.1
8.	Gujarat	103	1.0
9.	Uttar Pradesh	79	0.5
10	Sikkim	155 ^{&}	100.0
11	Chhattisgarh	71	1.5
12	Meghalaya	56	19.5
13	Kerala	54	2.7
14	Assam	43	1.5
15	Jharkhand	31	2.2
16	Tamil Nadu	30	0.6
17	Telangana	28	0.6
18	Jammu and Kashmir	26	3.4
19	Goa	23	18.1
20	Nagaland	23	6.0

21	Arunachal Pradesh	22	9.8
22	Manipur	19	5.0
23	Himachal Pradesh	18	3.3
24	Punjab	17	0.4
25	Mizoram	14	10.0
26	Bihar	12	0.2
27	Delhi	10	45.5
28	Dadar and Nagar Haveli	10	53
29	Andaman and Nicobar	9	60
30	West Bengal	9	0.2
31	Tripura	9	3.4
32	Haryana	7	0.2
33	Lakshadweep	3	~100 ⁵⁷
34	Chandigarh	3	~100 ⁵⁸
35	Daman and Diu	1	32 ⁵⁹
36	Puducherry	1	8 ⁶⁰
37	Total (India)	2,777	–

5. Crop protection measures in organic agriculture

Organic agricultural practices and methods are focused on three types of management strategies: prevention, monitoring, and suppression. The subsequent paragraphs will provide a detail description of these techniques:

5.1 Soil health management

Organic cultivation is the sole alternative for sustaining soil health, improving crop quality and shelf life, reducing environmental dangers, increasing farm profitability, and creating rural jobs. Finally, it helps to keep humans and animals healthy. Widespread nutrient deficits and poor soil health contribute to low nutrient usage efficiency, production, and profitability. Adoption of site-specific balanced and combined nutrient approach that include major, secondary, and micronutrients, organic manures, biofertilizers, and amendments. On the saying of water availability and utilization, organic cultivation tend to have an advantage since organically managed earth have higher water-holding ability and higher rates of infiltration. This additionally serves as a contributing factor to why organic systems are typically seen as more robust and yield-stable, especially under the condition of drought [7, 17].

5.2 Nutrient management

In order to grow, plants require a variety of mineral nutrients, including nitrogen, phosphorus, potassium, and numerous micronutrients, in addition to sunlight and optimal temperatures. Soil texture and soil composition, availability of water, and insect-pest and disease concerns are all important considerations. All of these characteristics may fluctuate between organic cultivation and conventional approaches, thus it is not unexpected that yield levels vary as well. As previously stated, organic standards ban the use of synthetic fertilisers. While organic fertilisers may deliver all of the necessary nutrients, nutrient management is more complex in organic agriculture systems [17]. Nitrogen and phosphorus deficiencies are frequently observed in organic systems [5, 19]. The distribution of available plant nitrogen from organic matter is sluggish and occasionally insufficient to meet nitrogen demand during peak crop development periods [23]. The quantity of phosphorus delivered in organic cultivation is often lesser to compensate amounts lost during the time of harvest [19]. In general, delivering the proper combination of nutrients to promote plant development is more difficult in natural systems since the nutritional ratio of organic inputs can only be adjusted to a limited extent [24].

Nutrient constraints are a significant element in explaining the observed production discrepancies in organic cultivation. In this context, lower-than-average production pause seen for legumes and fruits are conceivable. Pulses have the capability to fixate the atmospheric nitrogen, founded them to be less reliant on nitrogen from outside sources. Fruits grow on trees with extended growth seasons and large underground root structure, which gave them access to absorb nutrients in tune with crop need [23]

5.3 Natural Pest Management

Organic systems, on the next hand, might be more sensitive to insect outbreaks, resulting in yield losses and increased variability [24]. In organic agriculture, the absence of genetically modified crops and synthetic pesticides limits farmers' ability to manage invasive plants, wildlife, and plant diseases effectively. Thus, organic farming experiences greater production losses in high pest pressure environments, such as areas with pests and diseases that are challenging to manage biologically, than in low pest pressure situations. The losses due to pests in crop productivity and quality are usually more variable and higher in organic farms than in surrounding conventional farms. On the one hand, pest-related losses lead to a decrease in earnings and lower yields; on the other hand, organic farms benefit from lower operational costs and higher prices, resulting in an increase in income. The majority of synthetic pesticides used in natural cultivation are bio-pesticides, which function in a non-toxic manner and offer little dangers to human health and the environment. They are slow-acting, need certain treatment schedules, and suppress rather than destroy insect populations [20]. Bio-pesticides have low field persistence, a shorter shelf life and no residual concerns. As an end result, pest management in organic crops is allowed.

Table 3. Some important natural or botanical pesticides and their sources

Name of botanical pesticide	Origin	Characteristics of the product	Against which insect
Allicin	Garlic	Broad spectrum pesticide	Acts as antibacterial and bio-pesticide
Nicotine sulfate	Tabacco	Insecticide	Aphids, thrips, spider, mites and sucking insect.
Sabadiella	Sabadilla lily	Insecticide	Caterpillar, leaf hoppers, thrips, and bugs
Neemacide	Neem tree	Insecticide	Desert locust , potato beetle, grasshopper and moth
Acorin	Roots of sweet flag	Insecticide	Aphid and caterpillars
Karangin	Seed of karangin	Insecticide	Storage pests
Rotenone	Roots of <i>Derris eliptica</i>	Insecticide	Aphids
Pyrethrum	Chrysanthemum	Insecticide	Aphids and ecto-parasites of livestock's

Table 4. Biopesticides used in vegetables

Type	Biopesticides	Effective pesticides
Parasitoid	<i>Trichogramma chilonis</i>	Lepidopteron insect

Fungus	<i>Trichoderma spp.</i>	Fungal diseases
Bacteria	<i>Bacillus thuringiensis</i>	<i>Helicoverpa, Arotis, Spodotera, plutella</i>
Baculoviruses	NPVs, GV _s	Lepidoptera, coleopteron , diptra

6. Challenges in Organic Cultivation

- 1) Package of organic farming, has to be location specific.
- 2) Bulky nature of organic manure, leading to high transport and application cost.
- 3) Small farm holding reduce the scope for in-situ organic manure production.
- 4) Farmers lack awareness of scientific composting methods and applications.
- 5) Lack of scientific data long term benefit and limitation of organic farming.
- 6) Limited domestic market for organically grown agricultural produce.
- 7) Quality certification.

7. Advantages of Organic Farming

- I. It promotes environmental health by lowering pollutants.
- II. Minimizes health risks for humans and animals by lowering product residual levels.
- III. It promotes sustainable agriculture production.
- IV. It decreases agricultural production costs and enhances soil health.
- V. It maximizes natural resource use for short-term benefits while protecting them for next generations.
- VI. It conserves energy of both animals and machines and reduces the risk of crop failure.
- VII. Remediate soil physical qualities, including granulation, tilth, air circulation, root permeability, water-holding ability, and erosion resistance.
- VIII. Enhances soil chemical characteristics, including nutrient availability and retention, reduced nutrient loss to water bodies and the environment, and beneficial chemical interactions.

References

1. Adamchak, R. (2022). *Organic farming. Encyclopedia Britannica.* <https://www.britannica.com/topic/organic-farming>.
2. Altieri, M.; Letourneau, N.; Davis, J.R. Developing Sustainable Agroecosystems. *BioScience* 1983, 33, 45–49.
3. Anonymous 2008. <https://www.ifoam.bio/why-organic/organic-landmarks/definition-organic>.
4. Anonymous 2021. <https://www.10pointer.com/current-affairs/state-of-organic-farming-in-india>. 5th Apr, 2021.
5. Berry PM, Sylvester-Bradley R, Philipps L, Hatch DJ, Cuttle SP, et al. 2002. Is the productivity of organic farms restricted by the supply of available nitrogen? *Soil Use Manag.* 18: 248–55.
6. Gliessman, S.R. *Agroecology: The Ecology of Sustainable Food Systems*, 3rd ed.; CRC Press: Boca Raton, FL, USA, 2014.

7. Gomiero T, Pimentel D, Paoletti MG. (2011). Environmental impact of different agricultural management practices: conventional versus organic agriculture. *Crit. Rev. Plant Sci.* 30: 95–124.
8. Gomiero, T.; Paoletti, M.; Pimentel, D. (2008) Energy and environmental issues in organic and conventional agriculture. *Crit. Rev. Plant Sci.*, 27, 239–254.
9. Heckman, J. (2006). A history of organic farming: Transitions from Sir Albert Howard's War in the Soil to USDA National Organic Program. *Renewable Agriculture and Food Systems*, 21(3), 143-150.
10. I.F.O.A.M. (2005a). The IFOAM Norms for organic production and processing including IFOAM Basic Standards and IFOAM Accreditation Criteria. https://agritech.tnau.ac.in/org_farm/pdf/IFOAM_basic_standards.
11. I.F.O.A.M. (2005b). The four principles of organic agriculture. <https://ifoam.bio/whyorganic/shaping-agriculture/four-principles-organic>
12. Khurana, A., & Kumar, V. (2020). On a tardy trail: State of organic farming in India. *Agriculture, Tuesday*, 8.
13. Letourneau, D.K.; Bothwell, S.G. (2008) Comparison of organic and conventional farms: Challenging ecologists to make biodiversity functional. *Front. Ecol. Environ.* 6, 430–438.
14. Letourneau, N.; Van Bruggen, A.H.C. (2006) Crop protection in organic agriculture. In *Organic Agriculture. A Global Perspective*; Kristiansen, P., Taji, A., Renagold, J., Eds.; CSIRO Publishing: Clayton, Australia; CABI Publishing: Wallingford, UK, 2006; pp. 93–121.
15. Liebman, M.; Davis, V.M. Integration of soil, crop and weed management in low-external-input farming systems. *Weed Res.* 2000, 40, 27–47.
16. Migliorini, P.; Wezel, A. (2017) Converging and diverging principles and practices of organic agriculture regulations and agroecology. A review. *Agron. Sustain. Dev.*, 37, 63.
17. Niggli U. (2015) Sustainability of organic food production: challenges and innovations. *Proc. Nutr. Soc.* 74: 83–88.
18. Nitschelm, L.; Flipo, B.; Chambaut, H.; Colomb, V.; Gac, A.; Dauguet, S.; Espagnol, S.; Le Gall, C.; Perrin, A.; Ponchant, P.; (2021) Using life cycle assessment to assess and improve the environmental performance of organic production systems. In *Book of Abstracts of the Science Forum at the Organic World Congress 2021, Rennes, France, 8–10 September 2021*.
19. Oehl F, Oberson A, Tagmann HU, Besson JM, Dubois D, (2002). Phosphorus budget and phosphorus availability in soils under organic and conventional farming. *Nutr. Cycl. Agroecosyst.* 62: 25–35
20. Olson S. (2015) an analysis of the bio-pesticides market now and where it is going. *Outlooks on Pest Management*.;26(5):203-206
21. Pimentel, D.; Hepperly, P.; Hanson, J.; Douds, D.; Seidel, R. (2005) Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems. *Bio-Science*, 55, 573–582.
22. Reganold, J.P.; Glover, J.D.; Andrews, P.K.; Hinman, H.R. Sustainability of three apple production systems. *Nature* 2006, 443, 117.
23. Seufert V, Ramankutty N, Foley JA. (2012). Comparing the yields of organic and conventional agriculture. *Nature* 485: 229–32.
24. Seufert V, Ramankutty N. (2017). Many shades of gray—the context-dependent performance of organic agriculture. *Sci. Adv.* 3: e1602638.

25. Średnicka-Tober, D.; Obiedzinska, A.; Kazimierczak, R.; Rembiałkowska, E. (2016) Environmental impact of organic vs. conventional agriculture—A review. *J. Res. Appl. Agric. Eng.*, 61, 204–211.
26. Tuomisto, H.L., Hodge, I.D., Riordan, P., Macdonald, D.W.(2012) Does organic farming reduce environmental impacts? - A meta-analysis of European research. *Journal of Environmental Management*; 112 309-320.
27. Van Stappen, F.; Lories, A.; Mathot, M.; Planchon, V.; Stilmant, D.; Debode, F. (2015) Organic versus conventional farming: The case of wheat production in Wallonia (Belgium). *Agric. Agric. Sci. Procedia*, 7, 272–279.

Sustainable Practices for Soil and Nutrient Management in Horticulture

D. K. Vasoya¹, V. M. Gohil², Pratik Chaudhary and Janika Bhadarka

¹*Assistant Professor, Rai School of Agriculture, Rai University, Ahmedabad*

²*Ph.D. Student Navsari Agricultural University Navsari*

Abstract

Sustainable soil and nutrient management practices are essential for ensuring the long-term viability and productivity of horticultural systems. This chapter provides an overview of key strategies employed in sustainable horticulture to main soil health, conserve nutrients and minimize environment impact. In sustainable horticulture soil health is paramount, emphasizing the preservation of soil structure, organic matter content and microbial diversity. Conservation techniques such as minimal tillage, cover cropping and mulching are employed to mitigate erosion, enhance water retention and promote soil biodiversity. Nutrient management focuses on optimizing nutrient cycling through practices such as composting, green manuring and integrated pest management (IPM) to minimize reliance on synthetic fertilizers and reduce nutrient runoff. Organic farming principles underscore the importance of natural inputs and biological processes, promoting the use of organic soil amendments and fertilizers to enhance soil fertility and ecosystem resilience. Precision agriculture technology offer precise nutrient application and irrigation management, optimizing resource use and minimizing environmental impact. Water management strategies, including efficient irrigation techniques and rainwater harvesting, play a crucial role in sustainable horticulture, conserving water resources and reducing runoff and soil erosion. Agroforestry practices integrate trees and shrubs into horticultural systems, providing multiple benefits such as soil stabilization, nutrient cycling and biodiversity conservation.

Key word: Horticulture, Sustainability, Soil, Nutrient

Introduction

Sustainable horticulture refers to the practice of growing fruits, vegetables, herbs and ornamental plants in a manner that is environmentally friendly, socially responsible and economically viable. It involves minimizing negative impacts on the environment, conserving natural resources, promoting biodiversity and ensuring the well-being of workers and communities. Sustainable horticulture is important for ensuring food security, preserving ecosystems, mitigating climate change and promoting long-term prosperity for both present and future generations. Soil and nutrient management are fundamental to sustainable horticulture, as it directly impacts plant growth, health and productivity while also influencing environmental sustainability. An effective soil and nutrient management strategy involves

various practices aimed at maintaining soil fertility, optimizing nutrient availability and minimizing adverse environmental impacts. One of the key principles of sustainable soil management is maintaining soil health. This entails practices such as crop rotation, cover cropping and reduced tillage to improve soil structure, promote microbial diversity and enhance nutrient cycling. By rotating crops, different plants with varying nutrient requirements are grown in succession, reducing the risk of nutrient depletion and pest buildup while also promoting soil health. Cover crops, such as legumes or grasses, can be planted during fallow periods to prevent soil erosion, suppress weeds and add organic matter to the soil through decomposition. Reduced tillage practices help preserve soil structure and organic matter, reducing erosion and nutrient loss. Furthermore, sustainable nutrient management involves minimizing the use of synthetic fertilizers and optimizing the use of organic amendments and nutrient recycling. Organic amendments, such as compost, manure and biochar, enrich the soil with organic matter, improve soil structure and provide essential nutrients to plants in a slow-release form. These amendments also help retain moisture in the soil, reducing the need for irrigation and promoting drought resilience. Additionally, nutrient cycling plays a crucial role in sustainable horticulture by recycling nutrients within the agroecosystem. Practices such as mulching, composting and nutrient-efficient cropping systems help capture and recycle nutrients from plant residues, organic matter and animal waste, minimizing nutrient loss to the environment and reducing the reliance on external inputs. Overall, effective soil and nutrient management practices are essential for sustainable horticulture, as they support healthy plant growth, preserve soil fertility and minimize environmental impacts, ensuring the long-term productivity and resilience of agricultural systems.

Soil Health and Conservation

Understanding soil health parameters is crucial for effective soil conservation and management in horticulture. Soil health refers to the capacity of soil to sustain plant and animal productivity, maintain or enhance water and air quality and support diverse communities of soil organisms. Several key parameters help assess soil health.

Soil texture: Refers to the relative proportion of sand, silt and clay particles in the soil. It influences water retention, drainage and aeration.

Soil pH: A measure of the soil's acidity or alkalinity. pH affects nutrient availability to plants and the activity of soil microbes.

Organic matter content: Organic matter provides nutrients, improves soil structure, enhances water retention and promotes microbial activity.

Soil structure: The arrangement of soil particles into aggregates affects water infiltration, root penetration and soil aeration.

Soil moisture: Adequate moisture levels are essential for plant growth and microbial activity. Soil moisture also influences soil compaction and erosion.

Nutrient levels: Essential nutrients such as nitrogen, phosphorus and potassium are critical for plant growth. Soil tests help assess nutrient levels and guide fertilizer applications.

Microbial activity: Soil microbes play vital roles in nutrient cycling, organic matter decomposition and disease suppression. Healthy soils support diverse microbial communities.

Soil conservation techniques aim to preserve soil health and productivity while minimizing erosion, nutrient loss and environmental degradation. In horticulture, several practices promote soil conservation:

Mulching: Applying organic mulches like straw, wood chips, or compost to the soil surface conserves moisture, suppresses weeds, moderates soil temperature and reduces erosion.

Cover cropping: Planting cover crops such as legumes or grasses helps protect soil from erosion, improves organic matter content and enhances soil structure.

Crop rotation: Rotating different crops helps break pest and disease cycles, improves soil structure and prevents nutrient depletion.

Conservation tillage: Reduced tillage or no-till practices minimize soil disturbance, preserve soil structure and reduce erosion while maintaining organic matter levels.

Terracing: Terracing sloped terrain creates level planting areas, reducing erosion by slowing water runoff and allowing for better water infiltration.

Contour farming: Planting crops along the contour lines of the land helps reduce soil erosion by preventing water from flowing downhill and carrying away soil particles.

Agroforestry: Integrating trees or shrubs into agricultural systems improves soil structure, enhances biodiversity and provides additional income streams.

Importance of Soil Organic Matter and Microbial Activity

Soil organic matter (SOM) is crucial for soil health and fertility. It improves soil structure, water retention, nutrient availability and microbial activity. SOM also serves as a reservoir for carbon, helping mitigate climate change by sequestering carbon dioxide from the atmosphere. Microbial activity in the soil is essential for nutrient cycling, organic matter decomposition and soil fertility. Soil microbes break down organic matter into simpler forms that plants can absorb, releasing nutrients such as nitrogen, phosphorus and potassium. Beneficial microbes also help suppress soil-borne diseases and enhance plant resilience to environmental stress. In horticulture, maintaining soil organic matter and promoting microbial activity are key strategies for sustainable soil management. Practices such as adding compost, minimizing soil disturbance and fostering diverse crop rotations support healthy soil ecosystems, leading to improved plant productivity and resilience over the long term.

Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is a holistic approach to pest management that emphasizes the use of multiple strategies to prevent and control pests while minimizing risks to human health, beneficial organisms and the environment.

Reducing reliance on synthetic pesticides:

One of the primary goals of IPM is to minimize the use of synthetic pesticides by integrating various pest management tactics. This helps to mitigate the negative impacts of chemical pesticides on human health, beneficial organisms and ecosystems.

Preserving beneficial organisms

IPM prioritizes the conservation of natural enemies, such as predators, parasitoids and pathogens, which play key roles in regulating pest populations. By minimizing the use of broad-spectrum pesticides, IPM allows beneficial organisms to thrive and exert natural pest control.

Enhancing biological control

Biological control methods are central to IPM in sustainable horticulture. These methods involve the introduction, augmentation or conservation of natural enemies to suppress pest populations. Examples include releasing predatory insects, parasitoids or using microbial biopesticides to target specific pests.

Cultural and physical controls

IPM encourages the implementation of cultural and physical controls, such as crop rotation, habitat manipulation, trap cropping, mulching and exclusion techniques (e.g., row covers). These practices disrupt pest life cycles, reduce pest pressure and create unfavourable conditions for pest development.

Monitoring and decision making

IPM relies on regular monitoring of pest populations and their natural enemies to assess pest pressure and make informed management decisions. By using scouting, trapping and other monitoring techniques, growers can accurately determine when intervention is necessary and select the most appropriate control tactics.

Use resistant varieties

Incorporating pest-resistant plant varieties into horticultural systems is another IPM strategy. Resistant cultivars can withstand pest attacks better, reducing the need for pesticide applications.

Educations and outreach

IPM programs often include educational components to train growers and agricultural professionals in the principles and practices of sustainable pest management. Outreach efforts aim to promote adoption of IPM strategies and foster a deeper understanding of ecological interactions in agroecosystems.

Precision Farming Technologies for Sustainable Horticulture

Precision farming technologies enable farmers to make data-driven decisions and optimize resource use for improved efficiency and sustainability.

Application of Precision Agriculture in soil and nutrient management

- **Soil Mapping and Analysis:** Precision agriculture utilizes soil mapping techniques, including soil sampling and analysis, to assess soil variability in terms of texture, nutrient content, pH levels and organic matter. This information helps farmers create variable rate application maps for fertilizers and soil amendments.
- **Variable Rate Application (VRA):** Precision agriculture allows for precise application of fertilizers, lime and other soil amendments based on soil maps and crop requirements. VRA optimizes nutrient distribution, minimizes waste and reduces environmental impacts.
- **Soil Moisture Monitoring:** Sensors and probes are used to monitor soil moisture levels in real-time, enabling farmers to implement irrigation practices that match crop water requirements and minimize water wastage.
- **Soil Health Monitoring:** Precision agriculture also includes monitoring soil health indicators such as microbial activity, soil compaction and erosion risk. This data helps farmers assess the impact of management practices on soil quality and make adjustments as needed.

1. Use of sensors and GIS for precision farming

- **Remote Sensing:** Remote sensing technologies, including satellites, drones and aerial imagery, provide valuable data on crop health, growth patterns, and stress factors. This information is used to create prescription maps for targeted interventions such as pest control and nutrient application.

- **Sensor Technologies:** Various types of sensors, such as pH meters, conductivity sensors and optical sensors, are used to collect data on soil properties, crop health, environmental conditions and equipment performance. This data is integrated into decision support systems to optimize management practices.
- **Geographic Information Systems (GIS):** GIS software is used to analyze spatial data, create maps and identify patterns within agricultural landscapes. GIS helps farmers identify areas of soil variability, plan field operations and manage resources more efficiently.

Water Management and Conservation

Water management and conservation are critical components of sustainable agriculture, especially in horticulture where water demand can be high. Here are some strategies for efficient water use and conservation.

1. Efficient irrigation technique

- **Drip Irrigation:** Drip irrigation delivers water directly to the root zone of plants through a network of low-pressure tubing and emitters. This method reduces water waste by minimizing evaporation and runoff and allows for precise control of water application, matching crop water needs more closely.
- **Micro-Sprinklers:** Micro-sprinkler systems apply water in small droplets, reducing water loss to evaporation and wind drift. These systems can be designed to match the specific water requirements of different crops and soil types.
- **Subsurface Irrigation:** Subsurface irrigation involves delivering water directly to the root zone below the soil surface. This method reduces water loss due to evaporation and minimizes weed growth by keeping the soil surface dry.
- **Soil Moisture Sensors:** Installing soil moisture sensors helps growers monitor soil moisture levels in real-time and schedule irrigation based on actual crop needs. This prevents overwatering and ensures that water is applied only when necessary.

2. Rainwater harvesting and drip irrigation system

- **Rainwater Harvesting:** Collecting and storing rainwater runoff from roofs, greenhouses and other surfaces can supplement irrigation water supplies. Rainwater harvesting systems can range from simple rain barrels to more sophisticated storage tanks and cisterns.
- **Greywater Recycling:** Greywater, which is wastewater from sinks, showers and washing machines, can be treated and reused for irrigation purposes. Greywater recycling systems help conserve freshwater resources and reduce reliance on potable water for irrigation.

3. Strategies for reducing water in horticulture

- **Mulching:** Applying organic or synthetic mulches to the soil surface helps conserve soil moisture by reducing evaporation, suppressing weed growth and maintaining more uniform soil temperatures. Mulching also improves soil structure and reduces erosion.
- **Crop Selection and Rotation:** Choosing drought-tolerant crop varieties and rotating crops with different water requirements can help optimize water use in horticultural systems. Matching crops to the local climate and soil conditions can minimize water stress and improve overall water efficiency.
- **Soil Management Practices:** Improving soil structure through practices such as cover cropping, organic matter addition and reduced tillage enhances water infiltration and

retention capacity. Healthy soils with good structure and organic matter content require less irrigation water to support plant growth.

- **Irrigation Scheduling:** Implementing efficient irrigation scheduling based on crop water requirements, weather conditions and soil moisture levels helps avoid overwatering and underwatering. Using tools such as evapotranspiration (ET) data, weather forecasts and irrigation controllers can optimize irrigation timing and duration.

Agroforestry And Agroecology

Agroforestry and agroecology are both holistic approaches to agriculture that emphasize the integration of ecological principles and practices into farming systems.

Integration of trees and shrubs in horticultural system

- **Agroforestry:** Agroforestry involves the intentional integration of trees and shrubs into agricultural landscapes. In horticulture, trees and shrubs can be incorporated into orchards, vineyards, agroecosystems and other cropping systems to provide multiple benefits such as shade, windbreaks, biodiversity habitat and supplemental income from tree products like fruits, nuts, timber or medicinal plants.
- **Alley Cropping:** Alley cropping is a common agroforestry practice where rows of trees or shrubs are alternated with rows of annual crops. This arrangement maximizes land use efficiency, provides multiple sources of income and enhances ecological functions such as nutrient cycling, soil conservation and pest management.

1. Benefits of Agroforestry for soil health and biodiversity

- **Soil Health:** Agroforestry systems contribute to soil health by improving soil structure, fertility and organic matter content. Tree roots help to stabilize soils, reduce erosion and increase water infiltration, while leaf litter and organic debris from trees provide nutrients and organic matter to the soil.
- **Biodiversity Conservation:** Agroforestry enhances biodiversity by creating diverse habitats for plants, animals and microorganisms. The presence of trees and shrubs in agricultural landscapes increases habitat complexity, supports beneficial insects and pollinators and provides food and shelter for wildlife.

2. Agroecological principles for sustainable horticulture

- **Diversity:** Agroecology emphasizes the importance of biodiversity in agricultural systems. In horticulture, diversifying crops, incorporating cover crops and integrating trees and shrubs help to enhance ecosystem resilience, reduce pest and disease pressure and improve overall productivity.
- **Ecological Balance:** Agroecological practices aim to mimic natural ecosystems and promote ecological balance within agricultural landscapes. This includes optimizing nutrient cycling, minimizing external inputs and fostering beneficial interactions between plants, animals and microorganisms.
- **Soil Health:** Maintaining soil health is a core principle of agroecology. Practices such as minimal tillage, cover cropping, composting and organic matter addition help to improve soil structure, fertility and biological activity, leading to healthier and more productive soils.
- **Social Equity and Economic Viability:** Agroecology recognizes the importance of social equity and economic viability in sustainable horticulture. It promotes farmer autonomy, local food systems, fair labour practices and equitable access to resources, markets, and knowledge.

Techniques For Improving Nutrient Retention and Availability

Improving nutrient retention and availability in soil is essential for promoting healthy plant growth and maximizing crop yields.

Soil testing: Conduct regular soil tests to determine nutrient levels and pH. This information helps in understanding which nutrients are deficient and need to be supplemented.

Organic matter addition: Incorporate organic matter such as compost, manure or cover crops into the soil. Organic matter improves soil structure, increases nutrient retention and provides a slow release of nutrients as it decomposes.

Mulching: Apply mulch to the soil surface to reduce nutrient leaching, maintain soil moisture, and regulate soil temperature. Organic mulches also contribute to soil organic matter and microbial activity.

Crop rotation: Rotate crops to prevent nutrient depletion and soil-borne diseases. Different crops have varying nutrient requirements and root structures, which can help maintain soil fertility and structure.

Cover cropping: Plant cover crops during fallow periods to protect the soil from erosion, suppress weeds and enhance nutrient cycling. Leguminous cover crops can fix nitrogen from the atmosphere, enriching the soil with this essential nutrient.

Green manure: Incorporate green manure crops into the soil while they are still green and actively growing. These crops add organic matter and nutrients to the soil when tilled under, improving soil fertility.

Crop residue management: Leave crop residues on the soil surface after harvest to reduce erosion, improve soil structure and recycle nutrients back into the soil as they decompose.

Balanced fertilization: Use fertilizers judiciously and apply them based on soil test results and crop requirements. Balanced fertilization ensures that essential nutrients are available in the right amounts and ratios for optimal plant growth.

Precision agriculture techniques: Employ precision agriculture techniques such as variable rate application of fertilizers and soil amendments based on soil maps and sensor data. This allows for targeted nutrient management and reduces over-application, minimizing nutrient losses.

Microbial inoculants: Use microbial inoculants such as mycorrhizal fungi and rhizobacteria to enhance nutrient uptake by plants. These beneficial microbes form symbiotic relationships with plant roots, increasing nutrient absorption and improving soil health.

pH management: Adjust soil pH to optimal levels for nutrient availability. Liming can raise pH in acidic soils, while elemental sulphur can lower pH in alkaline soils, ensuring that essential nutrients are more readily available to plants

By implementing these techniques, you can improve nutrient retention and availability in soil, leading to healthier plants, increased crop productivity and sustainable agricultural practices

Conclusion:

In conclusion, implementing sustainable practices for soil and nutrient management is paramount for the long-term health of agricultural systems and the environment. By adopting practices such as crop rotation, cover cropping, composting, reduced tillage, and precision nutrient management, farmers can enhance soil fertility, improve water retention, reduce erosion and minimize nutrient runoff. These practices not only contribute to increased agricultural productivity and profitability but also play a crucial role in mitigating climate change by sequestering carbon in the soil. Additionally, sustainable soil and nutrient management practices promote biodiversity, support ecosystem services and safeguard water quality. However, successful implementation of these practices requires collaboration among farmers, researchers, policymakers and other stakeholders, as well as investment in education,

infrastructure and technology. By prioritizing sustainable soil and nutrient management, we can ensure the resilience and sustainability of our food systems for generations to come.

References:

- Bagyaraj, D.J. and Ashwin, R., 2017. Soil biodiversity: role in sustainable horticulture. *Biodivers Horticult Crops*, 5, pp.1-18.
- Chartzoulakis, K. and Bertaki, M., 2015. Sustainable water management in agriculture under climate change. *Agriculture and Agricultural Science Procedia*, 4, pp.88-98.
- Cuthbertson, A.G., 2020. Integrated pest management in arable and open field horticultural crops. *Insects*, 11(2), p.82.
- Das, U., Pathak, P., Meena, M.K. and Mallikarjun, N., 2018. Precision farming a promising technology in horticulture: a review. *Int. J. Pure Appl. Biosci*, 6, pp.1596-1606.
- M Hassona, M., 2023. Trends in Soil Resources Conservation and Restoration for Sustainable Horticulture, A Review. (September 12, 2023).
- M. Tahat, M., M. Alananbeh, K., A. Othman, Y. and I. Leskovar, D., 2020. Soil health and sustainable agriculture. *Sustainability*, 12(12), p.4859.
- Mosquera-Losada, M.R. and Prabhu, R., 2019. *Agroforestry for sustainable agriculture*. Burleigh Dodds Science Publishing Limited.
- Nandwani, D. ed., 2014. *Sustainable horticultural systems: issues, technology and innovation* (Vol. 2). Springer.
- Reddy, P.P., 2014. *Biointensive integrated pest management in horticultural ecosystems*. Berlin/Heidelberg, Germany: Springer.
- Singh, J. ed., 2013. *Precision farming in horticulture*. New India Publishing Agency.
- Wezel, A., Casagrande, M., Celette, F., Vian, J.F., Ferrer, A. and Peigné, J., 2014. Agroecological practices for sustainable agriculture. A review. *Agronomy for sustainable development*, 34(1), pp.1-20.
- Yadav, R.K., Yadav, D.S., Rai, N. and Sanwal, S.K., 2006. Soil and water conservation through horticultural intervention in hilly areas. *Envis Bull Himal Ecol*, 14(1), pp.4-13.
- Yadav, V. and Yadav, P., 2014. Precision farming: A sustainable approach for organic horticulture production. *Indian Horticulture Journal*, 4(1), pp.79-72.

Microbial Biosurfactants: Efficient Tools in Bioremediation of Hydrocarbons

Abhinandana, K. R¹, Krishna Naik, L¹. And Monisha, K. R²

¹Department of Agricultural Microbiology, UAS, GKVK, Bengaluru-560 065

²Department of Plant Pathology, KSNUAHS, Shivamogga-577 204

Corresponding author email: krabhinandana18@gmail.com

Abstract

Environmental pollution stemming from organic contaminants poses a significant challenge due to its widespread impact on diverse ecosystems. The issue is particularly pronounced with hydrophobic contaminants, as their molecules tend to bind to soil particles. However, these contaminants, characterized by low water solubility and high interfacial tension, present difficulties in removal. To address this challenge, surfactants play a crucial role in soil and water remediation technologies, aiding

in the desorption of contaminants. Surfactants, also known as surface-active agents, are amphiphiles capable of forming micelles. They stand out as ubiquitous chemicals in daily life. In recent times, there has been a shift from chemically produced surfactants to microbial-based alternatives, obtained through enzymatic or microbial synthesis. This approach not only addresses environmental pollution concerns but also aligns with sustainable practices by harnessing the potential of biologically synthesized surfactants.

Keyword: Biosurfactant, bioremediation, hydrocarbons

Introduction

Recently, numerous instances have surfaced concerning the contamination of soil and water by organic pollutants, significantly affecting both soil and water quality. The challenge lies in the difficulty of removing these pollutants due to their low solubility in water and high interfacial tension. As a response to this environmental concern, bioremediation has emerged as a viable method for addressing contaminated place. Reremediation strategies hinge on the utilization of diverse microorganisms, including bacteria, yeasts and fungi, which are often isolated from soil or locations where contaminants like hydrocarbons are present. This microbial intervention proves instrumental in facilitating the cleanup of contaminated sites (Okoliegbe and Agarry, 2012). Biosurfactants produced by environmental microorganisms aid in utilizing hydrocarbons as a carbon source. They achieve this by either releasing biosurfactants into the environment to make hydrocarbons accessible or by modifying their cell surface to facilitate the absorption of contaminants.

Biosurfactants gained attention in the late 1960s as potential substitutes for synthetic surfactants like carboxylates, sulfonates, and sulfate acid esters. This interest stemmed from their ability to dissolve hydrocarbons, particularly in industries such as food, pharmaceuticals, and oil. Synthetic surfactants currently in use often exhibit toxicity and resistance to microbial degradation, posing environmental risks. Biosurfactants offer advantages over synthetics, such as biodegradability, compatibility with the environment and low toxicity, which allows for their use in the cosmetic, pharmaceutical and food industries. Other advantages may include stability under extreme conditions of temperature, pH and salinity, as well as high selectivity, due to the presence of specific functional groups, which allows specificity in the removal of pollutants. These characteristics contribute to the biosurfactant applicability in different industries (Silva et al., 2019).

The categorization of surfactant is contingent on their chemical composition, mode/nature of action, and the microorganisms responsible for their production. These molecules can be classified as high or low molecular weight and may include phospholipids, glycolipids. Microorganisms also generate surfactants that, in some instances, comprise multiple chemical types, collectively termed polymeric microbial surfactants.

Biosurfactants: General characteristics

Amphiphiles capable of enhancing interactions between surfaces through micelle formation are known as surface active agents or surfactants (Rahman and Gakpe, 2008). Surfactants are molecules with both hydrophobic and hydrophilic components. Typically, the hydrophobic segment comprises a nonpolar long chain of fatty acids, while the hydrophilic part can be nonionic, positively charged, negatively charged, or amphoteric, often constituted of a carbohydrate, an amino acid, or a phosphate. (Okoliegbe and Agarry, 2012).

Elevating levels of surfactant within oil/water or water/air systems leads to a gradual decrease in surface tension until reaching a critical threshold where the surfactant can organize into structures such as micelles, bilayers, or vesicles. This threshold concentration is termed the critical micelle concentration (CMC). In mixtures of water, oil, and surfactant, the surfactant congregates at the interface between water and oil, resulting in emulsions or microemulsions, depending on their stability. These properties grant surfactants exceptional capabilities in detergency, as well as emulsification,

foaming, and dispersal, rendering them indispensable in a wide array of industrial processes (Al-Araji *et al.*, 2007).

These molecules exhibit a range of characteristics that distinguish them from chemical surfactants. Some key characteristics of microbial biosurfactants include:

- ✓ **Structural Diversity:** Microbial biosurfactants have diverse chemical structures, including glycolipids, lipopeptides, phospholipids, and polymeric surfactants. This diversity contributes to their wide range of applications.
- ✓ **Surface Activity:** Like chemical surfactants, microbial biosurfactants exhibit surface-active properties, allowing them to reduce surface tension and facilitate the dispersion of hydrophobic compounds in aqueous environments.
- ✓ **Stability:** Microbial biosurfactants can maintain their surface-active properties over a broad range of environmental conditions, including temperature, pH, and salinity. This stability is advantageous in various industrial applications.
- ✓ **Low Toxicity:** Microbial biosurfactants are often less toxic than synthetic surfactants, making them more suitable for use in pharmaceuticals, cosmetics, and food products where human exposure is a concern.
- ✓ **Emulsification and Dispersing Abilities:** Microbial biosurfactants possess emulsifying properties, enabling them to form stable emulsions of oil and water. This feature is beneficial in applications such as enhanced oil recovery and bioremediation.
- ✓ **Biodegradability:** Microbial biosurfactants are typically biodegradable, breaking down into non-toxic byproducts over time. This characteristic aligns with environmental sustainability goals.
- ✓ **Production from Renewable Resources:** Microbial biosurfactants can be produced using renewable resources, such as agricultural byproducts, waste materials, or renewable carbon sources, reducing dependency on non-renewable feedstocks.
- ✓ **Specificity and Selectivity:** Some microbial biosurfactants exhibit specificity in their interactions with certain substrates or environments, making them suitable for targeted applications, such as in medical or environmental settings.
- ✓ **Potential Antimicrobial Properties:** Certain microbial biosurfactants have demonstrated antimicrobial activities, which can be advantageous in applications such as pharmaceuticals or personal care products.
- ✓ **Foaming Properties:** In some cases, microbial biosurfactants exhibit foaming properties, which can be desirable in applications like food processing or cosmetics.

Microorganisms producing biosurfactant

In 1895, Misyoshi provided the initial documentation of microorganisms' capacity to break down hydrocarbons, noting the microbial degradation of paraffin. Various species of bacteria, yeast, and mold possess the ability to degrade hydrocarbons, with bacteria being the most extensively studied producers of biosurfactants.

The primary genera of bacteria known for their ability to degrade oil byproducts include *Acidovorans*, *Agrobacterium*, *Alcaligenes*, *Aeromonas*, *Arthrobacter*, *Beijemickia*, *Burkholderia*, *Bacillus*, *Corynebacterium*, *Flavobacterium*, *Gordonia*, *Microbacterium*, *Moraxella*, *Mycobacterium*, *Micrococcus*, *Nocardia*, *Paracoccus*, *Pasteurella*, *Polaromonas*, *Pseudomonas*, *Ralstonia*, *Rhodococcus*, *Sphingomonas* and *Stenotrophomonas*.

Main classes of biosurfactants and their producers

Biosurfactants Group	Biosurfactant types	Microorganisms
Glycolipids	Rhamnolipids	<i>Pseudomonas aeruginosa</i>
	Trehalolipids	<i>Mycobacterium tuberculosis</i> <i>Rhodococcus erythropolis</i> <i>Arthrobacter sp.</i> <i>Nocardia sp. Corynebacterium sp.</i>
	Sophorolipids	<i>Torulopsis bombicola</i> <i>Torulopsis petrophilum</i> <i>Torulopsis apicola</i>
Fatty acids, phospholipids and neutral fats	Corinomycolic acid	<i>Corynebacterium lepus</i> <i>Penicillium spiculisporem</i>
	Spiculisporic acid	<i>Acinetobacter sp.</i>
	Phosphatidylethanolamine	<i>Rhodococcus erythropolis</i>
Lipopeptides	Surfactin Lichenysins	<i>Bacillus subtilis</i> <i>Bacillus licheniformis</i>
Polymeric biosurfactants	Emulsan	<i>Acinetobacter calcoaceticus</i>
	Alasan	<i>Acinetobacter radioresistens</i>
	Liposan	<i>Candida lipolytica</i>

Biosurfactants are primarily produced when hydrophobic substrates are utilized as a carbon source for microbial growth. These surfactants can either be released extracellularly or remain attached to the microbial cell wall. Conversely, certain microorganisms produce bio-surfactant in the presence of various substrates, including carbohydrates and other water-soluble compounds. Studies have indicated that the choice of carbon source significantly influences the structure of the biosurfactant produced by the microorganism. Additionally, bio-surfactant production can be influenced by nitrogen sources and the presence of essential minerals such as phosphorus, iron, magnesium and sulfur. Some biosurfactants exhibit direct antimicrobial properties. They can inhibit the growth and proliferation of pathogens by disrupting essential cellular processes or structures, such as protein synthesis or cell wall formation. Biosurfactants can inder biofilm formation and disrupt existing biofilms, making the pathogens more susceptible to antimicrobial agents and immune responses.

In addition, biosurfactants can improve soil structure by reducing water surface tension, thereby enhancing water infiltration and retention in soil pores. This property is particularly beneficial in arid or sandy soils with poor water-holding capacity. Biosurfactants can stabilize soil aggregates by promoting the formation of stable soil-water-air interfaces, which reduces soil erosion caused by water or wind. This property is crucial for maintaining soil structure and preventing nutrient loss. Certain biosurfactants have been found to possess plant growth-promoting properties by facilitating the uptake of nutrients and phytohormones by plants. Additionally, they can enhance root elongation and improve plant stress tolerance, leading to increased crop yields. They enhance tolerance to wide range of stresses by improving water uptake, regulating osmotic balance, and mitigating oxidative stress, thereby enabling plants to better withstand adverse environmental conditions. Some biosurfactants can trigger systemic resistance mechanisms in plants, leading to enhanced defense responses against pathogens. This systemic resistance helps plants to resist infections and reduce disease incidence,

ultimately promoting healthier and more vigorous growth. Overall, biosurfactants play a multifaceted role in promoting plant growth and health by stress tolerance and defense mechanisms.

Role of bio-surfactants in hydrocarbons bioremediation

Biosurfactants enhance bioremediation effectiveness through two primary mechanisms. The primary mechanism involves improving substrate bio-availability for microorganisms. If the surface area accessible to microorganisms engaging with hydrophilic solvents such as water is restricted, the biomass tends to increase gradually rather than exponentially. The second mechanism entails interaction with the cell surface, enhancing the hydrophobicity of the microbial cell wall. This alteration allows hydrophobic substrates to readily associate with bacteria, facilitating bioremediation processes (Pacwa-Plociniczak et al., 2012).

Microbial cell hydrophobicity refers to their inclination to adhere to hydrophobic substrates, such as hydrocarbons. This trait enhances the microbial cells' capability to degrade hydrocarbons effectively and can account for differences in microbial biodegradation rates. When biosurfactant compounds bind to microbial cell walls, they increase the hydrophobicity of the cell surface. Microorganisms employ their biosurfactants to modulate their cell-surface properties, enabling them to adhere or detach from surfaces as per their requirements.

Pseudomonas is known for its ability to generate significant amounts of glycolipids. These biosurfactants, known as Rhamnolipids, have the capability to lower water surface tension to levels ranging from 25 to 30 mN/m. The critical micelle concentration (CMC) varies between 10 and 230 mg/L, contingent on the microbial sources as well as the pH and salinity conditions of the medium (Aparna et al., 2011). *Bacillus subtilis* is another extensively researched microorganism recognized for its biosurfactant production. It is renowned for its ability to produce a highly efficient lipopeptide surfactant, commonly referred to as surfactin or subtilisin, which is among the most powerful biosurfactants identified. Surfactin significantly decreases water surface tension from 72 to 27 mN/m, with a critical micelle concentration (CMC) observed in 24 mM water. (Al-Bahry et al., 2013).

Thavasir et al. (2011) showcased the augmented degradation of hydrocarbons through the incorporation of biosurfactants into culture media, along with the further enhancement of degradation. Number of studies have recorded that bacteria capable of producing biosurfactants can leverage microbial consortia to metabolize diverse classes of hydrocarbons, with *Pseudomonas aeruginosa* being frequently utilized (Karlupudi et al., 2018). Lee et al. (2018) isolated an indigenous biosurfactant-producing bacterial consortium from contaminated marine sediment samples to assess its capacity for polycyclic aromatic hydrocarbon (PAH) degradation. This consortium comprises *Bacillus algicola* 003-Phe1, *Rhodococcus soli* 102-Na5, *Isophtericola chiayiensis* 103-Na4, and *Pseudoalteromonas agarivorans* SDRB-Py1, which are known producers of monorhamnolipid and dirhamnolipid biosurfactants. These findings align with those of Cazals et al. (2020), who reported an increase in PAHs bioavailability when the soil consortium consisted of the genera *Pseudomonas*, *Enterobacteriaceae*, *Microbacterium*, and *Rhodanobacteraceae*.

In a separate experiment, hydrocarbon-contaminated soil underwent inoculation with *Acinetobacter haemolyticus* and *Pseudomonas* ML2, both strains known for biosurfactant production. The degradation of hydrocarbons was then examined. Following a 2-month incubation period, *Acinetobacter haemolyticus* exhibited a substantial reduction in hydrocarbons ranging from 39% to 71%, while *Pseudomonas* ML2 achieved reductions between 11% and 71%. These findings indicated that the biosurfactants produced by these bacteria, when present in their cell-free form, displayed remarkable capabilities in hydrocarbon degradation. Furthermore, the rhamnolipid content of *Pseudomonas aeruginosa* was extensively analyzed for its effectiveness in hydrocarbon degradation.

The distinctive properties of microbial biosurfactants render them highly valuable across various industries such as agriculture, bioremediation, food and beverages, cosmetics, and pharmaceuticals. A promising avenue for research involves isolating microorganisms capable of producing biosurfactants

while also degrading hydrocarbons. By utilizing indigenous microorganisms with dual capabilities in PAHs degradation and biosurfactant production, the biodegradation process can be accelerated. The demonstrated versatility and effectiveness of biosurfactants in applications ranging from the oil production chain to the removal of hydrophobic contaminants underscore the promising potential of these biomolecules. However, further research is needed to optimize their application methods and assess their long-term effects on soil health and ecosystem sustainability.

Reference

- Al-Araji L., Rahman R.N.Z., Basri M. Salleh A.B. Minireview: microbial surfactant. *Asia Pacific Journal of Molecular Biology and Biotechnology*. 2007;15(3), 99–105.
- Aparna, A., Srinikethan, G., Hedge, S. Effect of addition of biosurfactant produced by *Pseudomonas* spp. on biodegradation of crude oil. In: 2nd International Proceedings of Chemical, Biological & Environmental Engineering, vol. 6IACSIT Press, Singapore, pp. 2011, 71-75.
- Cazals F, Huguenot D, Crampon M. Production of biosurfactant using the endemic bacterial community of a PAHs contaminated soil, and its potential use for PAHs remobilization. *Science of the Total Environment*. 2020;709:136143.
- Karlapudi A.P, Venkateswarulu T.C, Tammineedi J. Role of biosurfactants in bioremediation of oil pollution-a review. *Petroleum*. 2018;4(3):241–249.
- Lee D.W, Lee H, Kwon B.O. Biosurfactant-assisted bioremediation of crude oil by indigenous bacteria isolated from Taean beach sediment. *Environ Pollut*. 2018;241:254–264.
- Okoliegbe I.N., Agarry O.O. Application of microbial surfactant (a review). *Scholarly Journals of Biotechnology*. 2012;1(1), 15–23.
- Pacwa-Plociniczak M., Płaza G.A., Piotrowska-Seget Z., Cameotra S.S. Environmental applications of biosurfactants: recent advances. *International Journal of Molecular Sciences*. 2012;12, 633–654.
- Rahman P.K.S.M., Gakpe E. Production, characterization and applications of biosurfactants—review. *Biotechnology*. 2008;7(2), 360–370.
- Thavasir R., Jayalakshmi S., Banat I.M. Effect of biosurfactant and fertilizer on biodegradation of crude oil by marine isolates of *Bacillus megaterium*, *Corynebacterium kutscheri* and *Pseudomonas aeruginosa*. *Bioresources Technology*. 2011;102, 772–779.
- Al-Bahry, S.N., Al-Wahaibi, Y.M., Elshafie, A.E., Al-Bemani, A.S., Joshi, S.J., AlMakhamari, H.S., Al-Sulaimani, H.S. Biosurfactant production by *Bacillus subtilis* B20 using date molasses and its possible application in enhanced oil recovery. *International Biodeterioration and Biodegradation*. 2013; 81,141-146.

Drone agriculture: Drone technology applied to improve farming

¹Divya Chaudhary, Dr. Mohd Shah Alam², Rakhi¹, Simran¹

¹M.Sc. Research Scholar, Department of Agronomy, ²Assistant Professor, Department of Agronomy, School of Agriculture, Abhilashi University Mandi, H.P

Corresponding author email: dc251856@gmail.com

Abstract

In many regions, drones have already shown to be an indispensable component of large-scale precision farming operations. Drone imagery of crops can be used by farmers to plan planting and treatment procedures for the best possible harvests. According to some reports, yields could increase by up to 5%

when precision farming techniques are used. In recent years, drone technology has become more and more prevalent in the agricultural industry. Drones provide farmers a multitude of advantages, one of which is higher yields at smaller areas. However, there are concerns that farmers may be hesitant to use drone technology because they don't comprehend it or because they fear losing their jobs. We may look at the benefits of drone technology for the farming sector as well as any barriers that farmers may be facing when putting it into practice. Farmers can use data collected by drone footage of their crops to plan their planting and treatment plans for optimal harvests. Some reports suggest that using precision farming techniques could increase yields by up to 5%, which would be a substantial increase in a sector where profit margins are typically thin. Drones are used in the agricultural industry to perform a wide range of duties, such as mapping, crop damage assessment, field mapping, fertilizer application, and land inspection. Drones of many kinds are being researched to see which has the greatest potential for gardening, farming, and agriculture. The best drones for fertilizing crops are multirotor drones, or quadcopters.

Keywords: Field mapping, drones, land inspection, precision farming and the agricultural sector

1. Introduction

India's economy is primarily centered on agriculture. Agriculture is the primary source of income in most rural communities. It is possible to state that all of India's citizens and economy are dependent on agricultural products. Agriculture has always been based on traditional practices, which are still employed by the majority of farmers. The agriculture industry is still far behind technology in this day and age. Technology is still not being completely utilized by our agricultural industry. Today's farmers still depend on the weather to produce their crops; in spite of new technologies, they use antiquated, traditional methods that frequently result in agricultural failure due to the weather. Dynamic Remotely Operated Navigation Equipment, or UAV for short, is a device that can fly by using radio signals and GPS coordinates, operating manually or following a predefined path with the use of a smart phone app or remote control. We are aware of the numerous applications for drones across a range of sectors, such as law enforcement efforts, military surveillance, filmmaking, wedding films, railroad track monitoring, wildlife observation, small package delivery, security goals, and search and rescue management of emergencies and operations. Numerous problems, including excessive labor costs or a shortage of workers, health risks related to pesticide exposure, etc., are currently plaguing farmers. When applying (fertilizers, insecticides, etc.) in the field, during an animal or insect bite, etc. Because of this, drones can help farmers avoid these problems while also offering the benefits of green technology.

Drone technology has gained popularity in the agriculture industry in recent years. Drones provide farmers with a number of advantages, such as higher yields, lower expenses, and enhanced efficiency. There are worries, meanwhile, that farmers may be hesitant to use drone technology because they don't know enough or are afraid of losing their jobs. We may examine the advantages of drone technology for the agricultural industry as well as the obstacles that might be preventing farmers from implementing this technology. Drones are a widely used technology that is becoming more and more common. Drone-based videography is more commonplace, whether it is being used to document an outdoor wedding or to showcase a home or other property for sale. On the more contentious end of the spectrum, drones are becoming increasingly prevalent in contemporary military and counterterrorism operations. Drones are also being utilized in agriculture, but this time the struggle is being waged against pests that deplete crops of yield (insects, weeds, illnesses).

2. Definition

- An unmanned aerial vehicle (UAV) utilized in agriculture operations, primarily for yield optimization and crop growth and production monitoring, is called an agricultural drone.

Drones used in agriculture can gather data on soil differences, crop health, and growth phases of crops. Agricultural drones employ multispectral sensors to capture electromagnetic radiation that extends beyond the visible spectrum, such as short-wave and near-infrared radiation.

- An unmanned aerial vehicle (UAV) used in agriculture to track crop growth and boost crop yields is called an agricultural drone. Farmers can see a more detailed picture of their fields with the use of sensors and digital photography capabilities. By using this information, agricultural productivity and crop yields may be increased.



Fig.1- Agricultural drone

3. CONCEPT

3.1 When did India start using drones for agricultural purposes?

- Although drones have been utilized in agriculture since the early 2000s, farmers weren't able to exploit the technology until the 2010s.
- Agricultural drones began to be used for other tasks, like crop spraying and crop monitoring, as technology developed.

3.2 Drones and the agriculture sector in India

Farmers can now watch their cattle's four movements in addition to their crops thanks to drone surveys. Animals can be found and injuries or illnesses can be detected with the use of thermal sensor technology. This is a task that drones can perform well, which increases vegetation output overall. Drones used in agriculture can gather data on soil differences, crop health, and growth phases of crops. However, drone technology may potentially be used in a number of agricultural industries now that it is more readily available.

- Despite the fact that technology is still in its infancy in India, a number of companies are working to make it easily available and ready for use by Indian farmers in order to boost the efficiency of agricultural production.

3.3 Drone usage in agriculture is increasing

In India, numerous drone-based agricultural projects are being carried out. Think about the following actual situations:

- On January 26, 2022, the Indian government also revealed a certification procedure for agricultural drones. These drones may now deliver a payload that contains none of the liquids

or chemicals used in drone spraying. Follow all guidelines and instructions when applying these solutions.

- The Indian government made an announcement on January 23, 2022, proposing to promote the use of drones in agriculture as a way to reduce the amount of labor that farmers need to accomplish. By March 2023, the State Agriculture Universities, Krishi Vigyan Kendras, ICAR Institutes, and Farm Machinery Training and Testing Institutes would receive a 100% subsidy, or 10% lakhs, whichever was less, as part of the offer.
- The Indian government gave their approval on November 16, 2020, for the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) to use drones for agricultural research. The government is hoping that the next generation of scientists and researchers would provide inspiration for drone solutions that will benefit over 6.6 lakh Indian peasants at the lowest possible cost.
- According to Amber Dubey, Joint Secretary, Ministry of Civil Aviation, drones can be used extensively in the agriculture sector, especially in areas where precision agriculture is practiced, to increase productivity and control locust populations.

3.4 Why use drones for agriculture?

- Drones in agriculture can benefit farmers in a number of ways, including increased yields, reduced costs, and improved production. However, because of concerns about job loss and a lack of education and training, farmers may be hesitant to adopt this technology.
- Temperature, weather, and soil quality are the three main external elements that have an impact on farming. Drones for agriculture give farmers the flexibility to adjust to specific situations and, thus, make well-informed judgments.
- Temperature, soil quality, and weather are the three primary external factors that affect farming. With the use of drones, farmers may make well-informed decisions by being able to adapt to unique circumstances

3.5 How Does Technology Affect Drones?

Drone Innovation

In order to get the most out of this article, it is necessary to have a firm grasp of drone features. Drones often have a GPS unit, a navigation system, many sensors, high-end cameras, programmable controllers, and equipment for self-piloting. For precision agriculture, unmanned aerial vehicles (UAVs) outfitted with cutting-edge technology can collect more accurate data than satellites.

3.6 How Do Drones Affect Contemporary Agriculture?

- Drones are increasingly being used in modern agriculture due to their accuracy, economy, and efficacy in a variety of farming operations.
- Farmers and agricultural researchers employ drones for precision agriculture, crop monitoring, and livestock management.
- Drones are equipped with a variety of sensors that allow farmers to collect vital information about their livestock and crops, such as high-resolution pictures, heat maps, and multispectral data.

4. Various drone kinds utilized in agricultural

Drones are widely used in agriculture and are available in many different types. Each type has unique characteristics and qualities that make them suitable for different tasks.

4.1 Fixed-Wing Drone: Fixed-wing drones are widely used in agriculture to map fields, monitor crops, and identify potential issues such as pests or irrigation issues. They are also used in surveying, mapping, and aerial photography.

➤ **The application of fixed-wing drones in agriculture**

In agricultural, fixed-wing drones are frequently employed for mapping, surveying, and crop monitoring applications. Fixed-wing drones have several uses in agriculture, such as:

- Getting high-quality aerial photographs of farms to assess crop health
- Mapping fields to identify variations in soil health and nutrient levels;
- Monitoring crop growth and development over time;
- Identifying pest and disease outbreaks.

4.2 Drone with a single rotor

Unmanned aerial vehicles (UAVs) known as helicopter drones, or single-rotor drones, are employed in agriculture to map and evaluate crops by capturing high-quality images and data. They are also fitted with advanced sensors and cameras to collect data on crop health, soil conditions, and other environmental factors

➤ **The Application of Single-Rotor Drones in Agriculture:**

Single-rotor drones are typically used for more precise and specialized tasks than fixed-wing drones. They are often used in agriculture for:

- Administration of irrigation,
- Analyzing and mapping soil,
- Plant tally and health evaluation,
- Applying fertilizer and pesticides to limited areas.

4.3 DROPA MultirotorMulti-rotor drones—drones with multiple rotors placed on their bodies—are frequently used in agriculture. They can also be equipped with state-of-the-art sensors, such as thermal cameras, which can detect changes in crop temperature. This enables farmers to recognize plant stress and adjust watering and fertilizer regimens appropriately.

➤ **The Application of Single-Rotor Drones in Agriculture:**

Multiple-rotor drones are versatile and widely used in agriculture for a variety of tasks, including:

- Soil analysis,
- Plant enumeration and health evaluation,
- Crop monitoring and mapping,
- Supervision of irrigation, application of fertilizer and pesticides on a small scale, and surveillance of livestock.

4.4 Mixed-Use

Drone

Hybrid drones combine the advantages of fixed-wing and multirotor drones for use in agriculture. These drones are capable of vertical take-off and landing (VTOL), just as multirotor drones. They can take high-resolution photos and create detailed maps of fields, providing farmers with vital information about the condition and health of their crops.

The Application of Single-Rotor Drones in Agriculture:

A range of applications exist for hybrid drones in agriculture, such as pesticide spraying, crop mapping, and agricultural scouting. Hybrid drones are perfect for large-scale agricultural operations because they have the speed and range of fixed-wing drones with the ability to take off and land vertically.

A few uses for hybrid drones in agriculture include:

- High-resolution mapping,
- Crop health monitoring and assessment,
- Plant counting and yield estimation, precision agriculture,
- Pesticide application, and irrigation control.



Fig. 2 Types of drones

5. Benefits of Drone Use in Agriculture:

As the industry develops, drone use in agriculture is expected to increase, so it's important to understand how to use this technology sensibly.

5.1 Monitoring of irrigation

Drones that are fitted with thermal, multispectral, or hyperspectral sensors are able to detect regions that are overly dry or in need of agricultural improvement. Drone surveys can assist identify crop health and energy emissions, boost water efficiency, and uncover potential irrigation leaks or pools by computing irrigation yields and the vegetation index.

5.2 Crop damage evaluation

Drones used in agriculture that are fitted with RGB and multispectral sensors may also detect pests, illnesses, and weeds in field areas. Thanks to this data, farmers may reduce their costs by precisely determining the amount of chemicals needed to combat pests.

5.3 Analysis of soil and field

Drones for agriculture can be used to analyze fields and soil in order to help with field planning. These can be equipped with sensors to monitor the terrain, nutrients, moisture content, fertility, and erosion of the soil.

5.4 Groundwork

Drones can now help farmers with the process of planting trees and crops, something they did before. This method will save labor costs in addition to gasoline. Drones that are more reasonably priced are expected to replace huge tractors in the near future due to their hazardous gas emissions and environmental degradation.

5.5 Spraying crops

Agri-drones can be used to spray chemicals on crops more quickly than with traditional methods since they have reservoirs that can hold insecticides and fertilizer. Thus, precision farming could enter a new era thanks to drone technology.

5.6 Examine crop health

Farming is a large-scale enterprise involving acres of land. Surveys must be carried out on a regular basis to monitor the state of the soil and the planted crop. This could take several days to complete by hand, and even then errors could occur. Drones can finish the same task in a few hours. Drones that use infrared mapping can gather information on the health of the soil and crops.

5.7 Refrain from overusing chemicals

When it comes to cutting down on the excessive use of pesticides, insecticides, and other chemicals, drones can be particularly useful. It's true that these compounds aid in crop protection. However, using them excessively may have negative effects. Drones can accurately gather data about the extent and degree of pest attacks, as well as identify minute symptoms of the attacks.

5.8 Be ready for weather anomalies

A farmer's deadliest enemy and greatest ally might both be the weather. Since these are unpredictable, it becomes very challenging to plan ahead for any changes in the patterns. It is possible to predict future weather conditions with drones.

6. Additional advantages of agricultural drones

In the agricultural industry, drones can be utilized for a variety of purposes, such as insect control, crop mapping, soil analysis, and irrigation. The following are the main advantages of drone use in agriculture:

6.1 Increased efficiency: Farmers are able to collect data and monitor crops more successfully because to drones' ability to cover large expanses of land swiftly and efficiently. Early problem detection can result in quicker and more efficient responses.

6.2 Increased crop yields: Farmers can discover areas that need care by using drones to collect data on crop health. Farmers can raise agricultural yields and profit margins by resolving these problems.

6.3 Reduced costs: Drones can help to reduce costs by identifying areas of the farm that require attention, reducing the need for manual labour and reducing the use of pesticides and other chemicals.

6.4 Improved accuracy: Drones can capture high-resolution images and data, providing farmers with a detailed view of their crops. This can help to identify areas that require attention and ensure that interventions are targeted and effective.

7. Drones in agriculture are limited

Although farms can profit greatly from drone technology, there are certain obstacles that may prevent farmers from utilizing this tool. These are a few of the main obstacles:

7.1 Fear of losing one's job: Since fewer people will be required to undertake physical labor on farms as a result of the adoption of drone technology, many farmers are worried about losing their jobs.

7.2 Lack of expertise and training: It's possible that farmers lack the skills or background required to

safely and proficiently use drones. They might not be confident in their abilities to utilize it, which can make it difficult for them to adopt this technology.

7.3 Cost: Since drones can be pricey, many farmers might not be able to afford to invest in this technology.

7.4 Regulatory obstacles: Farmers may find it challenging to use this technology if there are regulatory obstacles to the usage of drones in agriculture.

7.5 Weather-dependent: Drones are highly dependent on the weather, and they perform best in agreeable weather. For it to work properly, the days must be clear, serene, and dry. If not, it cannot.

7.6 Connectivity issues: Lack of a reliable network connection and network availability is a major source of drones in rural locations. A large number of farmers are unable to cover this cost.

8. Kisan Uav System

Narendra Tomar, India's Union Minister of Agriculture, introduced the "Kisan Drone Scheme." The Kisan Drone Program went live in February 2022. Under this scheme, the government gives Indian farmers 100 drones. FPOs would be qualified to obtain a subsidy of 75% of the drone's cost if it is only used for demonstrations.

❖ Kisan Drone Subsidy - Agriculture Drone Subsidy Scheme

Category	Available Subsidy
<ul style="list-style-type: none"> For State Agriculture Universities, Krishi Vigyan Kendras, Indian Council of Agricultural Research (ICAR) institutes, and Farm Machinery Training and Testing Institutes. 	<ul style="list-style-type: none"> A grant equivalent to Rs. 10 lakhs, or 100% of the cost of an agricultural drone.
<ul style="list-style-type: none"> For graduates in agriculture, creating Custom Hiring Centers (CHCs). 	<ul style="list-style-type: none"> 50% of a drone's base cost, up to a maximum of Rs. 5 lakhs.
<ul style="list-style-type: none"> For rural entrepreneurs and Farmer Producers Organizations (FPOs). 	<ul style="list-style-type: none"> FPOs in India are entitled to get a drone subsidy of 75% of the drone's cost if they utilize them purely for demonstration purposes.

CONCLUSION

In the near future, drone technology is anticipated to have a major impact on the agriculture sector. Drones have the ability to help farms and give the next generation of workers jobs. Consequently, a large number of companies and business owners are purchasing this technology. It can also assist farmers in learning about drone technology, which might be beneficial to them. Farmers can benefit from drones in a number of ways, but before spending a lot of money on equipment, it's important to know what they can and cannot do. Drone Deploy, a drone programming company and supplier of agricultural drones, advises beginning small and progressively incorporating drone data into your business for the greatest results.

Citations:

Bhavana Tamela (2021), Drone technology's future, 2456-5571
 Mahima Vijay Rana (2020), Drone technology's impact on agriculture, 2319-7706
 Purba Goswami and Gopal Dutta (2020), Drone applications in agriculture, 2321-4902
 Drones: The smarttechnology in modern agriculture, Yashika Gupta, Pooja Mudgil, Varsha Sharma, and Zardam Hussain (2022)

Kisan drone: What is it? Live Mint, "Five things you should know," February 19, 2022
What is the Kisan Drone and these are five things you should be aware of | 1645248791806 in this instance

Black Soldier Fly: A Sustainable Solution for Environment-Friendly Waste Management

Maharaj Satwika¹, Chava Asritha², N. M. Ramesha³, Burjikindi Madhuri⁴

^{1,2,4}Ph.D. Scholar, Department of Entomology, Professor Jayashankar Telangana Agricultural University, Hyderabad-500030, India

Corresponding author email: satwikam23@gmail.com

Abstract

Managing solid waste and ensuring food security remain pressing global concerns amidst growing populations and environmental complexities. Both the environment and human health are negatively impacted by inadequate waste management and inadequate food production. The black soldier fly (BSF), scientifically known as *Hermetia illucens*, has attracted increased interest in recent times for its potential role as an organic waste processor and as a sustainable alternative for food production. When contrasted with traditional composting methods, black soldier fly larvae (BSFL) can reduce the initial weight of organic waste by approximately 50% within a shorter duration. They achieve this by voraciously consuming various organic waste types, such as food scraps, agricultural byproducts, and poultry and dairy waste. The BSFL system consists primarily of the larval rearing area, where larvae feed and grow, and the fly habitat, where adult BSF reside and reproduce. Maintaining healthy populations of both adult BSF and larvae in the rearing facility is essential to generate a sufficient and consistent number of offspring for organic waste remediation. The process of BSF organic waste treatment involves waste pre-processing, BSFL bioconversion, separation of BSFL from the residual material, and refining of residue and larvae into marketable products. The nutrients present in the waste are broken down by BSFL and converted into valuable proteins and lipids, which can be used for animal feed production. The remaining residue from this process can be utilized as organic fertilizer. However, further research and innovation are needed to ensure the safety, quality, and economic feasibility of BSF-based products for both animal and human consumption.

Keywords: Bioconversion, Black soldier fly, Composting, Organic waste management

Introduction

Food waste is a growing part of the global organic waste problem (Kim et al., 2021). The rate of food waste is increasing at a concerning pace and presents a number of socioeconomic problems as a result of improving living standards and an expanding human population. Managing wastes, especially organic wastes, while also meeting the world's increasing demand for food, fuel, and feed has become a significant concern (Gold et al., 2018; Kumar et al., 2018; Lucifero, 2016). This leads to an increase in food waste, which is causing a number of socioeconomic issues. As per Liu et al. (2016) and FAO (2020), Food waste is the food that is discarded or lost at some point during the supply chain, from production to consumption. Food waste is making the world's food systems more unbalanced, and when it comes to hazardous waste, that imbalance might have harmful effects on ecosystems, biodiversity, and health of humans (Djekic et al., 2019). The compensation for food waste is on the rise, reflecting greater acknowledgment of its negative social, environmental, and economic consequences. (Kim et al., 2021; Loke and Leung, 2015). Food waste decomposes naturally and quickly, making waste management more difficult (Singh and Kumari, 2019; Yin et al., 2014). Much emphasis is paid to

the environmental issues brought on by the large-scale production of food wastes (Cuadros et al., 2011; Somroo et al., 2019). However, food waste poses a risk to the environment because it contains a high concentration of water-insoluble substances like fat, protein, and carbohydrates (Kim et al., 2021; Li et al., 2016). Furthermore, these water-insoluble compounds may make putrefaction easier to occur (Chen et al., 2020; Li et al., 2013). This might enable it to function as an appropriate medium for the development of foul-smelling microorganisms. Nowadays, the three main ways used to dispose of food waste are anaerobic digestion, incineration, and landfill disposal; nevertheless, there is a need for new, environmentally friendly methods to manage food waste. Because of their high natural and quick biodegradability, managing organic wastes is more difficult (Nanda and Berruti, 2021; Yin et al., 2014). The current methods for managing organic waste, which include landfilling and the disposal of waste by anaerobic digestion and composting, are compliant with environmental regulations. However, they come at a high cost and also have negative effects on the environment, including pollution of surface and groundwater, greenhouse gas emissions, and health problems for humans and animals (de Titto and Savino, 2019; Singh et al., 2020; Yin et al., 2014). Increased prosperity has led to a significant surge in the demand for food, fuel, and animal feed, along with a corresponding increase in waste generation due to the rapid growth of the global population. This escalating pressure on organic waste is anticipated to give rise to significant environmental challenges in the foreseeable future. Consequently, it is imperative to develop resource utilization strategies within the framework of a circular economy to effectively manage organic waste and strive towards achieving zero waste objectives. Hence, insects offer a single, potentially beneficial solution to two issues at once: the growing organic waste problem, which, if improperly managed, could result in major environmental problems, and the growing need for fuel, food, and feed (Salomone et al., 2017; Smetana et al., 2016). The use of black soldier fly larvae (BSFL) for organic waste treatment is gaining popularity among insect experts (Kim et al., 2021). Black soldier fly (BSF), *Hermetia illucens*, is a resource insect that effectively transforms organic waste and livestock manure (dairy or poultry) into larval biomass which is an excellent source of protein and fat. This biomass can be fed to animals directly or after drying (Liu et al., 2017; Shorstkii et al., 2020). Furthermore, the larval biomass has the potential to be used for separating protein and fat, with the protein being used for animal feed and the fat being used to produce biodiesel (Rehman et al., 2019; Zhu et al., 2019). Therefore, BSFL offer a solution to organic waste pollution while also addressing the protein and fat shortages in animal feed, thereby supporting the production of liquid energy. This approach shows promising potential due to its simplicity, affordability, efficiency, and added value, enabling the utilization of animal manure and other organic wastes. Researchers have directed their attention towards a recent organic waste treatment approach involving the black soldier fly (BSF), as an organic waste converter (Zurbrugg et al., 2018; De Smet et al., 2018). BSF larvae (BSFL) eagerly ingest organic-rich waste, including food scraps (Nguyen et al., 2015), agricultural by-products (Meneguz et al., 2018), and dairy waste (Ur Rehman et al., 2017). As a result, the nutrients within BSFL can be transformed into vital proteins and fats utilized in animal feed (Xiao et al., 2018; Liu et al., 2017), thereby addressing the scarcity of traditional animal feed sources, which have experienced rising costs over time (Stocker et al., 2014). Furthermore, the residual by-product from the BSFL bioconversion process can function as fertilizer. Another benefit of this approach is that BSF adults are non-pathogenic as they do not consume food. Additionally, the residue generated from the BSFL bioconversion process can be utilized as fertilizer (Ma et al., 2018). Another advantage of this method is the non-pathogenic nature of BSF adults, as they do not consume food. Studies have shown that BSFL secrete bactericidal compounds that deter house flies from laying eggs and reduce the presence of foodborne pathogens like *Escherichia coli* and *Salmonella enterica*. Consequently, there are minimal concerns regarding disease transmission associated with large-scale BSF farming. The economic viability of waste management depends on various factors, such as the organic source type, nutrient content, and the waste-to-biomass conversion ratio, as highlighted by Lalander et al. (2019). BSFL's ability to convert organic waste represents a highly effective recycling technique and a holistic solution due to its minimal adverse environmental effects, including reduced greenhouse gas emissions

and a smaller ecological footprint when producing protein feed and other nutrient supplements. The low initial investment required for this method makes it viable for implementation in low- and middle-income countries, as noted by Van Huis et al. (2013). Extensive research has been conducted on BSF larvae composting. This paper aims to summarize the findings of selected prior studies on BSFL organic waste treatment and the potential utilization of BSF by-products, focusing on larvae and frass, providing readers with a comprehensive and succinct source of knowledge.

Developments in the Bioconversion of Food Waste

The escalating pace of global organic waste, notably food waste, is a consequential aspect. The expanding demand for food, driven by improved living conditions and the growing human population, contributes to a disturbingly rapid increase in food waste (Kim et al., 2021). Municipal solid waste amounts to 2.1 billion tonnes with 45% of this constituting food waste across the world. Only around 16% of this food waste undergoes recycling, while more than 46% ends up being discarded, creating an imbalance in global food systems, particularly concerning is the impact of hazardous waste on human health, biodiversity, and ecosystems, highlighting the need for effective waste management strategies (Bras et al., 2020; Deus et al., 2019; Maalouf and Mavropoulos, 2023). Food waste is often used as fertilizer, disposed in landfills, or incinerated to create carbon dioxide. (Li et al., 2013; Prateep Na Talang and Sirivithayapakorn, 2021). Food waste is commonly managed through landfill disposal, incineration, and anaerobic digestion. However, environmentally friendly alternatives are needed to address this issue.

Challenges in the current management of organic waste

The rapid biodegradability, perishable characteristics, low calorific value, and high organic matter content of food waste make its effective management through sanitary landfills or incineration a more complex task. Organic waste decomposition in landfills produces greenhouse gases (GHGs) like methane (CH₄), carbon dioxide (CO₂), and non-methane organic compounds, which pose environmental concerns (Coskuner et al., 2020; US EPA, 2021). Methane, a potent greenhouse gas, has 28–36 times higher heat-trapping efficiency than CO₂ (US EPA, 2021). The release of landfill gases, including CH₄ and CO₂, is associated with air pollution, smog formation, and the exacerbation of conditions such as asthma (Ali et al., 2021). Current methods of managing organic waste, specifically landfilling, and waste treatment through anaerobic digestion and composting, have negative impacts on the environment including pollution of groundwater and surface water, and concerns for animal and human health (De Titto and Savino, 2019; Singh et al., 2020). Hence, it is crucial to establish resource utilization strategies for organic waste within the framework of a circular economy, aiming to achieve zero waste in the future.

An innovative and potential approach for handling organic waste

The innovative utilization of insects to convert organic waste into valuable resources presents a promising and forward-thinking solution, particularly in light of the growing global demand for food, feed, and fuel, as well as mounting concerns regarding organic waste management (Ites et al., 2020; Purkayastha and Sarkar, 2021). Utilizing insects for organic waste management results in lower greenhouse gas emissions (Parodi et al., 2020), and diminishes surface and ground water pollution by breaking down antibiotics (Liu et al., 2021; Mai et al., 2022). An emerging and promising strategy involves using organic waste to rear insects suitable for food and feed production. These insects, known for their high fat and protein content, can also be harnessed for biodiesel production (Shorstkii et al., 2020). This innovative approach offers a dual solution by addressing the challenge of increasing organic waste, which could lead to severe environmental issues without proper management, simultaneously fulfilling the increasing needs for feed, food, and fuel.

The use of black soldier fly larvae (BSFL) to treat organic waste has gained considerable attention within the insect research community. The resourceful black soldier fly (BSF), proves highly effective in converting organic waste into larval biomass rich in protein and fat. The larval biomass offers the

opportunity to separate protein and fat, with the fat suitable for biodiesel production, thus supporting liquid energy production and the larval protein serving as feed for animals (Rehman et al., 2019). The remaining residue from manure after the growth of BSFL can be repurposed as a versatile fertilizer (Mazza et al., 2020).

Black Soldier Fly: A Promising Agent for Bioconversion

Black soldier fly larvae (BSFL) possess up to 43% of their body weight in protein and are rich in minerals and amino acids (Zhu et al., 2019). They possess the capability to thrive on a diverse array of substrates, ranging from organic waste to manure, rendering them highly attractive for large-scale biotransformation (Lievens et al., 2021). The treatment system utilizing black soldier fly larvae (BSF) includes essential elements such as waste composting, nutrient reclamation, and income generation (Purkayastha and Sarkar, 2022). Due to its cost-effectiveness, ease of maintenance, straightforward operation, minimal land requirements, low environmental impact, and greater economic scalability, this system stands out as a notably superior option compared to other composting methods. Its rearing is characterized by efficient reproduction (a single clutch can produce up to 500 eggs) and a high feed conversion ratio (FCR). It is not considered a pest because it lacks attraction to feed, owing to the absence of functional mouthparts. Consequently, it does not come into contact with unsanitary organic waste and therefore, the black soldier fly (BSF) does not serve as a vector for diseases.

Life cycle and Biology of BSF

The Black Soldier Fly, *Hermetia illucens*, is a type of fly that belongs to the Hermetiinae subfamily within the Diptera order. Four other genera belong to this subfamily, namely *Chaetohermestia*, *Patagiomyia*, *Notohermetia*, and *Chaetosargus*. However, *H. illucens* is the most commonly found species among them. It is present in warm and tropical temperate regions worldwide, spanning across the Neotropics, Australasian, Nearctic, Palaearctic, and Afro-tropical climates. The Black Soldier Fly's physical characteristics include a large, slender, black body and brownish-colored wings. Their heads have antennae with three segments that extend outward. Similar to other dipteran species, the adult black soldier fly (BSF) is anatomically divided into three segments: the head, thorax, and abdomen. Notably, its eyes are widely spaced and exposed, giving it a distinctive appearance that sets it apart from other species. The abdomen consists of five segments, each adorned with white patches. Female BSF typically exhibit smaller body sizes compared to males, yet they possess longer terminalia and larger wings.

The life cycle of the Black Soldier Fly consists of five stages: egg, larva, prepupa, pupa, and adult. Flies typically avoid depositing eggs directly onto moist, decomposing material, taking approximately 3-4 days from emergence to egg laying. The larval phase lasts around 22 to 24 days at a temperature of 27°C. Following this stage, larvae transition into prepupae and migrate to a dry and sheltered location for pupation. Upon finding a suitable pupation site, prepupae undergo metamorphosis into pupae. The pupa undergoes molting, resulting in the emergence of an adult fly. Upon reaching sexual maturity, adult females mate and lay eggs in dry crevices near the food source. Adult BSF are harmless, devoid of disease transmission or causing harm. They solely require water for sustenance, feeding on accumulated fat reserves from their larval stage. Female BSF typically lay their eggs along the periphery of the larval feeding substrate rather than directly on the food, reducing the risk of pathogen spread from waste materials.

BSFLs are effective converters of organic waste due to their intricate feeding behaviors, voracious appetites, and resilience to adverse environmental conditions. Furthermore, BSF prepupae are nutritionally dense, and the species exhibits migratory tendencies, enhancing its suitability for waste conversion. Environmental factors such as light intensity, duration of illumination, temperature, and humidity significantly influence mating and egg-laying behaviors. Sufficient light is essential to stimulate mating, with overcast days potentially affecting mating activity. In cases of inadequate natural light, artificial lighting sources such as LED lamps and halogen lamps are utilized, whereas rare earth

lights prove ineffective for mating. Temperature and humidity levels are crucial for BSF growth and development, with the species demonstrating tolerance to a wide temperature range of 15°C to 47°C. Optimal oviposition occurs within a temperature range of 27.5°C to 37.5°C, accompanied by a relative humidity of 60%. Under laboratory conditions, BSF thrives in relative humidity levels ranging from 50% to 90%. The preferred culturing temperature is 27°C, as deviations from this range, either higher or lower, can negatively impact larval survival and adult emergence rates. Fluctuations in temperature and humidity can disrupt egg hatching and colony establishment. Additionally, maintaining a relative humidity of 70% can prolong the lifespan of BSF compared to lower humidity levels.

Different substrates for larval feeding

BSFL are known for consuming substantial quantities of decomposing plant and animal matter, including spoiled fruits and vegetables, various food items, as well as cow and poultry manure, along with human and animal waste, especially during their larval stage. Adult flies deposit their eggs in dry crevices near areas with moist organic waste, such as compost piles or landfill sites, which serve as breeding sites. Thanks to their unique biological and ecological traits, BSFL can thrive on a diverse range of organic waste materials. This adaptability is likely due to their versatile digestive system, detoxification mechanisms, selective feeding habits, microbial interactions, and preferences for certain types of waste. Understanding these mechanisms could be crucial for harnessing BSFL's adaptability for sustainable food production and efficient waste management.

Food Waste: Around 32% of the global food production, equal to approximately 1.3 billion tons, is lost or wasted each year (FAO, 2017). To tackle this issue, utilizing food waste as feed for larvae presents a solution that effectively tackles both waste management and food security challenges, while reducing dependence on traditional feed resources. Different types of food losses and waste contain inherent nutritional value and can be transformed into safe feed alternatives through modern techniques (Rajeh et al., 2021). Researchers have investigated the use of various food waste types for feeding black soldier fly larvae. These include kitchen scraps, vegetable remnants, uncooked food leftovers, fast food remains, and by-products such as fruit juice, banana peels, dessert scraps, orange peels, as well as remnants from various fruits and vegetables. This diversification in feed sources for BSFL contributes to sustainable insect farming and effective waste management.

Market Waste: The retail sector holds significance in the food supply chain, producing lesser waste quantities compared to other stages. Nonetheless, meat and bread contribute substantially to the environmental footprint of supermarkets. Hence, tackling waste related to meat and bread emerges as a critical aspect in minimizing the environmental impact of supermarkets. Studies, such as those conducted on market waste (Holeh et al., 2022) and supermarket food waste (Van Looveren et al., 2023), have been conducted to evaluate their viability as potential substrates for Black Soldier Fly Larvae.

Agro-industrial waste: The rapid pace of industrialization and globalization, alongside population expansion, has greatly intensified industrial and agricultural operations worldwide. As a result, significant amounts of agro-industrial food waste are generated annually by commercial farms, households, and food processing plants. Utilizing agro-industrial residues as primary resources can aid in lowering production expenses and alleviating environmental pollution. In BSFL rearing, studies have investigated the potential utilization of brewer's waste, bio-sludge from the pulp and paper industry (Norgren et al., 2020), and by-products from mills (Gold et al., 2020).

Slaughterhouse waste: Globally, slaughterhouse operations yield significant volumes of animal by-products, presenting a valuable source of industrial protein with diverse potential applications. However, current practices often underutilize these by-products, primarily directing them towards pet food and animal feed production. Certain by-products from slaughterhouses pose environmental challenges due to disposal difficulties. In this regard, fish waste has emerged as a preferred substrate for BSF larval feeding, as evidenced by studies like Isibika et al. (2021), contrasting with the use of

poultry slaughterhouse waste, as noted by Gold et al. (2020). This shift towards integrating fish waste into the BSF larval feeding process indicates a strategic approach to addressing the underutilization of slaughterhouse by-products and associated environmental concerns.

Manure and Feces: Animal manure, comprising animal excretions such as urine and feces along with bedding materials, serves as a valuable resource for enriching soils and enhancing agricultural productivity. Throughout history, it has been instrumental in agriculture and remains a vital fertilizer for organic farming. Before the widespread adoption of synthetic fertilizers, a significant portion of nutrient inputs for cultivated crops relied on animal manure. Various types of manures have been investigated as alternative feeds for BSFL. For example, research has delved into the utilization of pig manure (El Deen et al., 2023), as well as sheep, horse, chicken, dairy, duck, and cow manures (Peguero et al., 2023; Suprihanto & Rudianto, 2022). This underscores the diverse range of manures studied as potential feed sources for BSFL, highlighting the potential of utilizing different animal waste products in sustainable practices.

Organic waste Processing system by BSF

The process involves several stages, beginning with waste pre-processing, which includes steps like particle size reduction, dewatering, and removal of inorganic waste. The biowaste then undergoes treatment by BSFL, with the larvae and residue refined into marketable products post-separation. The larvero functions as a growth space for the larvae, while the fly house is dedicated to the housing and reproduction of adult flies. Maintaining a well-equipped rearing facility is essential to support the health of adult and larval BSF, ensuring a consistent supply of offspring for organic waste treatment. Following the BSF treatment process, the resulting by-products include larvae and frass, which are transformed into animal feed and organic fertilizer. BSF offers an attractive solution for recycling biological waste, given its natural and cost-effective potential.

Pre-treatment: The preparation of the substrate before treatment is crucial for enhancing its biodegradability and digestibility, which facilitates the digestion process and accelerates the growth of BSFL. The Waste Reduction Index (WRI) serves as a metric to assess the capacity of BSFL to decompose waste within a defined timeframe. A higher WRI value signifies a more effective reduction (Diener et al., 2009). The formula for calculating WRI is as follows

$$WRI = [(W-R)/W]/t \times 100$$

In the formula, W represents the total quantity of feeding substrate used during the time (t), and R is the residue remaining at harvesting time (t). It is recommended to shred or grind the substrate after separating inorganic materials from hazardous materials. This is because BSFLs have small mouthparts, and it takes them longer to break down large substrate chunks. Shredding or grinding increases the substrate's surface area, which fosters the growth of beneficial microbes and ensures uniform nutrient availability.

BSF treatment system: Concerns have arisen regarding the consistency and effectiveness of BSFL in treating organic waste due to variable performance. Various organic waste types, including kitchen waste, poultry waste, dairy manure, and human feces, have been utilized as substrates for BSFL treatment. The performance of BSFL is notably influenced by macronutrients like protein, carbohydrates, fibers, and lipids present in the organic waste. Higher protein levels in organic waste positively impact larval weights, bioconversion rates, and development times. Discrepancies in nutritional content across organic waste types affect BSFL performance, with municipal organic solid waste exhibiting the highest lipid content, while animal manure and fruit and vegetable waste have higher protein content. To optimize process performance and the quality of BSFL biomass, blending nutrient-rich substrates to achieve nutritional balance during pre-treatment is recommended. The efficacy of BSFL treatment is contingent upon factors such as feed type, quantity, and quality, in addition to environmental conditions.

Ideal operational conditions: BSF adults prefer a temperature range of 27–37°C for mating and oviposition, humidity levels between 40–60%, and a relative humidity of 60–70% (Jalil et al., 2021). An adequate water content of 80–90% in the feeding substrate is considered suitable for BSFL (Pang *et al.*, 2020). For efficient residue sieving, an optimal range of 70–75% is recommended (Lalander et al., 2020). Substrate pH also plays a role in larval development, with a pH range of 6 to 10 supporting optimal growth and higher weight (Meneguz et al., 2018). The BSFL treatment process begins by placing substrates and neonate larvae in a larvero to initiate composting. Larvae consume the substrate, processing and reducing waste. Operational effectiveness is significantly impacted by larval density, feeding rate, and feeding mechanism. Ideal conditions involve a larval density of 1.2 larvae/cm² and a feeding rate of 163 mg/larva/day (Paz et al., 2015). The substrate layer in the larvero should not exceed 5 cm to prevent odor and attraction of other filth flies. The composting process typically takes around 14–18 days until the larvae reach a harvestable size (Myers et al., 2008). Sieving the substrate is essential to separate BSFL biomass from residue before refining marketable products, which helps prevent unwanted fly populations and loss of harvest.

Post-treatment: The process of organic waste treatment using BSFL produces valuable by-products, namely larvae and frass, which can be separated to obtain useful materials like animal feed and fertilizer. During their feeding phase, the larvae accumulate crucial nutrients such as proteins and lipids, enhancing their value as a resource. Following the feeding stage, the larvae undergo pupation and develop into adult flies, leaving behind residue known as frass. The efficacy of the BSF system is underscored by the larvae's capacity to consume a variety of organic materials for growth, including decomposable by-products and wastes, until they reach the prepupal stage.

To enhance this procedure, Diener et al. (2011) suggested implementing several measures such as providing a consistent daily food supply to the larvero, incorporating a drainage system to eliminate excess leachate, and incorporating a ramp to facilitate the easy migration of prepupae, aiding in the separation of pupae from frass. Sieving plays a critical role in refining residue quality, particularly in the final stage, by eliminating any remaining prepupae. However, challenges arise when feeding organic waste directly to the larvae without adjusting its moisture content, leading to excessive wetness with a moisture level of 82–86%, rendering it too thick for sieving. Proper moisture management is essential to address this issue. Lalander et al. (2020) conducted experiments indicating that optimal moisture levels for sieving food waste are between 70% and 75%, rather than 80%. Residue with an initial moisture content of 80% is unsuitable for sieving due to the adhesive properties of water molecules, which promote particle aggregation and increase particle size. Dortmans et al. (2017) proposed a technique known as harvesting, involving the separation of larvae from residue using a shaking sieve after 12 days of treating BSFL waste. This process is conducted when the larvae have attained their maximum weight and nutritional value but have not yet reached the prepupal stage. The larvae or prepupae can then be processed into animal feed, while the residue can be refined to produce organic fertilizer.

BSF Organic Waste Processing Products

BSFL offer a means to extract protein meal, oils, and other derivatives through the treatment of organic waste. These resulting products find applications across animal feed, biodiesel production, and fertilizer manufacturing. By engaging in BSF farming, the conversion of low-value materials into high-value, marketable ingredients becomes feasible. Products derived from BSFL are deemed safe for animal consumption, devoid of mycotoxins or pesticides, and devoid of pests. In large-scale breeding operations, secondary waste, notably dead fly biomass, is generated. Research by UshaKova et al. (2019) has highlighted the potential of this biomass as a valuable source of pigments such as melanin and ommochrome. BSFL effectively convert a wide range of organic wastes into protein- and fat-rich biomass, offering a viable alternative to conventional proteins in animal diets.

During their larval stage, BSFL utilize the fats from their diet as an energy source, which they store for later use in their non-feeding adult stage. This stored fat can be extracted and processed through transesterification to yield biodiesel, as suggested by Wang et al. (2020). Utilizing BSFL to convert lignocellulosic biomass into valuable products presents a cost-effective approach that utilizes more economical raw materials for biodiesel production. The fat obtained from BSFL is characterized by its richness in medium-chain saturated fatty acids and low levels of polyunsaturated fatty acids, resulting in biodiesel with low viscosity and excellent oxidative stability. Biodiesel derived from BSF exhibits favorable combustion properties, high fuel efficiency, and reduced environmental emissions. Moreover, research indicates that the quality of biodiesel produced from BSF fat conforms to international standards, including those set by the American Society for Testing and Materials (ASTM D6751) and the EN 14,214 European standard.

Frass comprises BSFL excrement, leftover substrate, and shed exoskeletons, constituting approximately 30-50% of the original weight of the feeding substrates. Utilizing frass as an organic fertilizer offers a sustainable solution, aiming to decrease dependence on expensive mineral fertilizers known for their detrimental effects on soil and environmental well-being (Xiao et al., 2018). With its composition rich in macronutrients like nitrogen, phosphorus, and potassium, as well as micronutrients and organic matter, frass proves to be suitable for agricultural applications.

Conclusion and Future Perspectives

The utilization of black soldier fly larvae technology for waste decomposition has emerged as a financially feasible and environmentally sustainable approach to waste management. This method yields valuable outputs such as protein, fat, biodiesel, chitin, melanin, and fertilizer from frass, effectively mitigating environmental issues like greenhouse gas emissions and hazardous compounds generated by conventional waste disposal methods like landfills and incineration. Nonetheless, the composition of the organic waste utilized as feeding substrates for BSFL significantly influences the accumulation of protein and fat in the larvae biomass. In comparison to alternative composting methods, BSF larval composting exhibits superior viability and cost-effectiveness due to its simplicity, applicability, low technical demands, minimal environmental impact, and enhanced economic prospects. Future research endeavors should focus on exploring innovative applications of BSF waste treatment technology for tackling organic waste challenges, identifying low-cost and nutrient-rich substrates to optimize BSFL waste digestion, investigating the role of microorganisms in sustainable technology advancement, examining the bioaccumulation of contaminants in BSFL, assessing the impact of environmental factors on BSF breeding operations, and exploring the potential incorporation of BSFL in livestock and poultry feed formulations within regulatory frameworks.

References

- Ali, Y., Jokhio, D. H., & Dojki, A. A. (2021). Adoption of circular economy for food waste management in the context of a developing country. *Waste Management and Research*, 40, 676-684.
- Bras, I., Silva, E., & de Lemos, L. T. (2020). Feasibility of using municipal solid wastes rejected fractions as fuel in a biomass power plant. *Environment Protection Engineering*, 46, 53-62.
- Chen, C., Chaudhary, A., & Mathys, A. (2020). Nutritional and environmental losses embedded in global food waste. *Resources, Conservation and Recycling*, 160, 104912.
- Coskuner, G., Jassim, M. S., & Nazeer N. (2020). Quantification of landfill gas generation and renewable energy potential in arid countries: Case study of Bahrain. *Waste Management and Research*, 8, 1110-1118.
- Cuadros, F., Lopez-Rodriguez, F., & Ruiz-Celma, A. (2011). Recycling, reuse and energetic valuation of meat industry wastes in Extremadura (Spain). *Resources, conservation and recycling*, 55, 393-399.

De Smet, J., Wynants, E., Cos, P., & Van Campenhout, L. (2018). Microbial Community Dynamics during Rearing of Black. *Applied and Environmental Microbiology*, 84, 1-17.

de Titto, E., & Savino, A. (2019). Environmental and health risks related to waste incineration. *Waste Management and Research*, 37, 976-986.

Deus, R. M., Bezerra, B. S., & Battistelle, R. A. G. (2019). Solid waste indicators and their implications for management practice. *International Journal of Environmental Science and Technology*, 16, 1129-1144.

Diener, S., Studt Solano, N. M., Roa Gutierrez, F., Zurbrugg, C., & Tockner, K. (2011). Biological treatment of municipal organic waste using black soldier fly larvae. *Waste Biomass Valorizat*, 2, 357-363.

Diener, S., Zurbrugg, C., & Tockner, K. (2009). Conversion of organic material by black soldier fly larvae: Establishing optimal feeding rates. *Waste Management & Research*, 27, 603-610.

Djekic, I., Operta, S., & Djulancic, N. (2019). Quantities, environmental footprints and beliefs associated with household food waste in Bosnia and Herzegovina. *Waste Management and Research*, 37, 1250-1260.

Dortmans, B. M. A., Diener, S., Verstappen, B. M., & Zurbrugg, C. (2017). Black Soldier Fly Biowaste Processing-A Step-by-Step Guide Eawag: Swiss Federal Institute of Aquatic Science and Technology. *Dubendorf, Switzerland*, 100, 6-54.

El Deen, S. N., van Rozen, K., Elissen, H., van Wikselaar, P., Fodor, I., van der Weide, R., Hil, E. F. H., Far, A. R., & Veldkamp, T. (2023). Bioconversion of different waste streams of animal and vegetal origin and manure by Black Soldier Fly larvae *Hermetia illucens* L. (Diptera: Stratiomyidae). *InSects*, 14(2), 204.

Food and Agriculture Organization of the United Nations. (2017). *The Future of Food and Agriculture: Trends and Challenges*, 180.

Gold, M., Cassar, C. M., Zurbrugg, C., Kreuzer, M., Boulos, S., Diener, S., & Mathys, A. (2020). Biowaste treatment with black soldier fly larvae: Increasing performance through the formulation of biowastes based on protein and carbohydrates. *Waste Management*, 102, 319-329.

Gold, M., Tomberlin, J. K., & Diener, S. (2018). Decomposition of biowaste macronutrients, microbes, and chemicals in black soldier fly larval treatment: A review. *Waste Management*, 82, 302-318.

Holeh, G., Opiyo, M., Brown, C., Sumbule, E., Gatagwu, J., Oje, E., & Munyi, F. (2022). Effect of different waste substrates on the growth, development and proximate composition of black soldier fly (*Hermetia illucens*) larvae. *Livestock Research for Rural Development*, 34, 7.

Isibika, A., Vinneras, B., Kibazohi, O., Zurbrugg, C., & Lalander, C. (2021). Co-composting of banana peel and orange peel waste with fish waste to improve conversion by black soldier fly (*Hermetia illucens* (L.): Diptera: Stratiomyidae) larvae. *Journal of Cleaner Production*, 318, 128570.

Ites, S., Smetana, S., & Toepfl, S. (2020). Modularity of insect production and processing as a path to efficient and sustainable food waste treatment. *Journal of Cleaner Production*, 248, 119248.

Jalil, N. A. A., Abdullah, S. H., Ahmad, I. K., Basri, N. E. A., & Mohamed, Z. S. (2021). Decomposition of food waste from protein and carbohydrate sources by black soldier fly larvae, *Hermetia illucens* L. *Journal of Environmental Biology*, 42, 756-761.

Kim, C. H., Ryu, J., Lee, J., Ko, K., Lee, J. Y., Park, K. Y., & Chung, H. (2021). Use of black soldier fly larvae for food waste treatment and energy production in Asian countries: A review. *Process*, 9(1), 161.

Kumar, S., Negi, S., & Mandpe, A. (2018). Rapid composting techniques in Indian context and utilization of black soldier fly for enhanced decomposition of biodegradable wastes: A comprehensive review. *Journal of Environmental Management*, 227, 189-199.

Lalander, C., Diener, S., Zurbrugg, C., & Vinneras, B. (2019). Effects of feedstock on larval development and process efficiency in waste treatment with black soldier fly (*Hermetia illucens*). *Journal of Clean Production*, 208, 211-219.

Lalander, C., Ermolaev, E., Wiklicky, V., & Vinneras, B. (2020). Process efficiency and ventilation requirement in black soldier fly larvae composting of substrates with high water content. *Science of the Total Environment*, 729, 138-968.

Li, S., Zhu, D., & Li, K. (2013). Soybean curd residue: composition, utilization, and related limiting factors. *International Scholarly Research Notices*, 423-590.

Lievens, S., Poma, G., De Smet, J., Van Campenhout, L., Covaci, A., & Van Der Borgh, M. (2021). Chemical safety of black soldier fly larvae (*Hermetia illucens*): Knowledge gaps and recommendations for future research: A critical review. *Journal of Insects as Food and Feed*, 7(4), 383-396.

Liu, C., Hotta, Y., & Santo, A. (2016). Food waste in Japan: Trends, current practices and key challenges. *Journal of Cleaner Production*, 133, 557-564.

Liu, C., Mao, C., & Bunditsakulchai, P. (2020). Food waste in Bangkok: Current situation, trends and key challenges. *Resources, Conservation and Recycling*, 157, 104779.

Liu, X., Chen, X., Wang, H., Yang, Q., ur Rehman, K., Li, W., Cai, M., Li, Q., Mazza, L., & Zhang, J. (2017). Dynamic changes of nutrient composition throughout the entire life cycle of black soldier fly. *PLoS ONE*, 12, 1-21.

Loke, M. K., & Leung, P. (2015). Quantifying food waste in Hawaii food supply chain. *Waste Management and Research*, 33, 1076-1083.

Lucifero, N. (2016) Food loss and waste in the EU law between sustainability of well-being and the implications on food system and on environment. *Agriculture and Agricultural Science Procedia*, 8, 282-289.

Ma, J., Lei, Y., ur Rehman, K., Yu, Z., Zhang, J., Li, W., Li, Q., Tomberlin, J. K., & Zheng, L. (2018). Dynamic Effects of Initial pH of Substrate on Biological Growth and Metamorphosis of Black Soldier Fly (Diptera: Stratiomyidae). *Environmental Entomology*, 47, 159-165.

Maalouf, A., & Mavropoulos, A. (2023). Re-assessing global municipal solid waste generation. *Waste Management & Research*, 41(4), 936-947.

Mai, H. C., Dao, N. D., Lam, T. D., Nguyen, B.V., Nguyen, D. C., & Bach, L. G. (2019) Purification Process, Physicochemical Properties, and Fatty Acid Composition of Black Soldier Fly (*Hermetia illucens* Linnaeus) Larvae Oil. *Journal of the American Oil Chemists' Society*, 96, 1303-1311.

Mazza, L., Xiao, X., & Rehman, K. U. (2020). Management of chicken manure using black soldier fly (Diptera: Stratiomyidae) larvae assisted by companion bacteria. *Waste Management*, 102, 312-318.

Meneguz, M., Schiavone, A., Gai, F., Dama, A., Lussiana, C., Renna, M., & Gasco, L. (2018). Effect of rearing substrate on growth performance, waste reduction efficiency and chemical composition of black soldier fly (*Hermetia illucens*) larvae. *Journal of the Science of Food and Agriculture*, 98(15), 5776-5784.

Myers, H. M., Tomberlin, J. K., & Lambert, B. D. (2008). Development of black soldier fly (Diptera: Stratiomyidae) larvae fed dairy manure. *Environmental Entomology*, 37, 11-15.

Nanda, S., & Berruti, F. (2021). Municipal solid waste management and landfilling technologies: A review. *Environmental Chemistry Letters*, 19, 1433-1456.

Nguyen, T. T. X., Tomberlin, J. K., & Vanlaerhoven, S. (2015). Ability of Black Soldier Fly (Diptera: Stratiomyidae) Larvae to Recycle Food Waste. *Environmental Entomology*, 44, 406-410.

Norgren, R., Bjorkqvist, O., & Jonsson, A. (2020). Bio-sludge from the pulp and paper industry as feed for black soldier fly larvae: A study of critical factors for growth and survival. *Waste Biomass and Valorization*, 11(11), 5679-5685.

Pang, W., Hou, D., Chen, J., Nowar, E. E., Li, Z., Hu, R., Tomberlin, J. K., Yu, Z., Li, Q., & Wang, S. (2020). Reducing greenhouse gas emissions and enhancing carbon and nitrogen conversion in food wastes by the black soldier fly. *Journal of Environmental Management*, 260, 1-8.

Parodi, A., De Boer, I. J. M., Gerrits, W. J. J., Van Loon, J. J. A., Heetkamp, M. J. W., Van Schelt, J., & Van Zanten, H. H. (2020). Bioconversion efficiencies, greenhouse gas and ammonia emissions during black soldier fly rearing-A mass balance approach. *Journal of Clean Product*, 271, 122488.

Paz, A. S. P., Carrejo, N. S., & Rodriguez, C. H. G. (2015). Effects of larval density and feeding rates on the bioconversion of vegetable waste using black soldier fly larvae *Hermetia illucens* (L.), (Diptera: Stratiomyidae). *Waste and Biomass Valorization*, 6, 1059-1065.

Peguero, D. A., Gold, M., Endara, A., Niu, M. T., Zurbrugg, C., & Mathys, A. (2023). Evaluation of ammonia pretreatment of four fibrous biowastes and its effect on black soldier fly larvae rearing performance. *Waste Management*, 160, 123-134.

Prateep Na Talang, R., & Sirivithayapakorn, S. (2021). Environmental and financial assessments of open burning, open dumping and integrated municipal solid waste disposal schemes among different income groups. *Journal of Cleaner Production*, 312, 127761.

Purkayastha, D., & Sarkar, S. (2021). Sustainable waste management using black soldier fly larva: a review. *International Journal of Environmental Science and Technology*, 1-26.

Purkayastha, D., & Sarkar, S. (2022). Sustainable waste management using black soldier fly larva: A review. *International Journal of Environmental Science and Technology*, 19(12), 12701-12726.

Rajeh, C., Saoud, I. P., Kharroubi, S., Naalbandian, S., & Abiad, M. G. (2021). Food loss and food waste recovery as animal feed: A systematic review. *Journal of Material Cycles and Waste Management*, 23(1), 1-17.

Rehman, K. U., Rehman, R. U., & Somroo, A. A. (2019). Enhanced bioconversion of dairy and chicken manure by the interaction of exogenous bacteria and black soldier fly larvae. *Journal of Environmental Management*, 237, 75-83.

Salomone, R., Saija, G., & Mondello, G. (2017). Environmental impact of food waste bioconversion by insects: Application of life cycle assessment to process using *Hermetia illucens*. *Journal of Cleaner Production*, 140, 890-905.

Shorstkii, I., Comiotto, Alles, M., & Parniakov, O. (2020). Optimization of pulsed electric field assisted drying process of black soldier fly (*Hermetia illucens*) larvae. *Drying Technology*, 40, 595-603.

Singh, A., & Kumari, K. (2019). An inclusive approach for organic waste treatment and valorisation using black soldier fly larvae: A review. *Journal of Environmental Management*, 251, 109569.

Singh, A., Tiwari, R., & Joshi, P. (2020). Insights into organic waste management practices followed by dairy farmers of Ludhiana District, Punjab: Policy challenges and solutions. *Waste Management and Research*, 38, 291-299.

Smetana, S., Palanisamy, M., & Mathys, A. (2016). Sustainability of insect use for feed and food: Life cycle assessment perspective. *Journal of Cleaner Production*, 137, 741-751.

Somroo, A. A., Rehman, K. U., & Zheng, L. (2019). Influence of *Lactobacillus buchneri* on soybean curd residue co-conversion by black soldier fly larvae (*Hermetia illucens*) for food and feedstock production. *Waste Management*, 86, 114-122.

Stocker, T. F., Qin, D., Plattner, G. K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V., & Midgley, P. M. (2014). Technical Summary. In *Climate Change 2013: The Physical Science Basis; Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK; New York, NY, USA, 31-116.

Suprihanto, D., & Rudianto, W. P. (2022). Proximate and fatty acid profile comparison of black soldier fly larvae reared on palm kernel meal and cow manure. *RA Journal of Applied Research*, 8(11), 841-846.

United states Environmental Protection Agency. (2022). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020. *Environmental Protection Agency*, EPA 430-R-22-003.

Ur Rehman, K., Rehman, A., Cai, M., Zheng, L., Xiao, X., Somroo, A. A., Wang, H., Li, W., Yu, Z., & Zhang, J. (2017). Conversion of mixtures of dairy manure and soybean curd residue by black soldier fly larvae (*Hermetia illucens* L.). *Journal of Cleaner Production*, 154, 366-373.

Ushakova, N., Dontsov, A., Sakina, N., & Basrakov, A. (2019). Antioxidative Properties of Melanins and Ommochromes from Black Soldier Fly *Hermetia illucens*. *Biomolecules*, 9, 408.

Van Huis, P., Van Itterbeeck, A., Klunder, J., Mertens, H., Halloran, E., Muir, A., & Vantomme, G. (2013). *Edible Insects. Future Prospects for Food and Feed Security*; Food and Agriculture Organization of the United Nations: Rome, Italy, 45-55.

Van Looveren, N., Verbaet, L., Frooninckx, L., Van Miert, S., Van Campenhout, L., Borghet, M. V., & Vandeweyer, D. (2023). Effect of heat treatment on microbiological safety of supermarket food waste as substrate for black soldier fly larvae (*Hermetia illucens*). *Waste Management*, 164, 209-218.

Wang, H., Ur Rehman, K., Feng, W., Yang, D., Ur Rehman, R., Cai, M., & Zheng, L. (2020). Physicochemical structure of chitin in the developing stages of black soldier fly. *International Journal of Biological Macromolecules*, 149, 901-907.

Xiao, X., Mazza, L., Yu, Y., Cai, M., Zheng, L., Tomberlin, J. K., Yu, J., Van Huis, A., Yu, Z., & Fasulo, S. Efficient co-conversion process of chicken manure into protein feed and organic fertilizer by *Hermetia illucens* L. (Diptera: Stratiomyidae) larvae and functional bacteria. *Journal of Environmental Management*, 217, 668-676.

Yin, J., Wang, K., & Yang, Y. (2014) Improving production of volatile fatty acids from food waste fermentation by hydrothermal pretreatment. *Bioresource Technology*, 171, 323-329.

Yin, J., Wang, K., & Yang, Y. (2014). Improving production of volatile fatty acids from food waste fermentation by hydrothermal pretreatment. *Bioresource Technology*, 171, 323-329.

Z., Fasulo, Z., & Zhang, J. B. (2018). Efficient co-conversion process of chicken manure into protein feed and organic fertilizer by *Hermetia illucens* L. (Diptera: Stratiomyidae) larvae and functional bacteria. *Journal of Environmental Management*, 217, 668-676.

Zhu, Z., Rehman, K., & Yu, Y. (2019). De novo transcriptome sequencing and analysis revealed the molecular basis of rapid fat accumulation by black soldier fly (*Hermetia illucens*, L.) for development of insectival biodiesel. *Biotechnology for Biofuels*, 12, 194.

Zhu, Z., Rehman, K., ur, & Yu, Y. (2019). De novo transcriptome sequencing and analysis revealed the molecular basis of rapid fat accumulation by black soldier fly (*Hermetia illucens*, L.) for development of insectival biodiesel. *Biotechnology for Biofuels*, 12, 194.

Zurbrugg, C., Dortmans, B., Fadhila, A., Verstappen, B., & Diener, S. (2018). From Pilot to Full Scale Operation of a Waste-To-Protein Treatment Facility. *Detritus*, 1, 18-22.

Irrigation Regimes and Soil Amendments Response on Yield and Uptake of Basmati-370

Sheikh Amjid¹, Vikas Abrol¹, Vikas Sharma¹, A.P Singh².

¹ *Division of Soil Science and Agricultural Chemistry, SKUAST Jammu.*

² *Advanced Centre for Rainfed Agriculture, Dhyansar, SKUAST Jammu.*

E-mail: amjidsheikh66@gmail.com

Abstract

This research was conducted at the Division of Soil Science and Agriculture Chemistry, SKUAST Jammu, to study the effect of different soil amendments (biochar and polymer) on soil properties, growth, yield and water productivity Basmati-370. The pot experiment was laid out in 2-factorial CRD with three replications comprising two levels of irrigation viz. I₁ (continuously flooded upto 5 cm) and I₂ (water deficit) as one factor-I and soil amendments (biochar and PAM alone, as well as in combination with each other, 100 % RDF and control) as factor-II. The soil was sandy clay loam in texture, mildly alkaline in reaction, EC within a safe limit, with a low organic carbon, low available nitrogen, medium phosphorus and potassium. Among the irrigation regimes, continuous flooding proved superior to water deficit irrigation regimes and obtained higher values of growth parameters, grain and biological yield. Increase in almost all the growth parameters resulted in significant improvement in yield attributes which led to the significantly highest grain yield. Sole or combined application of soil amendments (biochar and polymer) along with 100 % RDF through inorganic fertilizers performed better than 100 % RDF alone in terms of shoot and root parameters, crop yield and improvement of soil properties. Treatment B₁₀ PAM₁₀ (10 tons biochar per hectare + 10 kg polyacrylamide per hectare) proved to be a promising combination and recorded significantly higher values for growth parameters, yield attributes, nutrient uptake compared to other treatments. Among the interactive effect of irrigation regimes and soil amendments, conjunctive use of biochar and polymer (B₁₀ PAM₁₀) under water deficit condition improved soil and plant parameters, grain yield and water productivity. This experiment underscored the significance of soil amendments, particularly the synergistic effect of biochar and polymer, in bolstering soil health, crop yield and water efficiency, especially under water-deficient conditions. These findings hold relevance for sustainable agricultural practices, offering insights into optimizing resource management for enhanced crop productivity in rice cultivation.

Keywords: Basmati-370, Soil Amendments, Irrigation Regimes, Water Productivity.

Low Tunnel Production of Muskmelon: Technological Advancement and Economic Analysis

Aakashdeep Yadav^{1*}, Dr. Parminder Singh², Dr. JS Papang¹

Department of Agricultural Economics, CCS Haryana Agricultural University, Hisar

DES, KVK Sonapat, CCS Haryana Agricultural University, Hisar

Correspondence: aakashdy02@gmail.com aakashdyo2@hau.ac.in +91 7015938760

Abstract

Cucumis melo, commonly known as Muskmelon, is a significant tropical crop mainly cultivated for its fruit which have a unique and hydrating flavour, along with a low caloric value. The nutritional

analysis of the fruit reveals that the edible component of muskmelon fruit comprises 95.0 per cent moisture, 3.5 per cent carbohydrates, 0.3 per cent each protein and minerals, and yields 17 kcal energy. Additionally, per 100 grams of the edible portion, muskmelon fruit contains 11 mg of calcium, 1 mg of ascorbic acid, 0.04 mg of riboflavin, and 0.02 mg of thiamine. Due to the nutritional benefits of muskmelon, its demand is ever growing and is being preferred by both, health-conscious individuals as well as food connoisseurs. However, one of the major problems with muskmelon cultivation is the seasonal production in northern India. The muskmelon growers are using low tunnels for enhanced and round the year production of the crop. The cost of producing muskmelon per acre under low tunnel in the case study was found to be ₹1,47,066 which includes cost of land lease, seedling, fertilizers, low tunnels and mulch, while the gross returns were ₹1,80,000. The B:C ratio was found to be 1.22 showing the profitability of the enterprise. The limitations in low tunnel production are the initial cost of establishment and requirement of removal of polyethylene cover when crop grows. These modern production techniques, combined with new marketing channels, contribute to improved pricing and a more efficient supply chain, benefiting both growers and consumers.

Keywords: Muskmelon, low tunnel production, polyhouse agribusiness, nutritional security

Harnessing the Circular Economy Paradigm for Sustainable Agriculture

Bheemanagouda¹ and Hanumantappa Jamanal²

*Ph.D. Scholar¹ Department of Food Science and Nutrition UAS, Dharwad and Teaching Assistant²
Kousali Institute of Management Studies KUD, Karnataka*

Abstract

Growing in popularity as a practical paradigm for achieving sustainability in various industries, including agriculture, is the circular economy. Establishing farming systems that maximize resource efficiency, limit waste, and encourage regenerative processes is the aim of the circular economy approach to agriculture. The concepts of the circular economy might improve resilience, sustainability, and economic viability in agriculture. Key components of the circular economy in agriculture include closed-loop nutrient cycles, resource optimization, and waste valorization. With the use of practices like composting, cover crops, and integrated pest management, farmers may restore soil fertility, reduce their need on outside inputs, and halt environmental degradation. Furthermore, the integration of agro-ecological principles promotes biodiversity conservation and ecosystem services, contributing to long-term agricultural resilience. Valuing agricultural waste streams and byproducts is a key component of the circular economy in agriculture. By transforming organic residues into bioenergy, biofertilizers, or animal feed, farmers can create additional revenue streams while reducing greenhouse gas emissions and landfill burden. Moreover, innovations in precision agriculture and digital technologies enable more efficient resource utilization, optimizing water, energy, and inputs. Moreover, the circular economy model promotes collaborations between the agriculture business and other sectors including energy, manufacturing, and urban waste management. For instance, by utilizing organic waste from urban centers for composting or biogas production, agriculture can contribute to closing nutrient loops and reducing environmental pollution. Similarly, collaboration between farmers and food processors can facilitate the valorization of by-products for animal feed or bio-based materials. In summary, adopting the circular economy concept in agriculture has enormous potential to promote rural development and sustainable food systems. By rethinking traditional linear production models and embracing holistic, regenerative practices, farmers can enhance resource efficiency, reduce

environmental impact, and create economic opportunities. Agricultural circular economy projects must be advanced and intensified by policymakers, academics, and stakeholders to address the urgent challenges of food security and climate change.

Keywords: Circular economy, sustainable agriculture, resource efficiency, waste valorization, regenerative practices

Assessment of soil available nutrients and micronutrients under different tea (Camellia sinensis) gardens of Himachal Pradesh, India

Ankit Gill¹ and Praveen Thakur²

Ph.D. Scholar, Department of Soil Science, CCS HAU, Hisar¹

Ph.D. Scholar, Department of Soil Science, CSK HPKV, Palampur²

Presenter: [Ankit Gill \(ankitgill07@gmail.com\)](mailto:ankitgill07@gmail.com); 9416471571)

ABSTRACT

Evaluation of different soil attributes provides an insight into the soil-related constraints and potentials for sustainable agricultural planning. In the present investigation, 37 tea gardens were selected at random from tea growing areas of Himachal Pradesh during 2017-19 to evaluate the status of different soil attributes in surface (0 - 0.30 m) and sub-surface (0.30 - 0.60 m) soils. All the collected soil samples were analyzed for available nitrogen, phosphorus, potassium, sulfur and available Fe, Cu, Mn and Zn. The available nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}), potassium (kg ha^{-1}) and sulfur (kg ha^{-1}) ranged from 290 to 820, 6.2 to 24.8, 140 to 381 and 26 to 65 in surface and 197 to 581, 3.3 to 14.3, 119 to 297 and 20 to 43 in sub-surface soils, respectively. Respective mean values, averaged for both the soil depths of tea garden ranged from 244 to 701, 4.8 to 19.2, 133 to 337 and 23 to 54 respectively. Available Cu, Fe, Mn and Zn ranged from 0.67 to 2.75, 42.2 to 78.7, 13.3 to 28.4 and 0.74 to 2.83 mg kg^{-1} in surface and 0.52 to 2.61, 18.4 to 35.9, 5.3 to 13.3 and 0.41 to 1.49 mg kg^{-1} in sub-surface soils of tea gardens, respectively. Respective mean values, averaged for both the soil depths in tea gardens ranged from 0.60 to 2.68, 32.1 to 54.1, 9.9 to 20.5 and 0.59 to 2.16, respectively.

Keywords: Tea, nitrogen, phosphorus, potassium, sulfur and micronutrients.

Incorporation of enriched city compost for improving soil health, yield and quality of wheat under system of wheat intensification

Ravindra M. Muchhadiya*, R. B. Thanki, H. L. Sakarvadia and P. D. Kumawat

Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh - 362001, Gujarat, India

*E-mail: ravindramuchhadiya@gmail.com Mobile no. 7096663590

ABSTRACT

A field experiment was conducted on medium black calcareous soil at Junagadh (Gujarat) during *rabi* season of 2019-20 to study the effect of incorporation of enriched city compost on soil chemical and biological properties, yield and quality of wheat (*Triticum aestivum* L.) under and system of wheat intensification (SWI). Total twelve treatment combinations, consisting of three system of sowing (S₁: normal practice at 22.5 cm, S₂: SWI at 20 cm × 20 cm and S₃: SWI at 25 cm × 25 cm) were assigned to main plot and four fertility levels (F₁: city compost 10 t/ha, F₂: 50% RDF +

city compost 5 t/ha, F₃: 75% RDF + city compost 5 t/ha and F₄: 100% RDF) were allotted to sub plots in a split plot design with three replications. The results revealed that sowing of wheat under SWI recorded significantly higher values of protein yield (562.63 kg/ha) and total fungal, bacterial as well as *Azotobacter* count in soil. SWI at 20 cm × 20 cm produced significantly maximum grain yield (5070 kg/ha) and straw yield (8289 kg/ha). Application of 75% RDF (90-45-45 kg N- P₂O₅- K₂O/ha) + city compost 5 t/ha enhanced almost all the quality parameters viz., protein, gluten and fiber content in grain, protein yield, available N, P and K as well as organic carbon content in soil after harvest and soil microbial population viz., total fungal, bacterial, actinomycetes, *Azotobacter*, PSB and KSB count in soil, and resultantly gave higher grain yield (5975 kg/ha) and straw yield (8344 kg/ha).

Keywords: Wheat, NPK, city compost, system of wheat intensification, soil properties, yield and quality

Utilizing the potential of buffalo as a meat animal for augmenting farmer's income.

Yashwant Singh¹ and Shwetambri Jamwal²

*Dept. of Livestock Farm Complex, College of Veterinary Science, Rampura Phul, Bathinda, Punjab.
(Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana- 141004)*

¹Corresponding author: ysinghvet@gmail.com

Introduction

Livestock plays a crucial role in the national economy, offering significant opportunities to boost rural economies and support the livelihoods of rural communities. The livestock sector provides essential animal protein in the form of milk, eggs, and meat, meeting the increasing demands of a growing population, urbanization, and rising incomes (Devi et al., 2014). Recent trends indicate a surge in demand for meat, emphasizing the sector's role in generating income, employment, and foreign exchange. Studies suggest that as consumer incomes rise in rapidly developing BRICS countries, such as Brazil, Russia, India, China, and South Africa, comprising over half of the global population, there are notable shifts in food consumption patterns. The livestock sector can significantly contribute to enhancing rural livelihoods, alleviating poverty, and ensuring food security.

Significance of buffalo to livestock sector

Buffalo is a versatile domestic animal that significantly contributes to people's livelihoods by providing high-quality milk and meat, dung for fuel and organic fertilizer, mechanical or draft power, and hides and skins for industrial use. Its performance surpasses that of other bovine species in tropical or sub-tropical regions with poor pasture quality, mainly due to its ability to efficiently digest low-quality feeds. Additionally, buffaloes exhibit flexibility in diet, high resistance to diseases, and adaptability to various housing, feeding, and management setups, giving them an advantage over other domestic animals.

The significance of buffaloes in India is evident from their faster growth rate compared to cattle. Primarily valued for their milk production and secondarily for meat, buffaloes play a crucial role in ensuring food security in the country. Buffalo meat is notably more affordable than beef, goat meat, lamb, pork, and poultry, making it the most economical protein source for disadvantaged sections of society. Its competitive pricing and favorable blending properties make it a key ingredient in various

value-added meat products such as corned beef and hotdogs.

India leads globally in buffalo population with 109.85 million, constituting 58% of the world's buffalo count. The country also dominates buffalo meat production, contributing around 43% to the global output. Uttar Pradesh leads in buffalo meat production, followed by Andhra Pradesh and Maharashtra. In the year 2022-23, 13.62 million buffaloes were slaughtered for meat production, accounting for 17.61% of India's total meat production. India hosts 53.84% of the world's buffalo population. In the same year, India exported 1,175,869.13 metric tons of buffalo meat products valued at Rs. 25,648.10 crores or 3,194.70 USD millions. The buffalo meat sector plays a significant role in the Indian economy, with the meat sourced primarily from spent dairy buffaloes after their productive life, making it a by-product. Carcass yield varies from animal to animal.

Utilizing the meat from younger male buffaloes, typically below 18 months of age, addresses the challenge posed by the dark, coarse, and tough texture of spent buffalo meat. Younger animals have more soluble collagen, which improves the organoleptic and processing characteristics of the meat. This approach resolves the issue faced by dairy farmers in raising male buffalo calves, while also creating opportunities for increased employment and income generation. Additionally, by enhancing the availability of high-quality meat, this initiative could contribute to alleviating malnutrition concerns in the country. Unlike some other meats, buffalo meat doesn't face religious taboos, making it a valuable source of red meat that is gaining popularity worldwide.

India leads in scientific and technological advancements related to buffalo nutrition, production, reproduction, biotechnologies, and genetic enhancement in Asia. Buffalo meat production shows significant growth compared to beef production. The quality and quantity of buffalo meat depend on various factors, including the type and breed of water buffalo, age, feeding practices, management systems, and environmental conditions. Buffalo meat is considered the healthiest among red meats for human consumption due to its low calorie and cholesterol content. It offers a considerable cost advantage over mutton and goat meat, with nearly 2-3 times lower costs. Numerous studies have indicated that buffalo meat has higher iron levels, protein content, and lower fat content, making it a valuable raw material for various industries. Buffalo meat demonstrates favorable physicochemical characteristics compared to beef, particularly in terms of protein, fat, and iron content, contributing to its potential as a healthy food option.

Contribution of livestock sector to economy

The contribution of livestock in total agriculture and allied sector Gross value added (GVA)(at constant prices) has increased from 24.32 per cent (2014-15) to 30.19 per cent (2021-22). Livestock sector contributed 4.75 per cent of total GVA in 2021-22 (at constant price) figure 1.

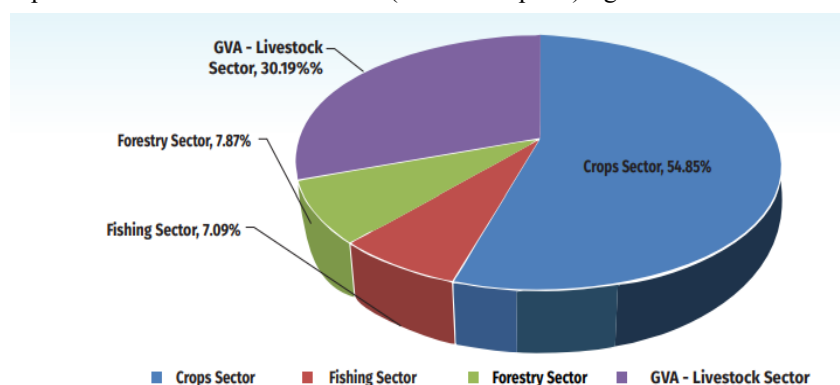


Figure: 1 Item wise % contribution in agriculture sector at current price 2021-22

Meat production and consumption

The Figure 2 shows the situation of meat production in the country with a steady increase from 2015-16 onwards and the production witnessed a leap in the same year due to inclusion of more parameters like commercial meat production. The total meat production in the country is pegged at 9.77 million tonnes in the year 2022-23, which marks a significant progress in the meat production.

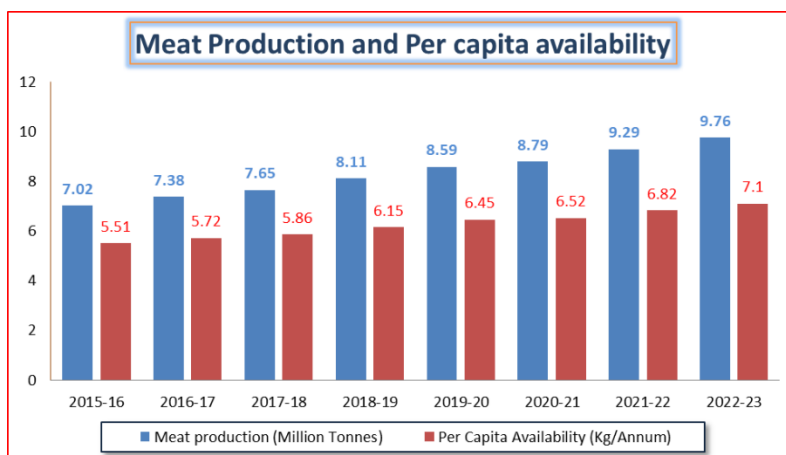


Figure 2: Pattern of meat production in India.

In India, 51.14% of meat production is contributed by Poultry. Buffalo, Goat, Sheep, Pig and Cattle contributed 17.61%, 14.47%, 10.51%, 3.85% and 2.43% of meat production respectively.

In 2021-22, Uttar Pradesh was the top buffalo meat producing state followed by Maharashtra and Maharashtra. Uttar Pradesh has emerged as the hub for export of buffalo meat in the country.

Domestic market chain of buffalo meat in India

The domestic value chain for buffalo meat production in India consists of a network of stakeholders, who work within specific stages from farm to plate. The chain integrates livestock producers, traders, butchers, wholesale meat dealers and retailers. Most meat consumed in India is produced in municipal slaughter houses. The major consuming states of buffalo meat in India are Uttar Pradesh, Maharashtra, Telangana, Andhra Pradesh (erstwhile), Kerala, West Bengal. The rising slaughter of buffalo in these states is indicative of increasing consumer demand for buffalo meat.

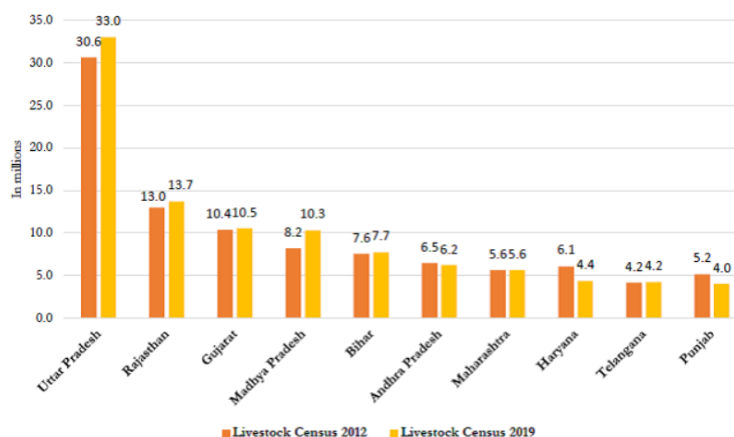


Figure 3: Percent share of Indian states in total buffalo population.

Export

India’s states which are major exporters of buffalo meat include Andhra Pradesh, Maharashtra, Punjab, and Uttar Pradesh, the state with the largest water buffalo population (Figure 3) As for the supply of animals for slaughter, the dairy farmers generally sell water buffaloes to traders. The slaughter houses then procure these animals from these traders and pay them on the basis of carcass weight.

India’s top five buffalo meat export destinations in 2022-23 were Malaysia, Egypt, Vietnam, Hong Kong, Iran and Saudi Arabia. Malaysia accounted for 16.5 % of total Indian exports followed by Egypt (15.9%), Vietnam (14.5%), Hong Kong (11.4%) and Iran (7.3%)

Table 1: India, Carabeef Top Export Destinations, 2022

	Countries	Total Exports Value	Total Exports Percent
	Total World	\$2,967,364,000	100.0
1	Malaysia	\$490,038,000	16.5
2	Egypt	\$472,219,000	15.9
3	Vietnam	\$429,535,000	14.5
4	Hong Kong	\$338,670,000	11.4
5	Iran	\$216,746,000	7.3
6	Saudi Arabia	\$179,332,000	17

Industry sources indicate that slack economies in some of the Middle East and African countries have depressed Indian buffalo meat exports, although the recent opening of the Indonesian market has helped recover some of those losses. Indonesia has granted market access for Indian buffalo meat mainly due to rising demand for affordable buffalo meat in its different consumer segments. India is the fourth largest buffalo meat exporter of the world with major export destinations (2022-23): Malaysia, Vietnam, Egypt, Indonesia and Iraq.

Inherent qualities of buffaloes to produce meat

Buffaloes are endowed with a unique ability to utilize coarse feeds, straws and crop residues converting them into protein rich lean meat. Hence buffaloes fit well in developing and poor countries having poor feed resources. Properly managed buffaloes domesticated as a meat producing animal yields high quality meat at a much lower cost than the cattle when slaughtered at sixteen to twenty months of age. Buffaloes are naturally lean animals. The sub-cutaneous fat layer of the carcass is usually thinner in comparison to cattle. The unique qualities of buffalo meat being lean and less fatty have propelled its demand amongst health-conscious consumers. In addition, buffaloes also have proportionately higher degree of disease resistance than cattle.

Characteristics of buffalo meat

Owing to its chemical composition, structural components and functional abilities, the buffalo meat possesses superior meat processing characteristics. The major striking features of buffalo meat are its dark red colour, high protein, desirable texture, water holding capacity, good marbling, myofibrillar fragmentation index, low connective tissue and emulsifying capacity. More pigmentation or less intramuscular fat (1-2% marbling compared with 3-4% in beef) content causes darker appearance of buffalo meat. The dark meat possesses good binding properties and is preferred in product manufacture. β -carotene in the fat gives yellow coloration and is totally absent in buffalo fat. Buffalo meat products are darker in colour owing to their higher myoglobin content compared to other livestock species. The intramuscular fat percentage varies between the muscles. The moisture content of buffalo meat decreases as the age of the animal increases, which is probably associated with an increase in fat content.

The normal ultimate pH of buffalo meat varies from 5.4 to 5.8. The pH of the meat from intensively reared young males was 5.57, which did not differ significantly from spent male buffalo meat. The significantly ($p < 0.05$) lower ultimate pH is spent female buffalo meat might due to the response of a female buffalo to transport stress. pH increased significantly with prolonged freezer storage due to the fact that meat undergoes analysis resulting in a decrease in extract release volume and water holding capacity to increase in pH.

Composition of buffalo meat

Buffalo meat has certain attributes such as lower intramuscular fat, cholesterol and calories, high unit of essentials amino acid, biological value and iron content. Buffalo meat has moisture (74.04-77.75%), protein (17.33-23.3%), total lipids (1.37%), ash (1.0%) and water soluble proteins (5.1%), salt soluble protein (7.2%), non-protein nitrogen (0.37%) and hydroxyproline (0.12%) of LD muscle from male buffalo. The meat of intensively reared young buffalo showed significantly higher moisture content than meat from spent and female buffalo. Meat from spent female buffaloes had a significantly higher fat content compared to the other groups. The energy value for buffalo meat was found to be 57.22% less than beef. Buffalo meat has less fat and saturated fat than beef. Palmitic, stearic, oleic, and linoleic acids were reported to be predominant fatty acids in the phospholipids of buffalo meat.

Potential for buffalo calves for meat production

According to Ranjhan (2008), in India, every year about 10 millions of male buffalo calves are removed or killed from the production system by farmers due to their intentional negligence in the management practices with a view to save on mother's milk and feed resources incurring loss of about US\$ 11 million per annum in the country. If salvaged for meat production, these calves will not only improve the economic condition of the farmers but also would increase meat production for domestic consumption and export market. These conditions have stimulated the need for development of technologies which would not only promote the consumption of calf meat but also result in healthier, nutritious and value added finished products. This will provide higher revenue to farmers which in turn will improve the managerial practices and lower the calf mortality rate, which may give the country a much needed quantum jump in the meat production sector. Good quality meat from male buffalo calves can be obtained after about 10-12 months of restricted suckling period. The dressing percentage of buffalo carcass of 130 to 500kg bodyweight has been found to range between 50 and 55%. Buffalo calf meat is brighter than beef but the amount of meat pigments do not differ significantly. Meat from

intensively reared young male buffaloes had significantly ($P \leq 0.05$) higher water holding capacity than the meat from spent female buffaloes.

National commission on Agriculture (NCA, 1976) recommendations on buffaloes for meat:

- The buffalo should be developed not only for enhancement of milk production but also for making it a source of production of quality meat.
- In buffalo farms and research institutes wide scale investigations and studies should be undertaken on early weaning of buffalo calves and their rearing on low cost calf starters.
- Research studies on the effect of feeding and husbandry on fattening of buffalo calves should be undertaken.
- Promotional activity for consumption of buffalo meat in the country and consumer educational programmes should be undertaken on a country wide scale.
- A deliberate and energetic drive should be made to develop export trade in buffalo meat.

Challenges/Bottlenecks:

- High buffalo male calves mortality (10 million annually) leads to loss of approx. Rs.200 crore annually.
- There are hardly 100 modern abattoirs and meat processing plants with state of the art facilities for hygienic meat production.
- Poor meat quality (weak and spent buffaloes constitute major portion of buffalo meat).
- Poor cold storage facilities for long term storage of meat and meat products.
- Lack of technology for efficient utilization of animal by-products.
- Problems in breeding and reproduction, poor nutrition, inadequate animal health services and management practices

Strategies to improve buffalo meat industry

- Upgradation of municipal slaughter houses to semi modern abattoirs with all basic requirements and minimum hygienic standards.
- The sanitary and phyto-sanitary (SPS) measures and hygienic standards of meat processing plants should be improved as per international standards.
- The Government should encourage setting up cold storages, supply/value chain and 100% export oriented buffalo slaughter houses in major buffalo belts of the country.
- Increasing the production of superior calves through embryo transfer technology, better disease control, adequate nutrition and improved levels of hygiene at meat handling will lead to a quantum jump in meat production by utilizing the surplus male calves
- Development of appropriate technologies for improving the quality of meat from spent animals.
- Appropriate consumer education programmes on popularization of quality and health benefits of buffalo meat and products will provide a cheap source of animal protein to the masses.
- Financial support by government institutions to establish abattoirs and processing industries.
- Strong linkage between liaison offices, meat industries, meat corporations, research workers and nodal bodies like APEDA (Agricultural and Processed food products Export Development Authority) and Directorate of Marketing and Inspection (DMI) for exchange of information and overall improvement of meat industry and national economy.

Revising buffalo slaughter regulations for realizing production potential

Existing buffalo slaughter provisions in some of the states like Madhya Pradesh, Gujarat, Bihar, Jharkhand, Karnataka, Andhra Pradesh and Telangana etc. are not favorable to farmers for realization of buffalo production potential in particular for utility of male buffalo calves which have lost draught function requirement over the decades due to mechanization in agriculture and relatively much cheaper energy costs from other sources than animal energy source. These states could consider following model buffalo slaughter regulations for amending the existing regulations which are not in the interest of farmers and for realizing higher productivity potential.

Way forward in augmenting buffalo meat

Major emphasis should be given on adoption of scientific management and feeding practices buffaloes by farmers. Developing specific meat breeds and salvaging of buffaloes calves from early death would augment the sustainable meat production. Growing of excess calves to larger weight (200-300 kg live weight) will enhance the export potential of the country, reduce the farmers' burden and improve their socio-economic status. Efforts to increase productivity of animals should be taken by popularizing silage production, use of urea, molasses and chaffing crop residues for sustained feed supplies. Development of livestock markets and transport facilities; Intensive and semi-intensive system of meat animal production; supply of critical feed inputs in the lean season for efficient animal production; FMD- Disease Free Zones in buffalo populous states to promote meat and dairy exports and improving health care facilities for animals and extension facilities for farmers are some of the steps that would led to increase buffaloes productivity and hence the meat production. Thus, the approaches in buffalo production and utilization have to be enhancing the role of buffaloes through economic demand driven situation with involvement of all the stake holders for sustained production and utility. Mutual role and benefit of various stake holders need to be realized with priority to the cause of farmers for sustained livelihood, food security and entrepreneurship development.

References

Devi SM, Balachander V, Lee SI and Kim IH. An outline of meat consumption in the Indian population – A pilot review. *Korean J food Sci Anim resour.* 2014; 34: 507-515.

DAHDF. 2023. *Basic Animal Husbandry & Fisheries Statistics.* AHS S.Department of Animal Husbandry, Dairying and Fisheries. New Delhi, India, pp. 1-172.

Ranjhan S.K. 2014. India buffalo meat industry vis-a-vis international trade. 6th Conference of Indian Meat Science Association and National Symposium on Sustainable Meat Production for Nutritional Security and Consumer Well-being: Challenges and Strategies. 28-30 November, 2014. *Compendium of Invited Papers and Abstracts.* Page 15-22.



+91-8006511800
+91-8006521800
+91-8006531800



saahasconference@gmail.com,
publicationsaahas@gmail.com

www.abhilashiuniversity.ac.in
www.saahas.info

