Souvenir-cum-Book of Abstracts

ISMPP 5th International Conference On

Pathogens, Plant Health *and* Food Security:

Recent Advances for Climate Resilient Agriculture and Landscape Conservation

April 8–10, 2026

Amity University, Uttar Pradesh, Lucknow Campus

Prof. (Dr.) Shalini Singh Visen

Prof. (Dr.) Anil Vashisht

Dr. Komal Pandey

Dr. Jameel Akhtar

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Prof. (Dr.) Anil Vashisht

Dr. Komal Pandey

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DEDICATION

This book is dedicated to all researchers, scientists, academicians, and students who are tirelessly working towards safeguarding plant health and ensuring global food security. Their commitment to advancing knowledge and developing sustainable solutions in the face of climate change continues to inspire progress in agricultural sciences.

It is also dedicated to the farming community, whose resilience and dedication form the backbone of our food systems. Their enduring efforts motivate the scientific community to innovate and contribute meaningfully towards a more sustainable and secure future.

ACKNOWLEDGEMENT

The successful completion of this book is the result of collective efforts, guidance, and support from numerous individuals and institutions. I extend my sincere gratitude to all the distinguished scientists, researchers, and contributors whose valuable research and insights have enriched this compilation.

I am deeply thankful to my colleagues, mentors, and academic peers for their constant encouragement, intellectual support, and constructive suggestions throughout the process. Their contributions have played a significant role in shaping the quality and depth of this work.

I would also like to acknowledge the support of Natals Publication for their professionalism and dedication in bringing this work to publication. Their efforts in editing, designing, and production have ensured that this book reaches readers in its best possible form.

Finally, I express my heartfelt appreciation to my family and well-wishers for their unwavering support, patience, and motivation throughout this journey.

PREFACE

In recent decades, the challenges posed by plant pathogens, climate change, and evolving agricultural landscapes have significantly impacted global food security. The need for innovative, sustainable, and climate-resilient approaches in plant health management has never been more critical. This book, "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation," aims to bring together contemporary research, emerging technologies, and scientific advancements that address these pressing concerns.

The volume is a comprehensive compilation of keynote lectures, invited talks, research findings, and scholarly contributions from leading experts in the field of plant pathology and allied disciplines. It reflects the transition from traditional disease management practices to modern, technology-driven approaches involving artificial intelligence, genomics, nanotechnology, and precision agriculture.

Each section of this book highlights significant developments in understanding plant–pathogen interactions, disease epidemiology, sustainable management strategies, and innovative tools that enhance crop resilience. The integration of interdisciplinary research presented here underscores the importance of collaborative efforts in addressing complex agricultural challenges.

This book is intended to serve as a valuable resource for researchers, academicians, students, and policymakers, providing insights into current trends and future directions in plant health management. It is our hope that this compilation will contribute to advancing scientific knowledge and inspire further research aimed at building a resilient and sustainable agricultural ecosystem.

Messages

सं-332/सी.एम.यू.पी./26

योगी आदित्यनाथ

मुख्य मंत्री
उत्तर प्रदेश

लोक भवन,
लखनऊ - 226001

दिनांक : 31.03.2026

संदेश

मुझे यह जानकर अत्यंत प्रसन्नता हो रही है कि एमिटी यूनिवर्सिटी की मेजबानी में 'Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation' विषय पर ISMPP का 5वां अतरराष्ट्रीय सम्मेलन दिनांक 08-10 अप्रैल 2026 को एमिटी विश्वविद्यालय, लखनऊ में आयोजित किया जा रहा है। यह सम्मेलन कृषि, पौध स्वास्थ्य एवं खाद्य सुरक्षा जैसे अत्यंत महत्त्वपूर्ण विषयों पर केन्द्रित है, जो वर्तमान वैश्विक चुनौतियों, विशेषकर जलवायु परिवर्तन, जैविक तनाव एवं सतत् कृषि के परिप्रेक्ष्य में अत्यंत प्रासंगिक हैं।

भारतीय परंपरा में **'अन्नं बहु कुर्वीत'** का आदर्श केवल उत्पादन की वृद्धि तक सीमित नहीं, अपितु संतुलित, सुरक्षित और सतत् कृषि-व्यवस्था की स्थापना का भी मार्गदर्शन करता है। आज आवश्यकता है कि वैज्ञानिक अनुसंधान, प्रौद्योगिकी नवाचार और पारंपरिक ज्ञान के समन्वय से ऐसी कृषि प्रणाली विकसित की जाए, जो पर्यावरण-संवेदनशील हो तथा भावी पीढ़ियों की खाद्य सुरक्षा सुनिश्चित कर सके।

यह सम्मेलन देश-विदेश के वैज्ञानिकों, शोधकर्ताओं एवं विशेषज्ञों के मध्य विचार-विमर्श, ज्ञान-साझाकरण और नवीन समाधान खोजने का एक सशक्त मंच सिद्ध होगा। इसके माध्यम से जलवायु-लचीली कृषि (Climate Resilient Agriculture) तथा प्राकृतिक संसाधनों के संरक्षण की दिशा में ठोस एवं व्यवहारिक मार्ग प्रशस्त होने की अपेक्षा है।

मुझे विश्वास है कि यह आयोजन एवं इससे संबंधित Abstract Book शोधार्थियों, नीति-निर्माताओं तथा कृषक समुदाय के लिए उपयोगी एवं प्रेरणास्पद सिद्ध होगी तथा राष्ट्र के सतत् विकास लक्ष्यों की प्राप्ति में महत्त्वपूर्ण योगदान देगी।

इस अवसर पर मैं आयोजकों, प्रतिभागियों एवं समस्त संबंधित जनों को हार्दिक शुभकामनाएँ देता हूं तथा सम्मेलन की सफलता की कामना करता हूं।

(योगी आदित्यनाथ)

दूरभाष : 0522-2289017 / 2289010 / 2289167 फैक्स - 0522-2239234 ईमेल - cmup@nic.in

केशव प्रसाद मौर्य
KESHAV PRASAD MAURYA

उप मुख्यमंत्री
उत्तर प्रदेश
Deputy Chief Minister
Uttar Pradesh

संख्या: 5 / कैम्प / टी-आई-पी-/उ-मु-मं(ज) 2026
दिनांक 23.03.2026

—: शुभकामना संदेश :—

मुझे यह जानकर अत्यंत हर्ष हो रहा है कि "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" विषय पर ISMPP 5th International Conference विषय पर का आयोजन दिनांक 08–10 अप्रैल 2026 को एमिटी विश्वविद्यालय, लखनऊ में किया जा रहा है। यह सम्मेलन कृषि, पौध स्वास्थ्य एवं खाद्य सुरक्षा जैसे महत्वपूर्ण विषयों पर केंद्रित है, जो वर्तमान समय में वैश्विक स्तर पर अत्यंत प्रासंगिक है।

उत्तर प्रदेश एक कृषि प्रधान राज्य है, जहाँ कृषि और उससे जुड़े क्षेत्रों का विकास राज्य की अर्थव्यवस्था की मजबूती का आधार है। राज्य सरकार किसानों के हितों की रक्षा, कृषि उत्पादकता में वृद्धि तथा आधुनिक तकनीकों के समावेशन के लिए निरंतर प्रयास कर रही है। ऐसे में इस प्रकार के अंतर्राष्ट्रीय सम्मेलन वैज्ञानिक शोध, नवाचार और नीति–निर्माण के लिए एक सशक्त मंच प्रदान करते हैं।

मुझे विश्वास है कि इस सम्मेलन में होने वाले विचार–विमर्श से कृ षि एवं उद्यानिकी क्षेत्र को नई दिशा मिलेगी, जिससे खाद्य सुरक्षा को सुदृ ढ बनाने, जलवायु परिवर्तन की चुनौतियों का समाधान खोजने तथा सतत कृषि प्रणाली को बढ़ावा देने में महत्वपूर्ण सहायता प्राप्त होगी।

मैं इस सम्मेलन के सफल आयोजन हेतु आयोजकों, वैज्ञानिकों, शोधार्थियों एवं सभी प्रतिभागियों को हार्दिक बधाई एवं शुभकामनाएँ देता हूँ।

आपका
(केशव प्रसाद मौर्य)

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Director- Amity Food and
Agriculture Foundation
Amity University, Uttar Pradesh Lucknow.
Mob. 8826588007

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email: dycmkpm@gmail.com

दिनेश प्रताप सिंह

राज्य मंत्री (स्वतंत्र प्रभार)
उद्यान, कृषि विपणन, कृषि विदेश व्यापार
तथा कृषि निर्यात विभाग
उत्तर प्रदेश।

दिनांक 23/03/2026

सन्देश

मुझे यह जानकर अत्यंत प्रसन्नता हो रही है कि "Pathogens, Plant Health and Food Security Recent Advances for Climate Resilient Agriculture and Landscape Conservation" विषय पर ISMPP 5th International Conference का आयोजन दिनांक 08 से10 अप्रैल, 2026 तक एमिटी विश्वविद्यालय, लखनऊ में किया जा रहा है। यह सम्मेलन कृषि, औद्यानिकी एवं खाद्य सुरक्षा जैसे अत्यन्त महत्वपूर्ण क्षेत्रों में नवीन शोध, नवाचार और तकनीकी प्रगति को बढ़ावा देने हेतु एक सराहनीय पहल है।

औद्यानिकी क्षेत्र कृषि विकास का एक महत्वपूर्ण अंग है, जो न केवल पोषण सुरक्षा सुनिश्चित करता है बल्कि किसानों की आय वृद्धि और रोजगार सृजन में भी अहम भूमिका निभाता है। उत्तर प्रदेश औद्यानिकी उत्पादन में अग्रणी राज्यों में से एक है और राज्य सरकार इस क्षेत्र में आधुनिक तकनीकी, मूल्य सम्वर्धन तथा प्रसंस्करण को बढ़ावा देने के लिए निरन्तर प्रयासरत है।

मुझे आशा ही नहीं पूर्ण विश्वास है कि इस अन्तर्राष्ट्रीय सम्मेलन के माध्यम से वैज्ञानिकों, शोधकर्ताओं, नीति-निर्माताओं एवं उद्योग जगत के विशेषज्ञों के बीच सार्थक संवाद स्थापित होगा, जिससे औद्यानिकी एवं कृषि क्षेत्र में नवाचार को नई दिशा मिलेगी। यह सम्मेलन जलवायु परिवर्तन की चुनौतियों के समाधान, टिकाऊ, कृषि प्रणाली के विकास तथा खाद्य सुरक्षा को सुदृढ़ बनाने में महत्वपूर्ण योगदान देगा।

मेरी ओर से इस अन्तर्राष्ट्रीय सम्मेलन के सफल आयोजन हेतु आयोजकों, प्रतिभागियों एवं सभी सम्बन्धित व्यक्तियों के लिए हार्दिक शुभकामनाएं।

(दिनेश प्रताप सिंह)
राज्य मंत्री (स्वतंत्र प्रभार)
उद्यान, कृषि विपणन, कृषि विदेश व्यापार तथा
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FOUNDER PRESIDENT'S MESSAGE

It is a matter of great pride that Amity Food and Agriculture Foundation, Amity University Uttar Pradesh (AUUP), Lucknow Campus is organizing **5th International Conference on Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation** jointly with Indian Society of Mycology and Plant Pathology (ISMPP) and Maharana Pratap University of Agriculture & Technology from Wednesday, 8th April to Friday, 10th April 2026.

Amity has always remained at the forefront of scientific, technological and innovative initiatives and laid special emphasis on a vibrant environment which encourages our brilliant scientists, researchers, faculty members, research scholars and students for undertaking research activities focusing on niche areas, to meet the present and future challenges of the world.

At a time when global agriculture faces unprecedented challenges due to climate change, emerging pathogens and resource constraints, the need for innovative and sustainable solutions has become more critical than ever. This conference provides a timely and significant platform to deliberate on integrated approaches that combine scientific advancements, technological innovation, and ecological sustainability.

I welcome the distinguished academicians, scientists, researchers, industry leaders, and other subject experts who are participating in this conference. Their collective expertise and exchange of ideas will be highly inspiring, motivating and enriching for brilliant students, research scholars, Ph.D scholars, faculty members and other worthy participants and ignite in them, innovative ideas that translate into technologies and innovations for societal benefit. The conference will provide a platform for forging bonds and mutual cooperation, undertaking joint research projects and joint publications, for achieving long-term goals and contacts for mutual benefits.

My sincere appreciation to all the esteemed members of International Advisory Committee and National Advisory Committee for their valuable advice.

I compliment Dr. Shalini Singh Visen, Organising Secretary of the conference & Director, Amity Food and Agriculture Foundation (Lucknow Chapter), co-organising Secretaries - Prof. (Dr.) Alpana Srivastava, Dr. Prachi Srivastava, Dr. Gurjeet Kaur and Dr. Komal Pandey as well as the dedicated faculty members, brilliant students, research scholars and staff for their sincere efforts to organise the event of this magnitude. I appreciate Prof. (Dr) Anil Vashisht Pro VC, AUUP, Lucknow campus and Wg. Cdr. (Dr) Anil Tiwari, Dy Pro VC, AUUP, Lucknow campus for their valuable guidance. My appreciation also goes to Dr. Balvinder Shukla, Vice Chancellor, AUUP and Dr. Nutan Kaushik, Director General, AFAF for their advice and cooperation.

The most strategic and unparalleled leadership of Dr. Aseem Chauhan Ji, Resp. Chairman, AUUP, Lucknow campus & Addl. President, Ritnand Balved Education Foundation (RBEF), would lead to outcome based and result oriented success of the Conference. The best wishes from our most visionary and exemplary leader, Dr. Atul Chauhan Ji, Hon'ble Chancellor, AUUP & President, RBEF, would always be there for a fruitful, meaningful, and successful event.

I warmly welcome all participants and hope they have a memorable and enriching experience that not only contributes to the goals of the conference but also leave a profound impact on the fellow participants.

(Dr. Ashok K. Chauhan)
Founder President
Ritnand Balved Education Foundation (RBEF)
(The Foundation of Amity Universities, Institutions & Amity International Schools)

Dr. Amar Nath Mukhopadhyay.

Honorary Fellow ISMPP,
Former Vice Chancellor, AAU
Director General, Tea Research Association

Message

It is a pleasure to extend my greetings to all participants of the 5th International Conference of the Indian Society of Mycology and Plant Pathology (ISMPP) on *"Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation"*, being held at Amity University Lucknow from April 08–10, 2026.

Plant pathology is rapidly evolving as cutting-edge technologies such as AI, ML, DL, and IoT are transforming and strengthening traditional disease management practices enabling faster diagnostics, real-time monitoring, and data-driven precision in plant health.

This conference reflects the power of collaboration, bringing together academia, research, and industry to exchange knowledge and forge partnerships essential for addressing the challenges of climate-resilient agriculture.

I commend the dedicated efforts of the Amity Food and Agriculture Foundation for organizing this impactful event with vision and commitment. Such initiatives are instrumental in driving innovation and advancing plant health research.

I extend my best wishes for a successful conference and hope it fosters meaningful discussions and enduring collaborations.

Dr A N Mukhopadhyay
Former Vice Chancellor AAU
Director General Tea Reseach
Mob 979320033

मा.कृ.अ.प.
ICAR

Dr. C. D. MAYEE
Ph.D (IARI) New Delhi, D.Sc.
AvH Fellow (Germany), NAAS Fellow,
Chairman: Agriculture Finance Corporation (Mumbai)
Agrovision Advisory Committee (Nagpur)
President: ISCI (Mumbai), SABC (New Delhi)
Board Member: African Biosafety Network (Uganda)
Dr. PDKV Akola, ISAAA (USA), SKAUST, Srinagar, (J & K)

Former :
Chairman, ASRB (ICAR), New Delhi
Agri Commissioner, GOI, New Delhi
Director, CICR, Nagpur
Vice Chancellor, MAU Parbhani

Message

I am extremely happy to learn that Indian Society of Mycology and Plant Pathology, Udaipur is organizing the Fifth International Conference on a subject very dear to all agricultural scientists in general and Pathologists in particular. Plant health, Food Security, Climate Resilient Agriculture and Landscape Conservation are very topical areas that need discussion and review of current research output. I am extremely happy that the society has collaborated with the Amity Agriculture Foundation at Amity University in Lucknow for conducting this mega event. I congratulate the organizers for timely holding this event. As the country step in for the VIKSIT BHARAT in 2047, the nation demands both sustainability and food security, reducing the losses due to pests, diseases and weeds becomes priority in securing enough production. Crop diseases take heavy toll of crops and some have been with the ecosystem for pretty long time as endemic problems but some have entered the system in recent past as epidemic or pandemic. Climate change is a larger problem but as Pathologist we must view this to know the changing crop-pathogen interactions. Over the years the principals of plant disease management have not changed but the way new diagnostics, detection, forecasting and management tools are rapidly undergoing shifts require deep understanding. AI, ML, IoT have already entered in every field and certainly pathologists cannot remain aloof from the new sciences. Ignorance is no bliss in science research if we have to progress in this world. Hope the younger generation learn all such aspects for what the object of the symposium has been set up. The Conference offers an unique opportunity to young researchers, scientists and students to share their views to exploring and harnessing the power of new technologies to achieve the final goal of food security and one health. I wish the Conference a grand success.

(C.D. Mayee)

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Prof. C. MANOHARACHARY
M.Sc., Ph.D., FNASc, FNAAS, FBS, FPS, FAFS, FMSC, FMS, D-Sc

Hon. NASI Senior Scientist
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Co-ordinator, AICOPTAX (MOEF)
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Date : 26-03-2026

MESSAGE

I am extremely Happy to note that, ISMPP – 5th International Conference is going to be organised at Lucknow in collaboration with Amity Food and Agriculture Foundation , Amity University, UP, Lucknow from April 08 – 10 , 2026. The topic entitled " Pathogens, plant Health & Food Security – Recent Advances for climate Resilient Agriculture and landscape conservation" is of much importantance for developing countries like India . Large number of participants and experts are going to discourse about plant health and Food Security along with climate change and control of plant Diseases. The discussions will have greater impact on Human Welfare . The outcome will not only help in framing policy for sustainable Agriculture and Crop productivity . Thus the worthy Contribution from Scientists , Young Researchers and policy makers will help in reducing Chemical inputs and Plant Protection . I congratulate the Executive Council , Plant Pathologists , Researchers and Students and also convenor of the International Conference for their sincere involvement and concern in making the conference a grand success .

Every country needs strengthening of Education and Agriculture to prosper and progress .

Regards

C. Manoharachary

To,

Professor Rawal Uday, Secretary
ISMPP, Department of Plant Pathology
Rajasthan College of Agriculture
MPUAT , Udaipur.

Professor (Dr) Shalini Singh Visen, Convenor
Amity University ,
Lucknow .

PANJAB UNIVERSITY

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Dr. S. S. Chahal
Honorary Emeritus Professor
(Former Vice Chancellor, MPUAT (Raj),
DBU and Khalsa University (Pb.)

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Message

It gives me pleasure to send a message to the participants attending ISMPP 5th International Conference on "**Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation**" at Amity University, Lucknow from April 08-10, 2026.

It is a matter of great appreciation that the Indian Society of Mycology and Plant Pathology (ISMPP) is upholding its traditions of periodically organising Global Conferences to provide a forum to deliberate emerging and critical issues related to plant disease management which is vital for profitable agriculture. For climate-resilient plant pathology there is need to focus on mitigating the increased risk of plant diseases under shifting climate. Climate change mediated accelerated pathogen life cycles, increased aggressiveness, altered host physiology, resurgence of pathogens with new combinations of host-pathogen-environment require updating of epidemiological models and devising suitable management strategies employing frontier technologies.

In this context, integrating Artificial Intelligence (AI) into plant disease management is fast becoming a cornerstone of climate-resilient agriculture offering tools to manage unpredictable disease dynamics driven by global warming. Machine Learning (L), Deep Learning (DL) and Internet of Things (IoT) are proving revolutionary technologies in early detection and diagnosis, precision surveillance, predictive modelling, decision support and accelerated resistance breeding. Widespread use of AI is expected in future with higher data availability, proficiency in interpretability, awareness among stakeholders and availability of resources.

Highly relevant technical sessions have been carved in the three day programme providing opportunity to the participants to discuss current and concerning issues in detail which will pave way for formulating useful recommendations and guidance to the researchers involved in advancements in plant pathology and sustainable agriculture.

I extend all my good wishes for the success of the Conference.

S.S. Chahal

(S. S. Chahal)
Honorary Fellow ISMPP

Prof. Appa Rao Podile
FNA, FASc, FNASc, FNAAS
Former Vice-Chancellor
Emeritus Professor & J.C Bose Fellow
Department of Plant Sciences
School of Life Sciences

University of Hyderabad
(A Central University created by an Act of Parliament)

27th March 2026

Message

It gives me great pleasure to be associated with the 5th International Conference of the Indian Society of Mycology & Plant Pathology being hosted at Amity University, Lucknow, on the timely and highly relevant theme of "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation."

My own scientific journey over the years has been closely aligned with understanding plant–microbe interactions, particularly the role of beneficial microorganisms in enhancing plant health and resilience. Work on plant growth-promoting rhizobacteria, induced systemic resistance, and biological control of plant diseases has continually reinforced my belief that sustainable agriculture must increasingly rely on nature-based and microbiome-driven solutions. In the context of climate change, such approaches acquire even greater importance, as they offer environmentally sound and adaptable strategies to manage emerging plant diseases and stress conditions.

The growing complexity of plant–pathogen dynamics under changing climatic regimes calls for integrative research that bridges molecular insights with field-level applications. Equally important is the need to translate scientific advances into technologies and practices that are accessible to farmers, thereby strengthening food systems and rural livelihoods.

It is heartening to see that this conference brings together a diverse group of scientists, academicians, policymakers, and young researchers. Such platforms are invaluable for exchanging ideas, fostering collaborations, and inspiring the next generation to pursue innovative and socially relevant research.

I commend the organizers for their vision and efforts in convening this important event. I am confident that the deliberations will lead to meaningful insights and collaborative initiatives that will contribute to advancing climate-resilient agriculture and sustainable plant health management.

I extend my best wishes for the grand success of the conference.

Prof. (Dr.) Appa Rao Podile
Former Vice Chancellor & Emeritus Professor
University of Hyderabad

Prof. C.R. Rao Road, Central University, P.O., Gachibowli, Hyderabad – 500 046 (Telangana) INDIA.
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MESSAGE

Prof H B Singh, FNAAS

Advisor- Cum- Coordinator

Uttar Pradesh Pollution Control Board, Lucknow

Former Professor & Head, Department of Mycology & Plant Pathology

Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005

It gives me immense pleasure to note that Amity University Uttar Pradesh, Lucknow in collaboration with Indian Society of Mycology & Plant Pathology, Udaipur is organizing 5th International Conference on " Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" from April 08-10,2026 at Amity University, Lucknow Campus, Uttar Pradesh India. It is a great honour and privilege to extend my warm greetings to all distinguished participants of the International Conference. This significant gathering of eminent scientists, researchers, policy makers, industry experts, and stakeholders reflects our shared commitment to addressing one of the most critical global challenges of our era—ensuring sustainable plant health to secure food for all.

Plant health lies at the very heart of agricultural sustainability and global food security. Yet, it is increasingly threatened by the rapid evolution and spread of plant pathogens, exacerbated by climate change, intensifying global trade, and environmental degradation. These challenges not only endanger crop productivity but also threaten livelihoods, biodiversity, and economic stability worldwide.

In this context, the conference provides a timely and invaluable platform for the exchange of knowledge, cutting-edge research, and innovative practices. It encourages interdisciplinary dialogue and fosters international collaboration aimed at developing resilient, science-based solutions for disease management, crop protection, and sustainable agriculture.

The insights and outcomes from this conference will play a crucial role in shaping future strategies, strengthening global partnerships, and advancing our collective efforts toward resilient agricultural systems and enhanced food security.

I am sure that the deliberations will be intellectually enriching, forward-thinking, and impactful.

I extend my best wishes to the organizers and participants for the grand success of 5th ISMPP International Conference.

Dated : March 27,2026 (H B Singh)

ICAR
डॉ. देवेन्द्र कुमार यादव
उप महानिदेशक (फसल विज्ञान)
Dr. Devendra Kumar Yadava
Deputy Director General (Corp Science)

भारतीय कृषि अनुसंधान परिषद
कृषि अनुसंधान एवं शिक्षा विभाग
कृषि एवं किसान कल्याण मंत्रालय, भारत सरकार
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Indian Council of Agricultural Research
Department of Agricultural Research & Education
Ministry of Agriculture and Farmers Welfare
Govt. of India, Krishi Bhawan, New Delhi-110001

MESSAGE

I am pleased to learn that the 5th International Conference on "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" is being jointly organized by the Indian Society of Mycology and Plant Pathology and the Amity Food and Agriculture Foundation at Amity University, Lucknow Campus, from April 8–10, 2026.

In the face of climate change, the emergence of new plant diseases, and growing pressures on global food systems, effective plant health management has become a cornerstone of sustainable agriculture. The theme of this conference is both timely and highly relevant, addressing critical issues related to climate resilience, ecological sustainability, and food security.

The program covers cutting-edge areas such as digital plant pathology, artificial intelligence, genomics, gene editing, and nanotechnology, all of which are transforming disease diagnosis and management. The emphasis on integrated disease management, soil health, and eco-friendly approaches including bio-intensive and microbiome-based strategies is particularly important for advancing sustainable farming systems.

The inclusion of topics such as post-harvest pathology, mycotoxins, and food safety underscores the need to ensure both the quality and safety of agricultural produce. Furthermore, applied mycology and value addition present opportunities to enhance farmers' income and improve nutritional security. Discussions on policy, biosecurity, and agri-entrepreneurship will further strengthen the vital connection between scientific research and practical implementation.

I am confident that this conference will serve as an excellent platform for knowledge sharing, innovation, and collaboration. I extend my warm greetings and best wishes to the organizers and participants for the success of this scientific event.

देवेन्द्र कुमार यादव
(D.K. Yadava)

March 27, 2026
New Delhi

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Prof. (Dr.) Balvinder Shukla
Patron
Professor of Entrepreneurship, Leadership & IT
Vice Chancellor, Amity University Uttar Pradesh

The 5th ISMPP Conference at Co-hosted by ISMPP, MPUAT Udaipur, and Amity's Food & Agriculture Foundation Lucknow Campus heralds a new era in addressing pathogens and plant health for food security, emphasizing climate-resilient strategies and landscape conservation.

The conference unites thought leaders for 10 thematic tracks: from digital pathology and genomics to eco-pathology, nutraceuticals, and agri-policy. The theme "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" is a timely initiative, aligning with global efforts to ensure sustainable food systems. With the vision of our Founder President Dr. Ashok K Chauhan of "Nurturing Tomorrow's Leaders Today", we strive to make a meaningful impact in this critical area.

The theme of this conference aligns with India's 'Viksit Bharat@2047' aspiration, leveraging cutting-edge research and innovation to propel the nation towards sustainable agricultural practices and food security. Amity University is poised to drive agricultural transformation, a key sector in India's economic development. I extend heartfelt gratitude to our Chancellor Dr. Atul Chauhan for providing the supportive environment that enables us to innovate, grow, and excel in our educational endeavors.

This conference will witness the delving of delegates into cutting-edge themes: digital plant pathology leveraging AI and ML for smart surveillance; the omics revolution encompassing genomics, transgenics, and gene editing; nanotechnology for next-gen therapeutics; bio-intensive IDM/IPM with biocontrol and endophytes; soil health via root microbiomes; eco-pathology for natural farming and agro-scaping; post-harvest pathology and mycotoxins; applied mycology for mushrooms and nutraceuticals; and policy dimensions like global biosecurity, agri-business, and IPR.

I would like to congratulate the Organizing Committee of ISMPP for their dedication and outstanding drive in organizing this conference.

Best wishes.

Prof. (Dr.) Balvinder Shukla

बिहार कृषि विश्वविद्यालय, सबौर (भागलपुर)
Bihar Agricultural University, Sabour (Bhagalpur)

डॉ. डी. आर. सिंह
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Dr. D. R. Singh
Vice Chancellor

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पत्रांक/Ref. : 536/VC

दिनांक/Date : 24/03/2026

Message

It is a matter of great pleasure to note that Amity Food and Agriculture foundation, Amity University, Lucknow in collaboration with Indian Society of Mycology and Plant Pathology, RCA, MPUA&T Udaipur is organising 5th International conference on the theme "Pathogens, Plant health and food security: Recent Advances for Climate resilient Agriculture and Landscape conservation" from April 8-10, 2026.

We are well aware that plant pathogens continue to pose serious and ever evolving threats to global food security, food safety, agricultural productivity and ecological balance. In recent years, these challenges have been further aggravated by climate change, increased global trade and the emergence of new and re-emerging plant diseases, making sustainable crop protection strategies more important than ever. There is an urgent need to integrate advanced scientific innovations with sustainable agricultural practices to ensure long term resilience and environmental stability.

In this context, the convergence of modern tools such as genomics, artificial intelligence, precision agriculture and ecological approaches to disease management offers new opportunities to tackle these challenges effectively. The present conference is therefore timely and highly relevant, as it focuses on connecting science, technology and policy for ensuring sustainable agriculture and food systems.

I am confident that this conference will provide an excellent platform for scientists, academicians, young researchers, industry professionals and policymakers to come together and exchange ideas, share research findings and discuss practical and scalable solutions for plant health management and food security. It will also encourage interdisciplinary deliberations and collaboration, which are essential for addressing the complex challenges facing agriculture today. I believe that the deliberations and outcomes of this conference will contribute significantly towards strengthening climate resilient agriculture, promoting sustainable agro-ecosystems and supporting farmer centric innovations. The knowledge generated here will benefit not only the scientific community but also policymakers, stakeholders and farming communities at large.

I extend my heartfelt congratulations to the organizers for identifying a theme of great contemporary relevance and future significance, and for their commendable efforts in organizing this significant international event.

I wish the International conference to be a grand success and impactful outcomes.

(D.R. Singh)
Vice-Chancellor

बिरसा कृषि विश्वविद्यालय
BIRSA AGRICULTURAL UNIVERSITY

रांची, झारखण्ड, भारत
Ranchi, Jharkhand, India

डॉ. सुनील चन्द्र दुबे
कुलपति
Dr. S.C. Dubey
Vice-Chancellor

Message

I am delighted to learn that the Indian Society of Mycology and Plant Pathology (ISMPP) is organizing its 5th International Conference on "*Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation*" at Amity University, Lucknow Campus, during April 8–10, 2026.

In an era defined by climate volatility and globalized trade, the sanctity of our food systems depends entirely on the resilience of our crops. This conference comes at a critical juncture where traditional plant pathology must converge with the Frontiers of Technology. The integration of AI-driven smart surveillance, the 'Omics' revolution, and Nanotechnology is no longer a future prospect but a current necessity for precision disease management.

The shift toward Integrated Disease Management and Ecology - focusing on the root microbiome, bio-intensive IDM, and natural farming - is essential for maintaining soil health and landscape conservation. Furthermore, addressing Post-Harvest Pathology and Applied Mycology is fundamental to ensuring that our agricultural output translates into nutritional security and value addition for our farmers.

As we navigate Global Biosecurity and IPR challenges, this platform provides an invaluable opportunity for plant pathologists, researchers, and entrepreneurs to bridge the gap from "Lab to Land". I hope the deliberations will generate a strategic roadmap for sustainable crop protection and agri-business innovation.

I congratulate the organizers, wish the event a grand success and hope the participants find these interactions professionally enriching and personally inspiring.

Sdubey
23/01/26
(S.C. Dubey)

वै.औ.अ.प. - राष्ट्रीय वनस्पति अनुसंधान संस्थान
CSIR - National Botanical Research Institute
राणा प्रताप मार्ग, लखनऊ – 226001, उ.प्र., भारत
Rana Pratap Marg, Lucknow - 226001, U.P., India

डॉ. अजित कुमार शासनी
निदेशक
Dr. Ajit Kumar Shasany
Director

Message

This important international forum, jointly organized by the Indian Society of Mycology and Plant Pathology, RCA, MPUAT, Udaipur, Rajasthan, and the Amity Food and Agriculture Foundation, Amity University Uttar Pradesh, Lucknow Campus, addresses some of the most pressing global challenges of our time. The focus on plant health, pathogen management, food security, and climate-resilient agricultural practices is both timely and crucial for sustainable development and ecological balance.

I am confident that this conference will provide an excellent platform for scientists, academicians, policymakers, and industry experts from across the world to exchange innovative ideas, share cutting-edge research findings, and foster meaningful collaborations. Such deliberations are vital for developing resilient agricultural systems and safeguarding food security for future generations.

I commend the organizers for their dedicated efforts in bringing together distinguished experts and participants for this significant scientific event. I wish the conference great success and hope that the deliberations will yield impactful outcomes for science, agriculture, and society at large.

With best wishes for a highly productive and memorable conference

Date: 27.03.2026

(Ajit Kumar Shasany)

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Associate Director of Research
Directorate of Research
Navsari Agricultural University,
Navsari Gujarat India

Dr. Lalit Mahatma
President, ISMPP

Message

Pathogens are among the greatest robbers of plant productivity, causing yield losses exceeding 30 percent annually and severely impacting food security as well as farmers' livelihoods. In the era of climate change, the dynamics of plant diseases are rapidly shifting. Rising temperatures, erratic precipitation patterns, and an increasing frequency of extreme weather events are enhancing the survival, spread, and virulence of pathogens. These emerging challenges call for a decisive transition toward climate-resilient agricultural systems that integrate plant health management with ecological sustainability.

There is an urgent need to deliberate, reflect, and collectively strategize through focused brainstorming on this critical and timely subject. Such intellectual engagements are essential to nurture young minds, strengthen scientific capacity, and guide our efforts in a clear and purposeful direction.

I am happy that the Indian Society of Mycology & Plant Pathology (ISMPP) by which we all are associated has the culture of nurturing the heritage and guiding young minds for the better tomorrow since its inception. In the same direction ISMPP is going to organize 5th International Conference on the topic "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" from April 08-10, 2026 with the collaboration of Amity Food and Agriculture Foundation, Amity University, Uttar Pradesh, Lucknow Campus, India. Looking at the themes of different session, I am confident that the International Conference is going to have great deliberations. ISMPP awards and lecture series have its own aura and will certainly add in the success of the event.

With great pleasure and gratitude I extend my warmest greetings & thanks to Honorary Fellows of the Societies, specially **Prof (Dr.) S.S. Chahal**; **Dr. Ashok K. Chauhan**, Founder President, RBEF, Amity Education Group, **Dr. Aseem Chauhan**, Chairman, **Prof. (Dr.) Balvinder Shukla**, Vice Chancellor, **Prof. (Dr.) Anil Vashisht**, Pro Vice Chancellor, **Prof. (Dr.) Shalini Singh Visen**, Director, Amity Food and Agriculture Foundation, Amity University, Lucknow, Uttar Pradesh of host institute; **Dr. Pokhar Rawal**, Secretary, ISMPP, MPUAT, Udaipur, all the committee members of different activities, each and every one who is going to participate in the event on my personal and esteemed society behalf.

May this International Conference mark the beginning of a transformative journey that inspires innovation, strengthens collaborations, and opens new avenues for sustainable agriculture and plant health management. Let it serve as a guiding force for future generations as we continue to explore new frontiers, overcome challenges, and build a lasting legacy for global food and ecological security.

(Lalit Mahatma)

Dr. R. S. Jaiman
Vice-President, ISMPP
&
Professor & Head, Department of Plant Pathology,
C. P. College of Agriculture, SDAU, Sardarkrushinagar

This conference thoughtfully encapsulates several critical dimensions of modern agriculture. The focus on pathogens and plant health highlights the urgent need to understand emerging and re-emerging plant diseases and to develop effective, eco-friendly management strategies. The emphasis on food security underlines the global challenge of ensuring sufficient, safe, and nutritious food for a growing population. Further, the integration of recent scientific advances reflects the importance of innovations in diagnostics, biotechnology, and sustainable disease management. Importantly, the theme also addresses climate-resilient agriculture, recognizing the impact of climate change on crop productivity and disease dynamics, and the necessity to adapt agricultural practices accordingly. Lastly, the inclusion of landscape conservation signifies the need to maintain ecological balance and biodiversity while promoting agricultural development. In an era marked by rapid climate change, emerging pathogens, and increasing pressure on natural resources, such a comprehensive and forward-looking theme is both timely and highly relevant. It encourages a holistic approach that bridges science, sustainability, and policy. This conference addresses some of the most pressing challenges of our time—ensuring plant health, safeguarding food security, and building climate-resilient agricultural systems. In an era marked by rapid climate change, emerging pathogens, and increasing pressure on natural resources, the need for innovative research and collaborative approaches has never been greater. The theme of the conference is both timely and highly relevant, as it integrates scientific advancements with sustainable practices for long-term agricultural and environmental stability.

It gives me immense pleasure to extend my warm greetings and best wishes on the occasion of the 5th International Conference on *"Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation"* being held from April 8–10, 2026.

I commend the joint efforts of the Indian Society of Mycology and Plant Pathology, RCA, MPUAT, Udaipur, Rajasthan, and the Amity Food and Agriculture Foundation, Amity University, U.P., Lucknow Campus for organizing this significant event. Bringing together leading scientists, researchers, academicians, and practitioners from across the globe, this conference will serve as an excellent platform for knowledge exchange, networking, and fostering interdisciplinary collaborations.

I am confident that the deliberations and outcomes of this conference will contribute meaningfully to advancing research in plant pathology and allied fields, ultimately supporting sustainable agriculture and food systems.

I wish the conference great success and all the participants a productive and enriching experience.

(R. S. Jaiman)

Secretary

Indian Society of Mycology and Plant Pathology
Department of Plant Pathology,
Rajasthan College of Agriculture,
MPUAT, Udaipur - 313 001, Rajasthan

MESSAGE

The Indian Society of Mycology and Plant Pathology (ISMPP) have been striving to serve the science of Mycology and Plant Pathology ever since its inception in 1970. The ISMPP has had a glorious past showing multifaceted growth in areas of publication of scientific researches in the *Journal of Mycology and Plant Pathology*, reviews on recent vital theme authored by learned Plant Pathologists in "*Reviews of Plant Pathology*" and highlights in *ISMPP News Letter.*

The Indian Society of Mycology and Plant Pathology, Udaipur feels greatly privileged and honoured for getting permission from the **Dr. Ashok K. Chauhan,** Founder President, RBEF, Amity Education Group, **Dr. Aseem Chauhan,** Chairman, **Prof. (Dr.) Balvinder Shukla,** Vice Chancellor, **Prof. (Dr.) Anil Vashisht,** Pro Vice Chancellor of host institute Amity University, Lucknow, Uttar Pradesh to host **ISMPP 5th International Conference**. I extend my heartiest thanks to **Prof. (Dr.) Shalini Singh Visen,** Organizing Secretary and, **Prof. (Dr.) Shalini Singh Visen,** Director, Amity Food and Agriculture Foundation, Amity University, Lucknow, Uttar Pradesh and his enthusiastic team members for involvement to organize this **International Conference**.

It is hoped that **ISMPP 5th International Conference** will provide a forum for interaction among researchers, impressive deliberations and sharing ideas to arriving to some conclusions apprehension to the crop diseases and their sustainable management through newer and innovative approaches in plant disease research and development of trained human resources for food security.

I extend heartiest welcome to all the learned speakers, delegates, past and present executive council & editorial board members for their support to continue striving for the mission of this prestigious society and my best wishes for the grand success of the **ISMPP 5th International Conference**.

(Pokhar Rawal)
Secretary, ISMPP, Udaipur

INDIAN SOCIETY OF MYCOLOGY AND PLANT PATHOLOGY
UDAIPUR, RAJASTHAN

Website: www.ismpp.org.in

Dr. Jameel Akhtar
Editor-in-Chief
Journal of Mycology & Plant Pathology

Message

It is a moment of great professional pride and academic significance as the Indian Society of Mycology and Plant Pathology (ISMPP) convenes for its 5th International Conference on "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" at Amity University, Lucknow.

As the Editor-in-Chief of the Journal of Mycology and Plant Pathology (JMPP), I am particularly heartened by the scientific breadth of this Souvenir-cum-Book of Abstracts. The research encapsulated within these pages reflects the evolution of our discipline from traditional diagnostics to a multi-dimensional science that is vital for global food security.

The themes of this conference - spread across the Frontiers of Technology, Ecological Management, Food Safety, and Policy - perfectly mirror the rigorous standards and diverse scholarship we strive to uphold in JMPP. We are witnessing a transformative era where AI, Machine Learning, and 'Omics' are providing us with unprecedented tools for smart surveillance and gene editing. Simultaneously, our focus remains firmly rooted in sustainability, as evidenced by the profound work being done in Bio-intensive IDM, Soil Health, and the Root Microbiome.

Beyond the laboratory, this conference rightly emphasizes Global Biosecurity and "Lab to Land" initiatives. In an increasingly interconnected world, the role of plant pathologists in managing trans-boundary pathogens and shaping IPR and trade policies has never been more critical. The innovations in Applied Mycology and post-harvest safety highlighted here demonstrate our commitment to not just protecting crops, but adding value to the entire agricultural ecosystem.

I am confident that the abstracts presented in this volume will serve as a foundation for future full-length research papers that will continue to enrich the pages of our Journal. I congratulate the authors for their scholarly contributions and the organizers at Amity University, Lucknow, for providing such a vibrant platform for exchanging the knowledge and ideas.

I wish all the delegates fruitful deliberations and an intellectually stimulating conference.

5/03/26

(Jameel Akhtar)

Mayank Singhal
Vice Chairperson & Managing Director
PI Industries Ltd.

I am delighted that Amity University, Lucknow, Uttar Pradesh (India) is hosting the **ISMPP 5th International Conference** of the Indian Society of Mycology and Plant Pathology, Udaipur on the theme **'Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation"** during **April 8-10, 2026.** The Society has made outstanding contribution to the science of Mycology and Plant Pathology.

Agriculture scientists have responsibility to provide both adequate and nutritious food to the growing population of the world; and this has to be safe and be available at affordable prices. Climate change and sustainability have added to our challenge. Nonetheless, we have outstanding scientists whose hard work and commitment will ensure that we find the right solutions to these challenges.

I wish the Society all the success with meaningful outcomes.

Mayank Singhal

ICARDA
Science for resilient livelihoods in dry areas

Shiv Kumar Agarwal, PhD
Regional Coordinator
South Asia and China Regional Program

2 April 2026

Message

I am pleased to learn that the Indian Society of Mycology and Plant Pathology, in association with the Amity Food and Agriculture Foundation, is organizing the 5th International Conference on *"Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation"* at Amity University, Lucknow during April 8–10, 2026. The theme is both timely and significant in the context of growing challenges posed by climate variability to agricultural systems worldwide.

Plant health remains fundamental to ensuring food and nutritional security while sustaining ecosystems and livelihoods. Climate-induced changes are reshaping pathogen behavior, distribution, and host interactions. These evolving dynamics demand integrated responses that combine scientific innovation with ecosystem-based management. Approaches such as biodiversity conservation, agroecological practices, and restoration of degraded landscapes play a critical role in enhancing resilience and reducing disease risks. Strengthened surveillance systems, early warning mechanisms, and international cooperation will further support effective preparedness and response. The 'One Health' approach provides a valuable framework by emphasizing the interdependence of plant, human, animal, and environmental health, thereby guiding more holistic and sustainable interventions.

Advances in genomics, molecular breeding, and integrated disease management are accelerating the development of resilient crop varieties and sustainable production practices. The promotion of biological control and precision agronomy offers practical pathways to minimize environmental impacts while maintaining productivity through integrated disease management. Translating these advances into tangible outcomes will require strong partnerships among research institutions, policymakers, and farming communities.

I extend my best wishes for the success of the conference and am confident that it will stimulate insightful deliberations and foster meaningful collaborations toward strengthening plant health, food security, and environmental sustainability.

Thanking you

(Shiv Kumar)

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(पादप संरक्षण एवं जैव सुरक्षा)

Dr. Poonam Jasrotia
Assistant Director General
(Plant Protection and Biosafety)

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MESSAGE

It gives me immense pleasure to learn that the Indian Society of Mycology and Plant Pathology (ISMPP) is organizing its 5th International Conference on "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" at Amity University, Lucknow, from April 8–10, 2026.

In the current global scenario, plant protection and biosafety have emerged as the primary safeguards for national food security. The themes of this conference are exceptionally pertinent, bridging The Frontiers of Technology with grounded Ecological Management. The integration of AI-driven smart surveillance and the 'Omics' revolution is vital for early detection, while nanotechnology offers transformative potential for next-generation therapeutics. As we advocate for climate-resilient agriculture, our focus must remain steadfast on Bio-intensive IDM, Soil Health, and the Root Microbiome. Strengthening these biological foundations is essential for sustainable landscape conservation and natural farming. Furthermore, ensuring Food Safety through the management of mycotoxins and post-harvest pathogens remains a critical link in the value chain.

From a regulatory and biosafety perspective, the sessions on Global Biosecurity, Quarantine, and Transboundary Pathogens are of paramount importance. Protecting our borders from exotic pests while facilitating trade under WTO guidelines requires a robust synergy between science and policy. I am confident that the "Lab to Land" approach, fostering agri-business and startups, will translate these scientific breakthroughs into actionable solutions for our farming community.

I congratulate the organizers and Amity University, Lucknow, for this initiative. I wish all the participants fruitful deliberations and hope this Book of Abstracts serves as a roadmap for future innovations in plant health management.

(Poonam Jasrotia)

Date: April 02, 2026

Message from Pro Vice Chancellor Amity University Uttar Pradesh, Lucknow Campus

It is indeed a privilege to be associated with the **5th International Conference of the Indian Society of Mycology and Plant Pathology (ISMPP)**, being organized from 8th to 10th April 2026 jointly by ISMPP, Rajasthan College of Agriculture (MPUAT, Udaipur), and the Amity Food & Agriculture Foundation at Amity University Lucknow Campus.

I am confident that this conference will serve as a confluence of thought leaders and practitioners in agro-intelligence, plant pathology, biotechnology, policy reform, landscape architecture, and sustainability, working together to develop resilient technologies, progressive policies, and innovative management strategies for food value chains in a rapidly changing global environment. A key objective of the conference is to deliberate on how enabling policy frameworks and institutional support can empower rural communities and enhance agricultural sustainability.

The conference will also highlight agro-scaping as a transformative tool for disease management and food security. Core themes including climate adaptive cropping systems, ecosystem restoration, rural landscape transformation, flood resilient agricultural design, and the aesthetic and cultural dimensions of agrarian landscapes emphasize the importance of holistic and sustainable land stewardship. By integrating digital innovations, smart technologies, and ecological design principles, the congress aspires to bridge traditional wisdom with frontier science. through active engagement among policymakers, scientists, entrepreneurs, extension professionals, and farming communities, the conference seeks to co-create strategies that strengthen global food resilience and promote sustainability.

I extend my sincere congratulations to all the contributors whose work has been included in this publication. Their efforts exemplify intellectual dedication and a commitment to advancing the frontiers of agricultural and food sciences. I also commend the organizing team for their meticulous efforts in curating this comprehensive volume and for providing a meaningful platform for dialogue, exchange of ideas, and interdisciplinary engagement.

I convey my best wishes for the success of the conference and hope that the deliberations will be highly enriching, impactful, and conducive to future advancements in this critical field.

Warmest Regards,

Prof. (Dr.) Anil Vashisht
Pro Vice Chancellor,
Amity University Uttar Pradesh, Lucknow Campus

From the Desk of the Organizing Secretary

It is a moment of immense pride to present this Souvenir and Abstract Book for ISMPP-5: Pathogens, Plant Health, and Food Security, held from April 8–10, 2026, at Amity University, Lucknow. This landmark collaboration between Amity University, ISMPP, and RCA-MPUAT has served as a critical nexus for over 10 sub-themes, bridging fundamental research with field-level application.

Our deliberations spanned the spectrum of modern agricultural science, including AI/ML-driven diagnostics, nanotechnology, omics, Bio-IDM strategies, and post-harvest security. This volume captures the essence of our discourse—from prestigious memorial lectures to high-Caliber oral and poster presentations—and celebrates excellence through the ISMPP Awards, including the Lifetime Achievement and Best Woman Scientist honours.

The Amity Food & Agriculture Foundation's commitment to precision farming and sustainability is perfectly complemented by ISMPP's 55-year legacy of excellence.

I extend my deepest gratitude to our **Hon'ble Founder President Sir**, whose visionary leadership continues to inspire our academic pursuits. My sincere thanks to **Prof. (Dr.) Anil Vashisht**, Pro Vice Chancellor, Amity University Lucknow, for his steadfast support and guidance.

I am profoundly grateful to Dr. Jameel Akhtar, Editor-in-Chief of ISMPP, and my Co-Secretary, Prof. Pokhar Rawal, alongside our dedicated committees, for their tireless efforts.

A special and heartfelt acknowledgment goes to my laboratory team: **Dr. Komal Pandey, Ms. Poornima Yadav, Mr. Abhinav Pal, Mr. Alok K. Maurya, Mr. Abhay Saroj, and Ms. Komal.** Their dedication and technical support formed the backbone of this event, and its success is a testament to their hard work.

Finally, to our participants: your intellectual contributions have made this a resounding success. May the synergies sparked in Lucknow continue to catalyze resilient agricultural landscapes worldwide.

Warm regards,

Professor Shalini Singh Visen
Organizing Secretary, ISMPP-5
Director, Amity Food & Agriculture Foundation (AFAF) Amity University,
Uttar Pradesh, Lucknow Campus

KEYNOTE LECTURES

KL1 What led us in last and what will lead us in next 25 years in plant pathology

S. S. Chahal

Former Vice Chancellor, Maharana Pratap University of Agriculture and Technology, Udaipur (Raj.)

During last twenty five years, mycological research has transitioned from descriptive taxonomy to high-throughput molecular genomics with expanded ecosystem related exploration of fungal biodiversity. Plant disease management has experienced a perceptible shift from reactive chemical applications to proactive, precise, and sustainable strategies driven by modern technologies. Visual diagnostic has largely been supported by molecular, digital and artificial intelligence (AI) technologies like robotics, smart sensing, Convolutional Neural Network (CNN) and image analysis from unmanned aerial vehicles (UAVs) and smartphones. Technological advancements in breeding for disease resistance include adoption of new gene sequencing, CRISPR/Cas9, disrupting S genes, RNA interfering ‘gene therapy’, bioinformatics and AI based prediction of gene functions. Focus remained on systemic and specific action fungicides, managing fungicide resistance and use of nanoparticles and botanicals. Biocontrol became a cornerstone of sustainable agriculture from just a niche alternative to chemicals. Integrated Disease Management occupied next stage with advanced diagnostics, biotechnology and precision farming interventions. Climate change drew attention as a driver of change in reshaping ‘disease triangle’ and formulating strategies to develop disease prediction models and refining decision support system. Pure descriptive studies are likely to become critical interest researching fungal adaptation and survival under global warming while exploring fungal biodiversity in the next 25 years. Disease diagnostics are expected to shift towards real-time, point-of-care solutions, AI and identifying pathogens before symptom appearance with global market growing at CGAR from 4 to 14%. Host plant resistance studies may yield designing synthetic immunity, combining resistance with ecological practices and developing non-host resistance. Progress is expected towards exploring highly selective environmentally safe systemic fungicides, counteracting fungicide resistance, longer systemicity for long lasting protection, focus on Succinate Dehydrogenase Inhibitors (SDHIs) and biocontrol-chemical integration. Biocontrol is set to become mainstream part of IPM with use of AI driven CRISPR engineered selected BCAs and microbiomes. IPM 2.0 will be enriched by incorporating precision and digital data and emerging technologies like AI and data analysis replacing or supplementing synthetic fungicides. Climate Change is expected to drastically increase prevalence, severity, life cycles and reproduction rate of pathogens altering pattern of soil, foliar and viral diseases. AI may bring major shift in plant disease management practices becoming proactive autonomous detection by expanding deep learning, vision transforming, multispectral and hyperspectral imaging with hybrid AI models. It will however need co-ordinated research sharing protocols and datasets for advancing participatory models, capacity building of farmers and updating regulations governing agricultural by AI policy makers bridging disciplinary divides.

KL2 Scaling epidemiological models in new plant health management ecosystems

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One compelling vision for global systems supporting plant health is the proposed global surveillance system for plant disease. A 'global epidemiology system' would be a key component. Epidemiologists can consider the 'core' epidemiological needs of even a small national program, and the most important epidemiological components to add when a program adds new resources and capacity. Core components can be evaluated in terms of the value of information generated and the corresponding cost of information. Identifying core epidemiological tools also supports the development of open-source ecosystems for software and databases, facilitating analyses and developing synergies among research programs. For example, our lab is advancing the R2M toolbox (garrettlab.com/r2m) including (a) software to evaluate habitat connectivity as a proxy for epidemic or invasion networks (the geohabnet package in R), (b) tools for expert knowledge elicitation to synthesize expert knowledge (including the MetaQuestion web app), and (c) software to implement scenario analysis for regional management options (the INA package in R). These tools are designed to make the most of currently available information and knowledge, with exciting possibilities for new synergies across applications of artificial intelligence. Realizing these possibilities globally depends on the development of global communities of practice supporting capacity development. Projects like Open Plant Pathology and the Global Plant Health Assessment help to strengthen these communities. New approaches for linked teaching and research, such as global research collaboration workshops (GRCWs), offer other opportunities for strengthening communities that leverage options for online development of global communities and projects.

KA 3 Decoding Friend and Foe - Differential Lipid–Chitin Oligosaccharide Signaling in Plant–Microbe Molecular Dialogues

Appa Rao Podile

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Plants thrive in microbe-dense soils where survival depends on the capacity to discriminate beneficial symbionts from destructive pathogens. This remarkable selectivity is achieved through finely tuned molecular signaling networks that perceive structurally related microbial molecules and channel them into distinct developmental or immune outputs. A central example is the differential recognition of **lipo-chitooligosaccharides (LCOs)** and **chitooligosaccharides (COs)**, chemically related signals derived from chitin.

Long-chain COs released from cell walls of pathogenic microbes function as microbe-associated molecular patterns (MAMPs). These molecules are detected by specific LysM receptor-like kinases (e.g., CERK1-containing complexes), triggering pattern-triggered immunity (PTI). This immune activation includes rapid calcium influx, reactive oxygen species production, MAP kinase activation, transcriptional reprogramming, and cell wall reinforcement, responses aimed at pathogen restriction.

In contrast, beneficial symbionts like rhizobia and arbuscular mycorrhizal fungi produce structurally modified short chitin oligomers decorated with lipid moieties, known as Nod and Myc factors (LCOs). These LCOs are perceived by distinct LysM receptor complexes (such as NFR1/NFR5 or LYK3-related receptors) that activate the Common Symbiosis Signalling Pathway (CSSP), characterized by nuclear calcium oscillations and downstream activation of symbiosis-specific transcription factors. The outcome is developmental reprogramming, root hair curling, infection thread formation, nodule organogenesis, or arbuscule development, rather than defense.

Despite their structural similarity, subtle variations in oligomer length, N-acylation, and additional chemical decorations enable plants to decode these molecules with high specificity. Work done in our lab in this direction will be discussed. Emerging evidence suggests partial receptor overlap and dynamic modulation between immune and symbiotic pathways, highlighting a sophisticated signal integration system rather than a binary switch.

This lecture emphasizes how the lipid component of chitin oligomers exemplifies the elegance of molecular discrimination in plant signaling networks. Understanding this fine balance between immunity and symbiosis not only deepens our knowledge of plant signaling plasticity but also offers translational potential for engineering sustainable crop–microbe partnerships in agriculture.

HOW AI AND SENSOR TECHNOLOGIES CHANGING THE DYNAMICS OF PREDICTING AND MONITORING PESTS AND DISEASES: Cotton Experience

C.D. MAYEE

President: South Asia Biotechnology Center, Jodhpur-New Delhi and Indian society for Cotton Improvement, Mumbai

The management principles of crop protection though not altered over the years but the way they are being implemented have drastically changed the scenario. For example; developing resistant cultivars for pest and disease management is the ultimate goal of every protection scientist. However, the way now breeding has shifted from traditional to modern tools make the entire process quick and result oriented. Similarly, the way diseases and pests are predicted and monitored have undergone substantial precision. In this presentation, how the pests and diseases of cotton now use AI and sensor-based technologies in India are explained. A system has been developed by cotton scientists for monitoring cotton pests with four components Viz., Weather sensor network, Image acquisition network for pest and pathogens, Algorithm for pink bollworm and Algorithm for sucking pests. This is called Cotton Microclimate and Insect Monitoring System(C-MIMS). Pink bollworm being most damaging of all pests in cotton, a wireless smart trap for automated pest monitoring and forecasting has also been developed. The smart trap provides a real time trap catch of cotton pests as images with corresponding weather data via an e-mail client and mobile application. It helps in studying the pest dynamics to establish a reliable pest forewarning system. Multi location trap data can be synchronized to assess the target pest population in a wider area. A similar approach is being developed for key pathogens too. Such systems for other crops will soon come up for precision management.

Presidential Address

Seed Transmission of Begomovirus: Unresolved Mystery Requiring Rigorous Scientific Evidence and Greater Research Attention

Lalit Mahatma

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The presence of begomoviruses, particularly Mungbean yellow mosaic virus (MYMV), in mungbean seed was first reported in 2010 by Pawar from Navsari, Gujarat. The virus was detected in the whole seed as well as in different seed components, namely the pod, seed coat, and cotyledons. However, it was absent in the embryo and did not transmit from seed to seedling. Subsequently, several studies reported the presence of begomoviruses in seeds and also seed transmission in different crops, including Sweet potato leaf curl virus (SPLCV) in sweet potato seed, Tomato yellow leaf curl virus (TYLCV) in tomato seed from South Korea, MYMV in blackgram seed from Tamil Nadu, Tomato leaf curl New Delhi virus in chayote in from Tamil Nadu and many more viruses. However, later investigations produced contradictory results. In 2020, it was reported that TYLCV could be detected on and within tomato seeds, including the embryo, yet seed-to-seedling transmission did not occur. Similarly, in 2021, grow-out experiments, seed coat and cotyledon testing, and vector transmission studies demonstrated that although SPLCV was present in sweet potato seeds, it was not transmitted through seed. Such conflicting observations have complicated our understanding of seed transmission in Begomovirus and have turned it into an unresolved mystery requiring rigorous scientific evidence and greater research attention. Once it is firmly established whether begomoviruses are truly present in seeds and capable of transmitting from seed to seedling, our understanding of their epidemiology will improve significantly. Various aspects of Begomovirus seed transmission and the complexities associated with it will be discussed in this address.

MEMORIAL AWARD LECTURES

PP Singhal Memorial PI Industries Award 2025

Outbreak of Alternaria Blight in Dry Temperate Region of Kinnaur, it's Epidemiology and Management

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Outbreak of Alternaria blight in apple has been recorded during 2024-2025 crop season. Prevalence of hot dry weather (25-30 °C) during spring coupled with intermittent rainfall aggravated disease incidence. The orchards at higher altitude (2000m) with dense fog in morning and evening during monsoon season exhibited higher disease incidence ranging from 6.72 to 35.07 per cent. Infected chlorotic leaves were collected, isolated in pure culture and based on cultural, morphological and molecular characteristic; the pathogen associated was identified as Alternaria tenuissima. Simple correlation has been found positive and highly significant with temperature and relative humidity, whereas, it was negative but significant with temp during 2024 and positive and significant during 2025. Foliar sprays of Hexaconazole 4% + Zineb 68% WP @0.25% exhibited maximum disease control of 88.14 % followed by Tebuconazole 6.7% + Captan 29.9% SC @0.25% exhibiting 78.06% disease control. However, Motive (Hexaconazole 4% + Mancozeb 68% WG)@0.15% & 0.125 % were found to be next best in order providing 73.83 %& 64.34 % disease control. Mancozeb 75% WG @0.3 % was found least effective in managing disease. Foliar sprays of spray schedule IV comprising sprays of Hexaconazole 4% + Zineb 68% WP(0.25%) +Hexaconazole(0.05%) + Tebuconazole 6.7% + Captan 29.9% SC (0.25%) at 15 day interval exhibited maximum disease control (92.94%) followed by spray schedule III and I exhibiting disease control of 85.88% and 80.81 % respectively.

Fine Tuning in Silico and in Vitro Fungicide Screening With Field Evaluation for Effective Management of Anthracnose in Mungbean

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Anthracnose is a major foliar disease limiting mungbean productivity under the humid kharif conditions of North Gujarat. To support rational fungicide selection for effective field-level disease management, the present study employed an integrated in vitro, in silico, and in planta approach to identify potential fungicides against anthracnose in mungbean. Initially, selected fungicides were screened in vitro for their antifungal activity against the anthracnose pathogen, and promising molecules were subsequently subjected to in silico molecular docking to confirm their binding affinity and interaction with key fungal target proteins. Based on these predictive assessments, field validation was conducted during the kharif season of 2024 and 2025 at the Pulses Research Station, SDAU, Sardarkrushinagar, on mungbean variety GM4 using eight treatments comprising seven fungicides with an untreated control. Treatments were applied twice at 15-day intervals following disease initiation. Fungicides exhibiting higher in vitro inhibition and stronger in silico binding affinity resulted in significantly lower anthracnose intensity under field conditions. Foliar application of tebuconazole 25.9%SC @ 1 ml l^{-1} recorded the minimum anthracnose severity (17.62%) followed by carbendazim 12% + mancozeb 63%WP, metiram 55% + pyraclostrobin 5%WG, and prochloraz based combi-products. These treatments also resulted in higher grain yield. Economic analysis revealed that tebuconazole 25.9%SC was the most profitable treatment, registering the highest net return (₹25,808 ha^{-1}) with a favourable cost-benefit ratio of 1:6. The study confirms that sequential in vitro screening followed by in silico validation is a reliable predictive strategy for selecting efficient and economically viable fungicides for field management of anthracnose in mungbean.

Transforming Maize Disease Management: Harnessing the Power of Novel Fungicide Combinations against Devastating Pathogens

M K Khokhar

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Maize (Zea mays L.) is the third most important cereal crop in the country after rice and wheat and is cultivated throughout the year. However, maize diseases significantly limit the realization of its potential yield, particularly under changing climatic conditions. Therefore, field experiments were conducted during Kharif seasons of 2022–2024 to identify promising components for the effective management of major foliar diseases of maize. The results indicated that Azoxystrobin 18.2% w/w + Cyproconazole 7.3% w/w SC (0.01%) was effective in managing banded leaf and sheath blight providing 52.20% disease control. For the management of Turcicum leaf blight, Kresoxim-methyl 44.3% SC (0.5%) and Azoxystrobin 18.2% + Difenoconazole 11.4% w/w SC (0.05%) were found to be significantly superior, achieving 44.88% and 69.33% disease control, respectively. Seed treatment with Sedaxane 15.27% w/w + Fludioxonil 7.64% w/w + Metalaxyl-M 3.06%w/w FS (10 ml/kg seeds) effectively reduced stalk rot incidence recording 68.22% disease control. In addition, foliar application of Pyraclostrobin 133 g/l + Epoxiconazole 50g/l SE @ 0.75% and Azoxystrobin 18.2% + Difenoconazole 11.4% w/w SC @ 0.1% significantly reduced the incidence of Maydis leaf blight, providing 58.2% and 44.45% disease control, respectively. The climate-resilient disease management strategies identified in this study could serve as effective options for maize growers to protect their crops from major diseases across diverse agro-ecological regions of India.

Volatilome mediated Nano-capsule application unveiled the suppressive nature of Fusarium wilt pathogen in Tomato

Praveen, T 1

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Fusarium wilt (Fusarium oxysporum f.sp. lycopersici) are a major cause of yield loss in tomato crop that were found to be economically important for developing suitable management practices according to the current ecosystem. The current study focused on evaluation of the antagonistic effects of cinnamon Volatilome and its encapsulated nano-capsule (NCs) on pathogenic suppression of Fusarium wilt in vitro and in tomato. Preliminary screening of cinnamon volatiles exhibited 98% reduction in the fungal growth of F. o f.sp. lycopersici. Volatilome profiling of cinnamon revealed the detection of 23 volatile organic compounds. Among the detected compounds, Isoborneol was found to be predominantly expressed to an extent of 48 h. Furthermore, nano-capsule based Volatilome formulation have been developed to validate the efficacy against F. o f.sp. lycopersici. Additionally, the survival of F. o f.sp. lycopersici in the sterile potting mix in the presence of tomato plant revealed the reduction of pathogenic propagules in the potting culture by 89 percent. The application of Nano capsule (200 ppm) at field trial exhibited 94.31% disease suppression in the wilt pathogenic abundant soil and significantly reduced expression of pathogenic growth compared to the control. Inoculation of nano-capsules found to exhibit improved root growth and antifungal activity with enhanced increase of root length and shoot length in tomato. Nano-capsule application in the form of broad casting under pathogen abundant soil revealed a significant reduction in the attachment of pathogenic spores to the host plant and exhibited significant yield of tomato. Thus, the research shown considerable evidence indicating that the application of volatile nano-formulation could be a suitable management practices for soil-borne plant pathogen, Fusarium wilt and thereby stimulating the crop growth pattern in yield enhancement.

Endophytic Bacillus subtilis from Onion: Characterization, Formulation and Its Role in Managing Twister Disease

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Onion (Allium cepa L.) is one of the most important vegetable crops cultivated worldwide and serves as both a food and cash crop. However, its production is severely constrained by twister disease, a complex disease associated with multiple pathogens causing significant yield losses. In the present study, three pathogens, namely Colletotrichum gloeosporioides, Fusarium oxysporum and Sclerotium rolfsii, were isolated from infected onion plants and confirmed as causal agents through pathogenicity tests. Diseased plants exhibited symptoms such as leaf twisting, necrosis, neck elongation and bulb rot, and the pathogens were identified based on morphological and cultural characteristics. To develop a sustainable management strategy, 26 endophytic bacteria were isolated from healthy onion tissues and screened for antifungal activity against the pathogens. Among them, isolate EB-13 showed strong antagonistic potential by effectively suppressing the growth of all three pathogens. Based on biochemical characterization and scanning electron microscopy, EB-13 was identified as Bacillus subtilis, and its identity was further confirmed through gene sequencing of 16S rDNA, gyrA, recA and rpoB genes. Compatibility studies indicated that EB-13 was compatible with most commonly used agrochemicals in onion except the fungicide Metiram + Pyraclostrobin. Talc- and oil-based formulations of EB-13 maintained viable populations up to 75 days and showed effective disease suppression under field conditions. Combined application of EB-13 and E-17 reduced disease incidence by 62.92 percent and significantly improved bulb yield with a cost–benefit ratio of 1:2.81. GC–MS analysis of EB-13 extracts revealed eleven bioactive metabolites including 2-pyrrolidinone and 2-piperidone with known antifungal activity. Treated plants also exhibited enhanced activities of defense-related enzymes such as phenylalanine ammonia-lyase, peroxidase, polyphenol oxidase and catalase, indicating induction of systemic resistance. Overall, Bacillus subtilis EB-13 demonstrated strong antifungal activity, formulation stability, agrochemical compatibility and field efficacy, indicating its potential as a promising bio-inoculant for sustainable management of onion twister disease.

Synthesis, Mechanistic Action and Field Efficacy of ZnO Nanoparticles and a ZnO-iturin A nano-biohybrid for sustainable management of fungal and bacterialphytopathogens in legumes and rice

Pranab Dutta

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Nanotechnology offers a transformative approach to sustainable agriculture by enabling precision delivery of agrochemicals and enhancing plant innate immunity. This study comprehensively investigates the synthesis, characterization, and multi-level efficacy of zinc oxide nanoparticles (ZnO-NPs) and a novel nano-biohybrid formulation for managing soil-borne and foliar phytopathogens. ZnO-NPs were synthesized via chemical precipitation and rigorously characterized using UV-Vis spectroscopy, FTIR, SEM, TEM, AFM, zeta sizing, and nanoparticle tracking analysis (NTA). In vitro assays demonstrated that ZnO-NPs at 100 ppm achieved complete (100%) inhibition of mycelial growth and sclerotial germination in soil-borne fungal pathogens. Mechanistic studies revealed that antifungal activity resulted from mycelial cell lysis, reactive oxygen species (ROS) generation, and oxidative burst, leading to cellular component degradation. Among application methods evaluated in French bean, foliar spray proved most effective for systemic nanoparticle establishment, significantly enhancing defense-related metabolites—including flavonoids, phenols, terpenoids, and proline—alongside improved nutrient uptake (NPK, Ca, Mg, Zn). Nodulation increased by 13.65%, with corresponding reductions in white mold incidence and significant yield improvement. Seed priming with 100 ppm ZnO-NPs also enhanced chickpea stand against Fusarium wilt under field conditions. Building on these findings, an encapsulated bioactive formulation (En-ZnO-NP-BF) was developed by integrating ZnO-NPs with iturin A (a lipopeptide from Bacillus subtilis) using gum arabic as the encapsulating agent. Characterization confirmed stable, roughly spherical nanoparticles with a hydrodynamic diameter of 1728.40 nm (PDI: 0.4095). In rice, the combined seed treatment plus foliar spray method at 200 ppm optimally suppressed brown spot (Bipolaris oryzae) and bacterial leaf blight (Xanthomonas oryzae pv. oryzae), reducing incidence by 3.41% and 10.31%, respectively. This treatment concurrently elevated secondary metabolite concentrations (phenols: 0.58 ppm; terpenoids: 793.18 ppm) and achieved significant grain zinc biofortification (19.70 ppm versus 13.80 ppm in controls). The study validates ZnO-NPs and En-ZnO-NP-BF as potent, dose-dependent agents for sustainable disease management, integrating targeted pathogen suppression, host defense priming, and crop biofortification within a single nano-enabled platform.

Smt Guman Devi Verma Memorial Best Woman Scientist Award

Elucidation of Adult Plant Resistance Genes and Early Warning for Wheat Stem and Leaf Rust: Safeguarding the Farm to Fork Continuum

Dr. Elangbam Premabati Devi*

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Stem rust, caused by *Puccinia graminis* f.sp. *tritici* being the most significant rust resulting to 60-80% yield loss mainly in Central Zone of India with the most common pathotypes, such as 11 and 40A. In addition, leaf rust caused by *Puccinia triticina* Eriks. is also the most widely prevalent rust in all wheat growing areas of India leading to 50-80% yield loss. A multilocaltional field screening of several advanced genotypes and vareities were carried out during *Rabi* seasons of 2021-22 to 2023-2024. It was observed that four genotypes had no infection and AUDPC values were ranged from 1.17 to 1610 for stem rust. Ten genotypes showed complete no infection while 12 genotypes with AUDPC value ranged from 1 to 100 were identified as phenotypically resistant to leaf rust. Later on, the effects of several meteorological factors on the growth of disease has examined and developed the best prediction model and geophytopathological model with the following equations: y = 100/(1+(100/b-1)*exp(-a*time)) for maximum temperature and y = 100*exp (-b*exp (-a*x)) for minimum temperature against disease severity furthermore Logistic and Gompertz were found to be the best fitted model. Moreover, a geo-phytopathological model was created and verified. While HTR model validation is location-specific, HTR is also the most useful metric for predicting the severity of any disease. Moreover, the results of molecular characterization of wheat genotypes with the linked marker such as SSR marker csGs for *Lr68* APR gene, SSR marker Xwmc313 for *Lr28* gene, SCAR marker SCS5 for *Lr9* gene, STS marker CsLV34 for *Lr34* /*Sr57*/*Pm38*/*Yr18* APR gene, XgWM-130 linked to *Lr19*/*Sr25* gene were detected in several genotypes. Therefore, application of molecular markers provides a more reliable tool to identify resistance genes at genetic level and also in speeding up the work of resistance breeding, thus these identified resistant wheat genotypes could be a promising source in wheat resistance breeding for combating stem and leaf rust of wheat. Besides, nowadays people are quite concerned about the significance of nutrient-rich and nutraceutical food products. The existence of several types of grain quality criteria at an ideal level may be the fundamental prerequisite for obtaining high quality wheat and genetic foundation is the primary determinant of wheat grain quality. The result of phenol colour test has depicted with low colour pigmentation value which indicates a good chapatti colour. The principle component analysis was also made for visualizing the differences and similarities among the various quality attributes of different wheat varieties then three clusters groups were constructed. Therefore, the present findings could able to generate valuable information for the various quality aspects of wheat varieties.

Exploring unsung potentiality of Gluconate stabilized silver nanoparticle as an effective shelf-life enhancer of *Khasi* mandarin

Devanushi Dutta[1] and Pranab Dutta[2]

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Khasi mandarin (*Citrus reticulata*, Blanco) is a widely cultivated commercial fruit crop of Meghalaya having diverse export potentiality. Different biotic and abiotic factors are responsible for its short shelf life. Nanocoating approaches was explored to mitigate this, by synthesizing and characterizing gluconate stabilized silver nanoparticle (Glu-Ag NPs) and explored its antimicrobial efficacy against the potent post-harvest pathogen *Penicillium italicum* (PV1913) isolated from *Khasi* mandarin. The synthesized Glu-Ag NPs showed SPR peak at 410 nm with average size of 94.10 nm with a polydispersity index of 0.413 and a negative zeta potential value of -15.0 mV. The concentration of nanoparticles was determined as 1.2 million/mL by NTA. The TEM image reveals the crystallinity of synthesized Glu-Ag NPs and SEM depicts the spherical shape of the nanoparticles. The synthesized Glu-Ag NPs showed the highest (58.22%) mycelial growth inhibition at 250 ppm concentration against *P. italicum*. The lowest Disease Severity Index (DSI) (14%) was recorded in nanocoated at 250 ppm for 120 seconds. FTIR analysis supports the restriction of Glu-Ag NPs migration to the fruit juice as well as seed. On studying different biochemical parameters of juice extracted from treated and untreated mandarin, the highest BI (0.549), TSS (10.66º Brix), Fruit Weight Loss (24.70%), and the lowest ascorbic acid content (0.059 mg/100g) were recorded in Uncoated (Control). The highest (0.975) BI was recorded in juice stored in ambient conditions (22±2ºC) than the juice stored in refrigerated conditions (4ºC) (0.476). The juice extracted from nanocoated mandarin showed the highest ascorbic acid content with the lowest fruit weight loss (%). The dual antimicrobial activity of Glu-AgNPs and their coating behaviour enhances the shelf life of *Khasi* mandarin by minimizing DSI. Thus, Glu-Ag NPs can be used as a coating material for shelf life enhancement of *Khasi* mandarin.

Integrative Genomics and Systems-Level Dissection of Quantitative Disease Resistance in *Hevea Brasiliensis*

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Major foliar diseases of natural rubber (*Hevea brasiliensis*), particularly Abnormal Leaf Fall (ALF) caused by *Phytophthora meadii*, Corynespora leaf fall caused by *Corynespora cassiicola*, and Colletotrichum leaf disease caused by *Colletotrichum acutatum* and *C. gloeosporioides*, significantly constrain rubber productivity. Deciphering quantitative genetic architecture and molecular defense mechanisms underlying host tolerance is critical for developing durable resistant clones.

An interspecific mapping population derived from *H. brasiliensis* (RRII 105) × *H. benthamiana* (F4542) was developed to identify resistance-associated loci. Genotyping using SNP and *in silico* DArT markers enabled construction of a high-density consensus linkage map spanning 3709 cM with 24,004 markers across 18 linkage groups (n = 18) and an average inter-marker distance of 0.14 cM. Phenotypic evaluation for resistance to these pathogens revealed continuous variation, confirming quantitative inheritance. QTL analysis identified resistance loci associated with these pathogens, providing promising genomic markers for marker-assisted selection in this perennial crop.

To elucidate defense mechanisms against ALF, integrated transcriptomic and proteomic analyses were conducted in contrasting clones: FX 516 (tolerant) and RRIM 600 (susceptible) following *P. meadii* infection. RNA sequencing revealed extensive transcriptional reprogramming, with approximately 19,000 differentially expressed genes per sample. The tolerant clone exhibited sustained induction of tolerance-related genes (RPP13, WRKY, SNC1, RPS2) and key transcription factors (WRKY, MYB, NAC, AP2/ERF), along with activation of salicylic acid, jasmonic acid, and ethylene signaling pathways and MAPK cascade components. In contrast, the susceptible clone showed transient defense activation and upregulation of susceptibility-associated genes such as MLO and SWEET.

Proteomic profiling corroborated transcriptomic trends, demonstrating higher accumulation of β-1,3-endoglucanase, Barwin domain proteins, and chitin-binding proteins in tolerant genotype, indicating reinforced antifungal defenses.

By integrating high-density genomics with systems-level molecular profiling, this work transforms quantitative resistance from a complex trait into actionable breeding knowledge, paving the way for durable disease-resistant rubber cultivars and sustainable plantation agriculture.

Integrative Approaches to Fungal Biodiversity with Genomic and Metabolomic Insights from Indian Ecosystems

Deeba Kamil, Amrita Das, Ashwini J.H., Vipin Verma, Gangaraj R. and Basudev Basak

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Fungi represent one of the most diverse groups of organisms, with an estimated 1.5 million species Fungi represent one of the most diverse groups of organisms, with an estimated 1.5 million species worldwide, although only a small fraction has been formally described. India, with its diverse agro-ecological regions and forest ecosystems, harbours rich and largely unexplored fungal diversity. Integrative approaches combining biodiversity exploration with molecular taxonomy, genomics, and metabolomics are increasingly being applied to understand fungal diversity and to harness its functional potential for agriculture and biotechnology. Morphological characterization integrated with molecular tools such as DNA barcoding and multilocus phylogeny has enabled accurate identification of several important fungal genera including *Fusarium, Alternaria, Curvularia, Bipolaris, Colletotrichum, Diplodia, Phoma, Phomopsis, Trichoderma, Chaetomium,* and *Beauveria*. Molecular techniques such as species-specific markers and multiplex PCR assays have further improved rapid and reliable detection of closely related taxa and cryptic species. Studies on fungal species complexes have provided valuable insights into evolutionary relationships and pathogenic variability. Investigations on the *Fusarium oxysporum* species complex (FOSC) and *Fusarium solani* species complex (FSSC) using multilocus sequence analysis have enabled the identification of cryptic species and the development of specific molecular markers for pathogen detection. Diversity studies of *Alternaria* species infecting apple revealed the predominance of *A. arborescens*, followed by *A. alternata* and *A. tenuissima*, with several isolates carrying toxin-related genes associated with pathogenicity. Population variability in *Sclerotium rolfsii* has also been elucidated using mycelial compatibility grouping and multilocus phylogenetic analysis. Functional studies highlight the significance of fungi in sustainable agriculture. Comparative genomic analysis of two *Trichoderma asperellum* strains (A10 and A15) revealed differences in genome structure, gene content, secretome composition, and biosynthetic gene clusters associated with secondary metabolite production. Strain A10 exhibited greater genetic and metabolic diversity linked to enhanced biocontrol potential. Furthermore, metabolite extracts and cell-free supernatant from the A10 strain showed strong antagonistic activity against *Fusarium oxysporum* f. sp. *pisi*, causing vascular wilt of pea, leading to the development of effective metabolite- and CFS-based formulations. Parallel studies in the northern Himalayan region documented diverse macrofungi such as *Ganoderma, Trametes, Pleurotus, Russula,* and *Schizophyllum*, several of which exhibited strong antioxidant activity correlated with phenolic and flavonoid content.

Collectively, these findings demonstrate that integrative studies combining biodiversity exploration, molecular taxonomy, genomics, and metabolomics are expanding our understanding of fungal resources in Indian ecosystems and promoting their application in sustainable agriculture and biotechnology.

PR Verma Award Competition for Ph D Student

In-Vitro Compatibility and Efficacy of Natural Farming Components on Management of Potato Leaf Roll Virus (PLRV)

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Potato (*Solanum tuberosum* L.) holds largest area among vegetable cultivation due to its wide adaptability, high productivity, and significant role in global food and nutritional security. It is cultivated across different agro-ecological regions making it one of the most extensively grown vegetable crops. Beyond its economic importance, potato is prone to more than 100 pest and diseases including insects, nematodes, viruses, bacteria, oomycetes and fungi causing direct yield loss. Microbial compatibility and viability of the isolates of *Trichodermaharzianum* (OM711281), *Pseudomonas fluorescence* (ON692906), and *Metarhizium robertsii* (OL375172) were assessed both individually and in combination with plant protection natural farming components. *In-vitro* Compatibility of Jeevamrutha integrated with the isolates of *Trichoderma harzianum* (T2) was showed highest compatibility (1129 × 10-1, 1029× 10-1 and 1096× 10-^{1}cfu/ml) as compare to the non-integrated treatment (T10, T11, and T12) which was after two four and six months of incubation subsequently. Minimum disease incidence (8.81%) was observed under treatment T2 (Jeevamrutha + *T. harzianum*) followed by T11 (*M. robertsii* + 3 Foliar sprays of UmComb @1.0%) and T3 (Agniastra + *T. harzianum)* with 10.16% and 15.41% respectively. The population of natural enemies over aphid and plant growth promotion activity such as germination percentage, number of leaves, vigour index, number of tillers, plant height, and yield were also shown significant impact on potato during experimental year 2024-25.Metgenomic study also demonstrated that infection status significantly influenced microbial community richness and evenness, with exhibiting higher diversity compared to individual components. Integration of Jeevamrutha and Agniastra with biocontrol group were shown stronger representation of *Firmicutes* (Romboutsia, Turicibacter, Paeniclostridium, Facklamia, Aerococcus, Staphylococcus) and broader bacterial lineages (Actinobacteria, Proteobacteria, Bacteroidetes). The study shows encouraging result of using compatible combination of natural farming components for management of PLRV disease.

Green Engineered Silver Nanoparticle can Enhances the Plant Defense Response against Huanglongbing Disease of Khasi Mandarin

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Northeastern India is home to citrus species of considerable commercial value, including the Assam lemon and Khasi mandarin. Nonetheless, the citrus industry in the northeastern region has been impeded by productivity declines and yield losses caused by Huanglongbing (HLB). Promising technologies like nanotechnology are worth taking into consideration because the existing approaches have not been successful in managing the disease. In four Northeastern states of the country, a survey was conducted to collect both healthy wild species and HLB-infected buds. Collected healthy leaves were utilized for the biosynthesis of novel silver nanoparticles (AgNPs), while the infected HLB buds were grafted onto seedlings that were free of the disease. Green synthesized AgNPs were characterized for size, shape, surface charge, functional group etc and found to have size (10 – 25 nm), shape (spherical), surface charge (-22.9 mV), functional groups (R-OH, C≡C, and C=O), crystallinity. In a dose-dependent manner, the AgNPs demonstrated antibacterial efficacy against *Eschercia coli* (0 - 76.96%). When AgNPs were injected into the stem of HLB-infected plants, the bacterial concentration was downregulated (<1) in comparison to the untreated infected plants. Additionally, a metabolomic analysis showed that the metabolites like (5Z,8Z,11Z,14Z,17Z)-icosa -5,8,11,14,17-pentaenoic acid, 5-methoxy-DL-tryptophan, GDP, 2-napthaldehyde, dihyroconiferyl alcohol etc) responsible for plant defense system were upregulated. The potential application of green engineered AgNPs as a component for the management of HLB in Khasi Mandarin is highlighted in this work. However, more research under different agroecological conditions is encouraged to increase wider applicability.

Deciphering Genetics and Molecular Basis of Fusarium Wilt Resistance in Pigeonpea

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The present investigation entitled "Deciphering genetics and molecular basis of Fusarium wilt resistance in pigeonpea" was undertaken to isolate and characterize the wilt pathogens, evaluate their pathogenic variability, identify stable resistant sources, develop F_1 involving contrasting parents, and elucidate the expression dynamics of key LRR-receptor-like kinase (LRR-RLK) genes associated with wilt resistance in pigeonpea. Fusarium wilt caused by *Fusarium udum* Butler continues to be a major constraint in pigeonpea production, resulting in substantial yield losses across India. Despite the identification of resistant genotypes, the molecular basis of resistance and its inheritance in hybrid progenies remains insufficiently explored.

Field samples of wilted pigeonpea plants exhibiting vascular discoloration and drooping symptoms were collected from multiple locations in Gujarat. The pathogen was isolated using the tissue segment method on Potato Dextrose Agar (PDA) and purified through monoconidial isolation. Morphological studies revealed typical Fusarium characteristics, including slightly curved macroconidia with 3–5 septa and oval microconidia produced in false heads. Molecular identification using ITS, TEF1-α, and RPB2 gene markers confirmed the genetic identity of Fusarium isolates.

Pathogenicity tests using hydroponic assays on the susceptible cultivar ICP 2376 confirmed the virulence of fourteen Fusarium isolates, with disease incidence ranging from 82.22% to 100%, identifying Fsp-6 and Fsp-14 as the most virulent. Cultural and morphological variability among isolates was evident in growth rate, colony texture, pigmentation, and sporulation, highlighting the genetic heterogeneity of *Fusarium* sp. populations in Gujarat.

A set of eleven pigeonpea genotypes (host differentials) were evaluated under both hydroponic and field conditions across two *Kharif* seasons (2023 and 2024). The results showed a clear distinction between resistant and susceptible genotypes. ICP 2376, Bahar, and BDN 1 consistently recorded high wilt incidences (58–78%), categorizing them as highly susceptible. Conversely, ICP 9174, ICP 7035, ICP 8859, ICP 8862, ICP 8863, and C 11 remained disease-free throughout both years, confirming their stable resistance. These resistant lines serve as valuable donors for future breeding programs. Moderate reactions in BDN 2 and ICP 8858 suggested partial or quantitative resistance.

To study inheritance and hybridization success, resistant parents (ICP 7035, ICP 8863) were crossed with the susceptible parent (ICP 2376). Two successful F_1 crosses ICP 2376 × ICP 7035 and ICP 2376 × ICP 8863 were evaluated under wilt-sick field conditions. ICP 2376 × ICP 7035 showed moderate resistance (33.33% disease incidence), while ICP 2376 × ICP 8863 exhibited strong resistance (14.28%), confirming the dominance of resistance genes.

Twelve SSR markers were screened to confirm hybridity and identify polymorphism between the resistant (ICP 8863) and susceptible (ICP 2376) parents and their F_1 progenies. Six markers (PFW-26, PFW-68, ASSR-1, ASSR-23, ASSR-148, and PS-9) were polymorphic, producing distinct banding patterns. The resistant parent ICP 8863 exhibited unique alleles absent or varied in ICP 2376. All F_1 individuals displayed heterozygous profiles for polymorphic SSRs, confirming true hybridity. The SSR markers PFW-68 and ASSR-148 were especially informative, distinguishing resistant and susceptible alleles with high precision. The findings highlight the potential of these markers for genetic purity testing, hybrid validation, and marker-assisted breeding in pigeonpea.

Quantitative real-time PCR (qRT-PCR) analysis uncovered striking contrasts between susceptible and resistant genotypes. The susceptible ICP 2376 exhibited generalized suppression of nine out of ten LRR-RLKs across all time intervals, reflecting compromised perception and signaling ability. In contrast, ICP 8863 showed strong induction of LRR-RLK 2, 3, 5, 6, and 7, with maximum expression observed between 24–48 hours post-inoculation. These early and sustained transcript accumulations underline the robust immune activation machinery of resistant genotypes.

Expression profiling across seven F_1 hybrids derived from ICP 2376 × ICP 8863 demonstrated clear segregation at the transcriptional level. Six hybrids exhibited high-amplitude induction of the defense-associated LRR-RLK 3, 5, and 6 genes, paralleling the resistant parent. LRR-RLK 5 showed the most prominent fold-change (10–14 fold), highlighting its probable role as a central regulator of wilt resistance. One hybrid (F_1 Plant 6) showed consistent down-regulation, correlating with its phenotypic susceptibility. These results confirm the inheritance of defense-related transcriptional responsiveness from the resistant parent and demonstrate the utility of LRR-RLK expression signatures in identifying resistant segregants.

Five target proteins β-tubulin, sterol 14-demethylase, cytochrome b, RNA polymerase II, and calmodulin were modeled for in silico fungicide interaction studies. Structural validation (Ramachandran plot and ERRAT analysis) confirmed high reliability (93–96% accuracy). Molecular docking using AutoDock Vina revealed that Propiconazole (-7.5 kcal/mol) and Azoxystrobin (-7.6 kcal/mol) exhibited the strongest binding affinities, effectively interacting with sterol 14-demethylase and cytochrome b, respectively. *In vitro* mycelial inhibition assays supported these predictions, showing up to 100% inhibition of *Fusarium udum* growth, and a strong correlation ($r = -0.952$) between docking energy and antifungal activity. This validates molecular docking as a predictive and cost-effective screening tool for antifungal compound discovery.

Unravelling Molecular Mechanisms of Resistance to Mungbean Yellow Mosaic India Virus in Soybean

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Yellow mosaic disease (YMD), which is caused by the mungbean yellow mosaic India virus (MYMIV), is one of the most destructive viral diseases affecting soybean in South Asia, particularly in India, where it leads to significant yield losses. Understanding the mechanisms behind host resistance is crucial for developing effective management strategies. This study employed a comprehensive approach that combined field screening, molecular characterization, transcriptomics, metabolomics, and functional genomics to explore the basis of MYMIV resistance in soybean. A large-scale screening of 28 soybean breeding lines from the All India Coordinated Research Programme (AICRP) conducted under natural epidemic conditions identified four highly resistant genotypes. Among these, SL 1074 and SL 958 consistently demonstrated stable resistance under controlled inoculation conditions, showing minimal symptom development and significantly lower viral titers, as confirmed by quantitative PCR. Molecular characterization of MYMIV isolates from New Delhi and Dharwad confirmed the identity of the virus and revealed genetic variation between the isolates. Comparative biochemical analyses between resistant (SL 1074 and SL 958) and susceptible (JS 335 and AMS 19-01) cultivars suggested that resistance is linked to enhanced antioxidative defenses and the preservation of chlorophyll and flavonoid levels following infection. Multivariate analyses indicated that chlorophyll, flavonoids, and polyphenol oxidase activity are critical biochemical indicators associated with resistance. To delve further into the molecular basis of this response, transcriptome profiling of the resistant (SL 958) and susceptible (JS 335) cultivars after MYMIV infection revealed a strong activation of defense and metabolic pathways in the resistant plants. Notably, genes involved in isoflavonoid biosynthesis (*GmIF7-O-MT, GmPTS1, GmIFR, and GmF4-RL*) and RNA silencing (*GmDCL2A, GmSGS3,* and *GmRDR1*) were significantly upregulated, and these expression patterns were further validated using qRT-PCR. Targeted metabolomics confirmed a higher accumulation of antiviral isoflavonoids—including glycitein, daidzin, genistein, malonylgenistin, and biochanin A—in the resistant plants following infection. Molecular docking and dynamics simulations demonstrated strong binding between these metabolites and the viral replication initiator protein (Rep), suggesting their potential role in inhibiting viral replication. Sequence analysis of RNA silencing genes revealed SNP-based variation in *GmSGS3*, which enabled the development of a CAPS marker capable of distinguishing resistant from susceptible genotypes. Protein interactions between GmRDR1 and GmSGS3 were confirmed through in silico docking and yeast two-hybrid assays. Additionally, RNA interference-mediated gene knockdown led to increased viral accumulation, validating their roles in resistance. Overall, this study reveals that soybean resistance to MYMIV is governed by a combination of biochemical defenses, transcriptional reprogramming, antiviral metabolites, and RNA silencing mechanisms. The identified resistant genotypes, molecular markers, and candidate genes provide valuable resources for breeding MYMIV-resistant soybean cultivars and advancing sustainable disease management strategies.

Formulation and Multitrophic Evaluation of Microencapsulated Biopesticides Derived from Endophytic Fungal Bioactive Compounds in Tea Ecosystems

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Tea (*Camellia sinensis* (L.) Kuntze) is a vital cash crop in India, where the nation stands as the world's second-largest producer and fourth-largest exporter, contributing significantly to national income. However, its cultivation as a perennial monoculture frequently exposes it to various biotic stresses that threaten both yield and quality. In recent decades, fungal endophytes have emerged as promising biocontrol agents due to their production of secondary metabolites and plant growth-promoting (PGP) properties. This study aimed to identify novel endophytic isolates from the tea ecosystem, evaluate their efficacy against blister blight, grey blight, die-back, and red spider mite (RSM) *in vitro* and *in vivo*, and develop a microencapsulated product based on the secondary metabolites of a potential fungal endophyte for testing across different agro-ecological conditions in Northeast India (NER). During the study, 31 fungal endophytes were isolated from north eastern states and characterized. *In vitro* screening identified EnRAM-8 as the most promising strain, exhibiting over 86% inhibition of the targeted diseases. This isolate demonstrated ten positive PGP traits and caused significant mortality of RSM at a concentration of 1×10^6 spores/ml. Molecular identification confirmed EnRAM-8 as *Trichoderma reesei* (Accession No.: ON711280). Metabolite extraction from *T. reesei* yielded a potent bioactive crude extract effective at 1 ppm against key pathogens and pests. Characterization via UPLC-ESI-QTOF-MS/MS revealed key compounds, including gliocladic acid, harzianic acid, and gliovirin, with no cytotoxicity observed up to 1 ppm. A novel microencapsulated product, named TrichoSpectra, was developed from these secondary metabolites and demonstrated over 86% *in vitro* inhibition of target pathogens. Field trials across two agro-ecological zones confirmed its effectiveness, significantly reducing disease incidence and severity without phytotoxic effects, while also increasing yield. NMR analysis of the bioactive extract confirmed a complex mixture of polyphenols, alkaloids, terpenoids, and other bioactive compounds. This study paves the way for utilizing endophytic fungi and their metabolites in integrated disease and pest management for sustainable tea cultivation.

Management of Twister Disease of Onion

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Onion (*Allium cepa* L.) is an important vegetable crop cultivated worldwide and plays a significant role in the agricultural economy of India due to its culinary and medicinal value. However, its productivity is severely affected by several diseases during the rainy season, among which twister disease has emerged as a major threat in recent years. Therefore, the present investigation was undertaken to study the epidemiology and etiology of twister disease and to develop effective management strategies through integrated approaches, including germplasm screening, cultural practices and nutrient-based disease management under field conditions.

Survey conducted during *Kharif* 2022–23 and 2023–24 in major onion growing districts of Karnataka revealed the widespread occurrence of twister disease with considerable variation in disease severity across locations. Diseased plant samples collected during the survey yielded 72 isolates of *Colletotrichum* sp., 34 isolates of *Fusarium* sp. and 20 isolates of *Agroathelia rolfsii*. The identity of the pathogens was confirmed using ITS and species-specific primers, followed by studies on pathogen diversity. Biochemical analysis of infected tissues using Liquid Chromatography–Mass Spectrometry (LC–MS) further supported the association of these pathogens with twister disease development in onion.

A total of 126 onion germplasm, including commercial cultivars, released varieties and local collections, were screened under field conditions during *Kharif* 2022–23 and 2023–24 to identify resistant sources against twister disease. Considerable variation in disease reaction was observed among the genotypes, with most entries showing susceptible to highly susceptible reactions. Among the tested germplasm, genotypes 1254, 1369, W-329, W-398 and W-464 exhibited comparatively lower per cent disease index and were identified as the best performing genotypes against twister disease. These genotypes showed relatively higher levels of resistance compared to the remaining entries, which were categorized as moderately susceptible to highly susceptible. All commercial cultivars were found to be highly susceptible to the disease. The effect of different dates of sowing on disease incidence revealed that sowing time significantly influenced the development of twister disease. Early sowing on 1st June and 15th June recorded the highest disease incidence, whereas delayed sowing on 15th August and 1st September resulted in significantly lower disease severity along with higher bulb yield.

A total of 46 endophytic bacterial isolates were obtained from onion tissues and their cultural and morphological characteristics were studied. The isolates were evaluated through *in vitro* antagonistic assays against *Colletotrichum*, *Fusarium* and *Agroathelia rolfsii*, among which isolate E17 showed the highest inhibitory activity. Further metabolite profiling of isolate E17 using Gas Chromatography–Mass Spectrometry revealed several bioactive antifungal compounds that were screened against the pathogens under *in vitro* conditions. Molecular identification using species-specific primers and a housekeeping gene confirmed isolate E17 as *Bacillus velezensis*.

Field experiments were conducted during 2023–24 and 2024–25 to evaluate fungicides and bioagents for the management of twister disease of onion. Among the treatments, (Azoxystrobin 11% +

Tebuconazole 18.3% SC) @ 1 ml/lit sprayed as three sprays at the onset of disease recorded the lowest disease incidence (15.13 and 25.15% PDI after the last spray) and the highest bulb yields of 29.17tons/ha and 30.75 tons/ha during the respective seasons. This treatment also recorded the highest economic returns with an incremental cost benefit ratio (ICBR) of 3.18 and 3.81 respectively. Further, the residue analysis of the fungicide sprayed plots indicated that fungicide residues declined gradually and reached below detectable limits within twenty days after application.

PR Verma Award for M Sc Students

Studies on Biological Management of Water Hyacinth [*Eichhornia crassipes* (Mart.) Solms] Using Fungal Pathogens

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The experiment entitled **"Studies on Biological Management of Water Hyacinth [*Eichhornia crassipes* (Mart.) Solms] Using Fungal Pathogens"** was conducted at Department of Plant Pathology, Rajasthan College of Agriculture, MPUAT, Udaipur during 2025.
The research aimed to identify effective fungal biocontrol agents and develop practical and scalable, talc-based formulation to enhance shelf life, enabling eco-friendly and efficient weed management as an alternative to chemical herbicides. Six fungal species-*Alternaria eichhorniae*, *Cercospora rodmanii*, *Curvularia lunata*, *Fusarium pallidoroseum*, *Fusarium oxysporum*, and *Colletotrichum gloeosporioides*, were isolated from diseased water hyacinth plants collected from water bodies around Udaipur. These were identified based on morphological and cultural characteristics and confirmed from ITCC, New Delhi.

Fungi produced infection on leaves and petioles in five to seven days after inoculation and caused 26.89 to 75.55 per cent disease severity on water hyacinth. However, culture filtrates caused 44.64 to 73.77 per cent damage and resulted scorching on leaf blade and petioles.

During the host range studies, *A. eichhorniae* and *C. rodmanii* did not infect brinjal, chilli, tomato, potato, pearl millet, barley, wheat, cotton, bhindi, chickpea, soybean, alfa-alfa, pumpkin, bitter gourd and cucumber, however *F. pallidoroseum* infected tomato, brinjal, chilli, cotton and cucumber crops.

Talc-based mycoherbicide formulation of *A. eichhorniae, C. rodmanii,* and *F. pallidoroseum* were prepared and tested for water hyacinth management. Application of *A. eichhorniae* @ 2 per cent caused 85.06 per cent disease intensity at 15 days after spray followed by *C. rodmanii* (75.20%) and *F. pallidoroseum* (62.20%) compared to 100 per cent in chemical herbicide (glyphosate 41 SL @ 0.1%).

Shelf-life of mycoherbicide formulations could retain the viability up to four months of storage under refrigerated condition (10□C). However, viability of fungal propagules in formulations gradually decreased when temperature was increased up to 35°C.

Profiling, Pathogenicity and Management of Pathogen causing Bacterial Wilt of Brinjal

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The present investigation on "Profiling, Pathogenicity and Management of Pathogen Causing Bacterial Wilt of Brinjal" was carried out on various aspects which include collection, isolation, identification of pathogen, cultural, biochemical and molecular characteristics, host range studies, screening of different germplasms and efficacy of biological agents, botanicals and organic inputs against *Ralstonia solanacearum* Smith under *in vitro* conditions. The experiment was carried out at the Department of Plant Pathology, B. A. College of Agriculture, Anand Agricultural University, Anand during 2023-24.

The isolation made from discoloured vascular tissues and roots of the infected plants collected from different locations of Gujarat, showing typical symptoms of bacterial wilt of brinjal, revealed the association of *Ralstonia* sp. The isolated bacteria satisfied Koch's postulates on brinjal plants by employing the soil inoculation method. The identification of the pathogen was confirmed based on cultural and morphological characters as well as through DNA sequencing. The 16S rDNA region-based sequencing of *R. solanacearum* Smith proved accurate for species-level identification of the pathogen. The phylogenetic tree was also constructed and compared with other similar worldwide bacterial isolates available in the NCBI database. It is evident from the 16S rDNA sequence that pathogenic *R. solanacearum* Smith is responsible for causing the bacterial wilt of brinjal in different regions of Gujarat.

The symptoms were initially observed as drooping of leaves on top branches. On infected plants, lower leaves were seen turning pale yellow. The younger leaves were seen losing turgidity and brownish discoloration of vascular bundles was observed. The microscopic observation revealed that the bacteria was gram negative having rod shaped cells.

The cultural studies showed that the bacteria produced creamy white to white colonies on nutrient agar medium and King's B medium. Whereas it produced fluidal colonies with white border and reddish pink centre on triphenyl tetrazolium chloride medium. With respect to biochemical characteristics, the pathogen was gram negative, positive to potassium hydroxide test, catalase test, and indole production test whereas negative to starch production and gelatin liquefication test.

In case of host range studies, it was found that the bacteria belonged to race 1. In case of screening of different germplasms of brinjal against the disease, out of 315 germplasms ninety-three were found highly resistant and only thirteen were found highly susceptible.

Out of seven biological agents evaluated under *in vitro* condition against *R. solanacearum* Smith (RS1) by paper disc method, only *Pseudomonas fluorescens* inhibited the growth of pathogen. Among the ten botanicals evaluated at 5 and 10 per cent concentrations by paper disc method under *in vitro* conditions against *R. solanacearum* Smith, ginger rhizome extract and garlic bulb extract at 10 per cent concentration significantly inhibited the growth of the pathogen and proved to be the most effective. Out of five organic inputs evaluated at 5, 7 and 10 per cent concentration by agar well diffusion method under *in vitro* conditions against *R. solanacearum* Smith, only fermented buttermilk at 10 per cent concentration significantly inhibited the growth of pathogen.

Unraveling The Antiviral Properties Of Medicinal Plants And Their Effect On Mungbean Yellow Mosaic Disease

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Mungbean (Vigna radiata (L.) Wilczek.) belonging family Fabaceae is an important pulse crop that mainly cultivated in Kharif season and can be adjusted in cropping systems of Rabi and Zaid in India. However, its cultivation is severely impacted by Mungbean yellow mosaic virus (MYMV), the most destructive viral pathogen of mungbean worldwide. Infected plants typically exhibit yellowing or chlorosis of the leaves followed by necrosis, shortened internodes and severe stunting, leading to significant economic losses. The virus is transmitted by whitfly in a persistent manner, facilitating rapid disease spread. Understanding the virus's biology, transmission and impact is critical for developing effective management strategies to protect this important crop. Considering the significance of viral diseases in crop production, the present study investigated the antiviral potential of medicinal plants and their impact on mungbean yellow mosaic disease. The research was conducted at the Department of Plant Pathology, B. A. College of Agriculture, Anand Agricultural University, Anand, during 2023-2025. The study aimed to develop sustainable and also exploring the antiviral properties of indigenous medicinal plant extracts against mungbean yellow mosaic disease**.**

A survey was carried out to know the occurrence of mungbean yellow mosaic disease in Bharuch and Vadodara districts of Gujarat. The surveyed area covered 30 locations of 2 districts with an average 33.16 per cent disease incidence. Maximum MYMV incidence (37.92%) was reported in Vadodara district followed by Bharuch district (28.41%). Among cultivated varieties, GM 4 was found most susceptible, whereas GM 6 and GM 7 exhibited resistance. Disease progression varied with growth stages, peaking at maturity and declining during pod formation.

The molecular characterization of MYMV was done to confirm its identity. Viral DNA was extracted from surveyed diseased leaf samples. The DNA was amplified in the PCR. The PCR analysis confirmed the presence of MYMV in 30 symptomatic mungbean leaf samples collected from two districts of Gujarat. High-quality total DNA was extracted, verified by agarose gel electrophoresis and Nanodrop quantification. The specific primer (MYMV-CP) which generated an amplicon of ~1000 bp corresponding to gene that codes for coat protein of the virus, confirming MYMV infection with high sensitivity and specificity. The PCR products were purified, sequenced and sequence alignment with GenBank entries validated them as MYMV isolates.

An in-vitro study was conducted during Kharif 2024-25 to evaluate the antiviral efficacy of medicinal plant extracts against MYMV in mungbean. GM 4 variety of mungbean was used. Significant variation in disease incidence was observed across treatments. Clerodendrum sp. was most effective, reducing incidence to 30.00 per cent, followed by Boerhavia diffusa and Glycyrrhiza glabra (33.33%). Vitex negundo and Andrographis paniculata also showed promising results, while Asparagus spp. and Leptadenia reticulata were least effective.

To determine physical properties of efficient phytoextracts against MYMV, three key parameters were assessed viz. dilution endpoint, longevity in-vitro and thermal inactivation point. Clerodendrum sp. exhibited superior efficacy across all parameters, showing strong antiviral activity even at 1:100000 dilution, maintaining effectiveness up to 30 days and withstanding temperatures up to 90 °C. Boerhavia diffusa and Vitex negundo showed moderate stability across all tests. In contrast, Andrographis paniculata and Glycyrrhiza glabra were less effective at higher dilutions, longer durations and elevated temperatures, indicating reduced stability of their active constituents.

Identification of antiviral compounds in promising medicinal plant extracts through GC-MS analysis was performed against Mungbean Yellow Mosaic Virus. Andrographis paniculata, Boerhaavia diffusa, Vitex negundo and Clerodendrum extract contained major compounds such as 4,5-dimethylnonane, 3,7-dimethyldecane, 5 dimethylnonane, 2,7 dimethylundecane.

Study of Cucumber Powdery Mildew and Its Management

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Cucumber (*Cucumis sativus* L.) is a widely cultivated vegetable crop in India, highly susceptible to powdery mildew caused by *Podosphaera xanthii*. This study, conducted during *Kharif* 2022 at Sardarkrushinagar Dantiwada Agricultural University, aimed to evaluate host range, spacing effects, eco-friendly and chemical management and meteorological influences on disease development.

The powdery mildew of cucumber is caused by *Podosphaera xanthii* an obligate ectoparasitic fungus with distinct morphological and pathological characteristics. It primarily infects foliar surfaces and it is first identified by the appearance of small, circular white powdery spots on the adaxial leaf surface. The symptoms gradually spread to the petioles and young stems, often leading to leaf chlorosis, premature senescence and in severe cases, defoliation. Also, the pathogen is characterized by superficial hyaline mycelium with septate hyphae, which grow epiphytically on the leaf surface. *Podosphaera xanthii* produces short, erect conidiophores arising from the mycelium, each terminating in a single conidium. Conidiophores are unbranched, straight to slightly curved. The conidia are ellipsoidal to cylindrical, hyaline, single-celled and borne singly in chains. These conidia are responsible for secondary spread and are easily dislodged by wind, facilitating rapid disease dissemination.

The host range of *Podosphaera xanthii* trials confirmed all tested eight cucurbits were susceptible, with sponge gourd showing the highest per cent disease intensity at 52.44% and AUDPC of 1351.59 units and round gourd has the lowest per cent disease intensity 20.79% and 549.91 AUDPC.

To study the effect of spacing on development on powdery mildew significantly impacted disease and yield, where the widest spacing 2.0 m × 1.0 m had the lowest PDI 12.65% but also the lowest yield 51.58 q/ha, while closest spacing 1.0 m × 1.0 m had the highest PDI 67.69% and maximum yield 97.76 q/ha.

Among eco-friendly treatments, salicylic acid reduced PDI to 27.02%, increased yield to 130.18 q/ha with 50.81% disease reduction over control and showed the lowest AUDPC (577.05 units).

In field experiment, all the fungicides significantly reduced powdery mildew. Propiconazole 25% EC was the most effective fungicide, reducing PDI to 30.54% with increasing yield to 152.64 q/ha and 55.62% disease reduction over control and recording the lowest AUDPC (582.29 units).

Assessment of defence related enzymes activity in cucumber infected by *Podosphaera xanthi* focusing on chlorophyll, peroxidase, polyphenol oxidase and chitinase levels. Enzyme activity was recorded at 1 day before spray and at 1, 5 and 10 days after spray. Various eco-friendly treatments and fungicidal treatments were most effective in enhancing and sustaining chlorophyll content, indicating improved photosynthetic efficiency. Among, all the treatments in comparison to control exhibited the high peroxidase, polyphenol oxidase and chitinase activity. The enzyme activity was increasing and decreasing highlight the differential roles of these treatments in activating specific plant defense pathways.

Disease onset was observed in the 37th SMW with PDI of 9.86%, peaking at 76.26% by the 41st SMW. Powdery mildew showed positive correlation with maximum temperature ($r = 0.314$) and sunshine hours ($r = 0.673$) and negative correlation with minimum temperature ($r = -0.772$), morning humidity ($r = -0.809$), evening humidity ($r = -0.754$) and rainfall ($r = -0.402$).

The findings support integrated disease management combining wider spacing, eco-friendly treatments and selective fungicide use to improve cucumber yield and reduce disease impact sustainably.

Pathogenic and Morpho-genetic Characterization of *fusarium* spp. Associated with Head Blight in Wheat and its Management

Aishna Srivastava[1], Prem Lal Kashyap[2], Manoj Kumar Yadav[3], Pramod Prasad[2], Kumarnag KM [4], Rajendar Singh[2], Vikas Gupta[2] and Arun Gupta[2]

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Fusarium Head blight (FHB) is a major global constraint to wheat production, causing severe yield losses and mycotoxin contamination that threaten food safety. In India, diverse *Fusarium* spp. profiles and the quantitative nature of host resistance limit current management. The present study, **"Pathogenic and morpho-genetic characterization of *Fusarium* spp. associated with head blight in wheat and its management"**, aimed to: (1) determine the pathogenic and molecular identity of *Fusarium* spp. causing wheat blight; (2) assess compatibility, mycotoxin production, stress resilience, and management options; and (3) standardize inoculation methods and identify resistant wheat genotypes.

Ten morphotypes representing eight species, *F. pernambucanum*, *F. tanahbumbuense*, *F. annulatum*, *F. incarnatum*, *F. proliferatum*, *F. cf. incarnatum*, *F. cerealis*, *F. culmorum*, and *F. graminearum*, were identified via morphology and multilocus analysis (*TEF1-α*, *HIS 3*). *F. graminearum*, *F. culmorum*, and *F. cerealis* were most aggressive; *F. tanahbumbuense* and *F. pernambucanum* were first reports on wheat in India. All isolates harbored mycotoxin genes (*Tri6, Zea 13F, Tox5, HATri*). Most aggressive species i.e, *F. cerealis* showed moderate drought sensitivity (75.72% inhibition at 37% PEG) and salt intolerance (42.043% inhibition at 2 EC). Tebuconazole (76.137% at 100 ppm) and Azoxystrobin (78.4% at 500 ppm) were most effective fungicides; camphor extract (96.43%) and garlic extract (60.71%) showed strong eco-friendly antifungal activity. Among four inoculation techniques (spray, agar bit, injection, and cotton swab), injection produced the most consistent symptoms (60.15% severity). Screening of 100 genotypes identified four moderately resistant lines (IC 624502, IC 536365, IC 566223, IC 621837), but resistance SSR markers and Principal component analysis failed to separate resistance classes, highlighting the need for improved molecular tools.

Standardization of Encapsulation Technique of *Streptomyces* spp. against Fusarium wilt of Tomato

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Tomato (*Solanum lycopersicum* L.) is one of the most economically important vegetable crops widely grown in Meghalaya. Among the major diseases infecting tomato, Fusarium wilt caused by *Fusarium oxysporum* f.sp. *lycopersici* (FOL) is the most destructive disease which causes wilting and death of tomato plants thereby inflicting a devastating yield loss (60-70%). The present study was undertaken to isolate a native potential *Streptomyces* spp. and to develop the safe encapsulated product of effective isolate of *Streptomyces* spp. for the management of the disease. In the present study, six native *Streptomyces* spp. were isolated from rhizosphere of solanaceous crops and coded as PDRSM, PDRSI, PDRSN, PDRSS, PDRSU and PDRSMW. Among these six isolates, isolate PDRSM showed the maximum inhibition of mycelial growth (64.8%) of FOL in dual culture assay. Based on 16SrRNA gene sequencing, these six isolates were identified as *Streptomyces* spp. and the best isolate PDRSM closely related to *Streptomyces abikoensis* with maximum bootstrap support. Furthermore, 22 functional attributes of *Streptomyces* isolates were identified. *Streptomyces* isolate PDRSM found positive for 18 functional attributes which includes hydrolytic enzymes such as amylase, cellulase, chitinase, protease, lipase, pectinase, and xylanase, as well as PGP activities like phosphate solubilization (54.10%), IAA production and ammonia production. Based on higher antifungal activity and maximum number of functional attributes *Streptomyces* isolate PDRSM was selected for development of encapsulated product. The encapsulation technique was standardized with biopolymers for the formation of beads. After encapsulation, the moisture content, size, swelling ratio and survivability per cent of beads were determined. The encapsulated beads showed the *in vitro* release of *Streptomyces* spp. when placed on ISP 2 media which indicated the viability of organism inside the beads. The encapsulated *Streptomyces* beads were evaluated at different concentrations against FOL by agar well diffusion assay. Among the different concentration of encapsulated *Streptomyces* beads, 1% concentration of beads exhibited 40.0% mycelial growth inhibition followed by 0.5% concentration which showed 38.5% mycelial growth inhibition. The bead concentrations of 0.1%, 0.2%, 0.5% and 1% showed higher mycelilal growth inhibition than 0.1% carbendazim. The encapsulated beads also preserved the major functional attributes of organism. Therefore, this encapsulated product of *Streptomyces* spp. will be used for the management of Fusarium wilt of tomato, thereby reducing reliance on chemical fungicides.

Study of Cucumber Downy Mildew and its Management

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Cucumber (*Cucumis sativus* L.) is an important vegetable crop cultivated worldwide for fresh consumption and processing purposes. Despite its economic significance, cucumber production is severely affected by downy mildew, a destructive foliar disease caused by *Pseudoperonospora cubensis*. The disease leads to heavy yield losses under favorable environmental conditions, thereby threatening sustainable cucumber cultivation. The present investigation was undertaken to study symptomatology, molecular detection, host range, epidemiology, and integrated management strategies for effective control of cucumber downy mildew.

Symptoms of the disease appeared 25–30 days after sowing, initially as chlorotic, angular lesions on the upper leaf surface, followed by the development of ashy-white, frost-like mycelial growth on the lower surface. Severe infection resulted in premature leaf drying and significant reduction in photosynthetic activity. Microscopic examination revealed coenocytic, hyaline, irregularly branched mycelium and dichotomously branched sporangiophores bearing ovoid sporangia. Molecular confirmation using species-specific primers targeting the ITS region of rDNA produced an amplicon of approximately 605 base pairs, confirming the identity of *P. cubensis*. Host range studies indicated that several cucurbit crops, including ridge gourd, sponge gourd, bitter gourd, bottle gourd, pumpkin, round gourd, watermelon, and muskmelon, were susceptible to the pathogen, with muskmelon showing maximum disease intensity. Evaluation of different plant spacing treatments revealed that wider spacing reduced disease severity due to improved aeration, whereas closer spacing resulted in higher fruit yield, highlighting the need for a balanced agronomic approach. Among the fungicides tested, Metalaxyl 8% + Mancozeb 64% WP proved most effective, recording the lowest disease intensity and highest yield. Eco-friendly treatments such as salicylic acid also significantly reduced disease severity and enhanced yield by stimulating defense-related enzymes like peroxidase and polyphenol oxidase. Weather parameter analysis showed positive correlation of disease intensity with temperature and relative humidity, indicating the importance of climatic factors in disease progression.

The study concludes that integrated disease management combining optimized spacing, effective fungicides, eco-friendly resistance inducers, and weather-based forecasting can significantly reduce downy mildew severity and improve cucumber productivity in a sustainable manner.

Y L Nene Memorial Award Lecture 2025

Apple Scab Forecasting: when climate changes the rules

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Apple scab caused by the fungal pathogen *Venturia inaequalis* (Cooke) G. Winter is a continuous problem for apple grower in India. From this disease, the fruits become scabby brown or black spotty, losing their value. It is a complex disease that develops following two phases, a monocyclic phase caused by ascospores produced in pseudothecia originating from leaf lesions present the previous fall, and a polycyclic phase produced by conidia originating from lesions on leave and fruits. Various management tactics to manage apple scab were developed during the last half century. These tactics are either biologically/culturally or chemically based. Fungicides play a major role in maintaining crop health and reliable yields of products that meet the demand for high quality. Hence, fungicides represent a key component of most integrated disease management programs, and their effectiveness should be sustained as much as possible. However, fungicide effectiveness has been significantly affected by the development of resistance in some fungal pathogen populations. Moreover, environmental considerations are becoming increasingly important and, as a consequence, it is less acceptable to apply fungicides needlessly. As the global climate continues to shift, it is crucial for plant pathologists to grasp how unusual weather events can influence the emergence of plant diseases. Fungal infections in plants are heavily influenced by temperature and precipitation-climate factors that are expected to undergo significant changes in this century. Temperature and precipitation play a crucial role in apple scab infections and inform forecast models that assist growers in applying fungicides more efficiently and effectively. In recent years in Uttarakhand, these models have struggled to accurately predict the availability of ascospores from this fungus for primary infections, leading to an increased reliance on fungicides. By identifying the causes of these model failures, we can restore confidence in their accuracy, allowing growers to use fungicides more judiciously. As technology plays a growing role in on-farm decision-making, educating farmers about the advantages of Integrated Pest Management (IPM) is equally essential. This research aims to uncover the reasons behind the failures of ascospore maturity models, assess how key parameters of ascospore maturity have shifted, and develop a tool to navigate the complexities of IPM research and contemporary farming practices. In many areas of Uttarakhand, dry periods will be assessed to determine whether pseudothecia failed to mature or matured without releasing ascospores. In certain regions of Himachal Pradesh and Kashmir, pseudothecia have not matured over the past 5 to 6 years, preventing primary infections and resulting in a scab-free status. However, recently, the fungus has begun maturing over an extended period on fallen orchard leaves, leading to the emergence of primary infections and an increasing frequency of scab in previously unaffected zones. Degree days during the fall and winter have been analyzed to assess the potential impact of a warming climate on ascospore maturity, tree development, and ultimately, the occurrence of apple scab. However, in most IPM programs, the control of apple scab is based on the use of fungicides and these programs are developed to improve fungicide efficacy using procedures to estimate potential ascospore dose, weather-based models to estimate ascospore maturity, leaf growth and risk of infection periods. These tools were integrated into various disease decision support systems (DDDS). Almost all of the DDSS focus on management of primary infections (monocyclic phase) and much less attention has been paid to secondary infections (polycyclic phase) that develop during the summer, despite that up to 6-8 additional fungicide sprays are often used to manage summer scab. At the beginning, those systems were often too expensive for average growers to afford them, as well as not really user-friendly. But things have changed with the improvement and accessibility of IT technology, and DSSs are nowadays widely available for only larger apple growers. The system operates on a personal computer and thus can be managed independently at any time by the user. Since 1993, together with numerous colleagues, has developed advisory services for reducing the chemicals regarding management of scab and late blight of potato. Apple disease control advisory (ADCA), a computerized decision support system for managing scab, was procured from Austria and tested over 10 years in 5 fruit valleys of Garhwal Himalayas of India. In orchards managed according to advisory information, a significant increase of yield was obtained relative to the common management policy. The environmental conditions varied from location to location, and infection periods ranging from 19–47 were recorded from April to September every year revealed that number of infection periods varied from year to year depending upon the weather conditions. The observation revealed delay in ours and Mill's data by 1 day for severe and moderate infection and 2 days for light infection in symptom expression under field conditions. During some years, the complete management of scab by applying 3-4 fungicide and 2 per cent urea spray at the time of leaf fall was obtained. Warnings are issued mainly via a call in telephone, SMS, WhatsApp, Agriculture Govt. department, and broadcasted through radio stations.

N Prasad Memorial lecture

Biopesticides for sustainable Agriculture: Current scenario, challenges and future prospects

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Biopesticides based on living microbes and their bioactive compounds have been promoted as replacements for synthetic pesticides for control of plant diseases. However, lack of efficacy, inconsistent field performance, low shelf life and strict regulatory requirements by CIBRC has generally relegated them to niche products. Significant increases in market penetration have been made, but microbial pesticides still only make up a small percentage of disease control products.

Thiry four microbes have been included in the schedule to the Insecticide Act 1968 for production of microbial based biopesticides.. While working with some important antagonistic microbes (*Trichoderma* spp.), we have documented the biocontrol ability of these organisms at field level as well as up to the extent of commercialization.

We have started promoting the usage of biopesticide formulations as a component of integrated farming practices with involving farmers of eastern Uttar Pradesh in order to produce pesticide residue free crop.

The research on biocontrol agents (BCAs) can be fruitful only when we commercialize and register the product based on novel strains. Biopesticide registration require data on technical and formulation related information such as biological characteristics, pathogenic contaminants, other microbial contaminants, bioefficacy, toxicity, container compatibility and self life etc. To achieve this, certain norms specified by Central Insecticides Board are to be followed. Till date, about 970 microbial based biopesticides products are registered with CIBRC (http://cibrc.nic.in/bpr.doc) under section 9(3B) and 9(3) of the Insecticides Act, 1968 Government of India). None of the biopesticides registered in India have level claim of controlling the diseases of medicinal plants . During the presentation emphasis will be given on regulatory requirements and quality control of biopesticides in India.

Molecular Mechanism of Sclerotinia Stem Rot Resistance in Rapeseed-Mustard - An Innovative Approach

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To breed a *Sclerotinia* stem rot resistance cultivar, stable and reliable sources of resistance from *Brassica* species genotypes and their wild relatives, protocols have been developed under controlled conditions by various methods. The use of appropriate inoculation and assessment method significantly reduce variability in the responses of genotypes to *Sclerotinia*. A genotype with specific antioxidant response assay may differentiates Indian mustard genotypes for resistance to *Sclerotinia*. The applications of genomics and effectromics approaches during *Brassica* host-pathogen interactions have allowed to understand the molecular mechanisms of effector genes for their expression and effects on the host by the pathogen. *Brassica* genotypes exhibited distinct molecular mechanisms of resistance compared to susceptible plants. These mechanisms involve the upregulation of various molecules such as phytoalexins, phenolic compounds, and sequestration of oxalic acid. Additionally, presence of QTLs associated with QDR response, and QTLs linked to resistance at flowering time, further contribute to the resistance phenotype. The co-location of QTLs for the overexpression of specific genes (*NPR1, BnaNPR1, OsPG/Ps, BnWRKY33, BnMRPK4, BnMPK3, BnMPK6, AtWRKY28, AtWRKY75*) play crucial role in providing resistance. Mapping of *Sclerotinia* resistance loci (QTLs) have been carried with microsatellite markers (GWAM), GWAS, SNPs, and GBS1. The involvement of NPR1-like genes, is crucial in the regulation of plant defense. The genes *BnMED25* and *BnWRKY33* activate defense-signaling pathways to impart resistance. Similarly, genes *BnMPK4-BnMKS1-BnWRKY 33* exit in a nuclear localized complex that regulates resistance; and the gene *BnMYB43* positively affects vascular lignification, plant morphology, and yield. According to functional genomics analysis, the genes *BnMPK4, BnMPK6, BnMPK33, BnWRKY15, BnWRKY70, BnRRKY28*, *BnYQ 12, BnNPR1, BnMED 16, BnCCR2, pBn GH17, pBnGH1707, BnTGA7*, and *BnGH17* have been identified as conferring molecular mechanisms for resistance against *Sclerotinia*. Extra-large G-proteins (XLGs) in *B. juncea* are signaling molecules which modulate host defense pathways to *Sclerotinia*. Loss and retention of *R*-genes in family *Brassica*ceae have been observed using next generation sequencing. Molecular studies have revealed general host responses to *Sclerotinia* and molecular basis of host resistance. Biometabolomics of *Brassica*-*Sclerotinia* interaction has revealed metabolic changes in resistant and susceptible hosts. Over-expression of UGT74B an indolic GSL pathways gene of *B. napu*s enhances resistance to *Sclerotinia*. Glucosinolate biosynthesis genes differentiate resistant and susceptible *Brassica* genotypes to *Sclerotinia*. The *BnPG*/Ps gene interacts with *Sclerotinia* PGs to improve stem rot resistance at different levels. Pathways and biological process associated with *Brassica* resistance to *Sclerotinia* have been revealed. Over-expression of *AtGDSL1* in *B. napus* enhances resistance by increased ROS and SA levels, and reduced jasmonic acid levels. The *BnaMPK3* gene in *Brassica* is a key regulator of multiple defense responses to *Sclerotinia*. The *BnMED25* and *BnWRKY* 33 genes activate defense signaling to confer *Sclerotinia* resistance in *Brassica*. The gene *BnMYB43* positively regulates vascular lignification, plant morphology, and yield, but negatively affects resistance to *Sclerotinia*. Decreasing S/G ratio by knocking out of the *BnF5H* gene improve

Sclerotinia resistance in *B. napus*. The *BnaTIFY* genes contribute to multiple stress responses and phytohormone crosstalk in *B. napus*. Over-expression of *AtWRKY* 28 and *AtWRKY* 75 genes enhance resistance to Oxalic acid and *Sclerotinia* in *Brassica*. Microsatellite markers have been used for GWAM of partial resistance loci in *Brassica*. Proteomics of R and S genotypes of *Brassica* has revealed differential expression of several genes in *Brassica*- *Sclerotinia* interaction.

R. Prasada Memorial Award Lecture

Molecular Methods for Diagnosing Plant Pathogens

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Global population is exploding in the geometric progressing and food production is increasing in arithmetic progression. The major biotic constraint in the crop production is diseases, caused by microorganisms, like fungi, bacteria and viruses. About 30 to 35% of agriculture produce is going as waste towards pests and diseases at various stages of production. About 15-20% agricultural loss incurred due to fungi, 10 to 12% agricultural loss due to bacteria and 8-10% loss due to viral microorganisms. On the other sector, only two out of every five people on this globe are having balanced two meals per day. Remaining three people out of five are going to bed either hungrily or malnourished. This situation is worst in the under developed nations. By any chance, if we can save this large amount of agricultural waste, we can feed the millions of hungry mouths. Why and how this large amounts of agricultural produce going towards pests and diseases. The majority of the microorganisms are beneficial and only a small percentage of microbes are responsible for the diseases, hence, disease resistance is a rule in nature and susceptibility is just an accidental phenomenon. This accidental phenomenon only will be responsible for so much of yield loss in the different crop species. How these small microbes are having the interactive cross talk between resistant and susceptible hosts are intriguing to humans. Disease triangle says the concurrent occurrence of three important factors will only leads to the development of the diseases, they are; the susceptible host, virulent pathogen and favorable environmental conditions.

Precise molecular diagnosis of pathogenic infections decreases the spread of the disease and facilitates to make suitable disease management strategies. Advanced molecular diagnostics has taken a noticeable place and has revealed advantageous in diagnostic laboratory for routine detection, fingerprinting and epidemiologic analysis of infectious microorganisms. Molecular tests reduce the exposure to infectious agents and decrease the health risk for the consumers. This research aims to discuss our most recent of state-of-the-art molecular diagnostic techniques enabling fast and accurate detection and identification of plant and food borne pathogens based on well-developed genotyping techniques like polymerase chain reaction, Multiplex PCR, RT PCR, LAMP, LSSP PCR and SSCP PCR assay.

Molecular diagnostics play a crucial role in enhancing plant yield by enabling early and accurate detection of Plant diseases. In summary, molecular diagnostics are essential for improving plant yield by providing rapid and accurate disease detection, effective management, cost savings and sustainability in agriculture.

Securing Plant Genetic Resources: Challenges and Innovations in Seed Health Testing for Quarantine and Conservation of PGR

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The global exchange of plant genetic resources (PGR) is the lifeblood of contemporary agricultural science. As we face the dual pressures of a burgeoning global population and a rapidly changing climate, the movement of germplasm across international borders has become more than a scientific necessity - it is a cornerstone of global food security. At the heart of this exchange lies the Division of Plant Quarantine at ICAR-NBPGR, acting as the sentinel at the gates of India’s agricultural landscape. However, the very pathways that bring in the genetic diversity required for crop improvement also serve as high-risk conduits for the ‘hitchhikers" of the microbial world. Among these, seedborne fungi are particularly insidious. Unlike insect pests, which may be detected through visual inspection, fungal pathogens frequently exist in latent states, embedded deep within the seed coat or as dormant mycelium. This ‘Genetic Heritage’ we seek to protect is thus under constant threat from trans-boundary movements that can inadvertently introduce exotic pathogens, potentially leading to catastrophic ecological and economic consequences.

Fungi are among the most resilient and adaptable plant pathogens as trans-boundary invaders. In the context of quarantine, we categorize threats into those not yet present (exotic) in the country and those with restricted distribution (indigenous). The introduction of even a single exotic fungal pathogen could result in the loss of millions of tons of crop production. The challenge is exacerbated by the sheer diversity of the material handled. The trans-boundary movement of these resources is no longer a localized event; a germplasm packet might travel through multiple climate zones and handling facilities before reaching its destination, increasing the risk of contamination. Furthermore, the ‘cryptic’ nature of fungal invasions - where a pathogen remains asymptomatic until it meets a susceptible host under favourable environmental conditions - makes traditional quarantine methods alone insufficient for modern biosecurity.

Historically, seed health testing relied heavily on the ‘trained eye’ of the mycologist. Classical techniques, such as the blotter test, agar plate methods, and washing tests, have been the bedrock of mycology for decades. While these methods are invaluable for identifying culturable and morphologically distinct fungi, they possess inherent limitations in a high-throughput quarantine environment. Firstly, traditional methods are time-consuming, often requiring 7 to 14 days for incubation. In a world where plant breeders require rapid access to PGR, this ‘quarantine lag’ can become a bottleneck. Secondly, many high-consequence fungi are either slow-growing or non-culturable on standard media, leading to ‘false negatives’. Lastly, the reliance on morphology can be deceptive; many fungal species exist as complexes where pathogenic and non-pathogenic strains are morphologically indistinguishable. These limitations necessitate a shift from the classical to the molecular, bridging the gap between morphology and genomics.

The true measure of a quarantine examination lies in its ability to intercept pathogens before they establish a foothold in the national soil. Between 2011 and 2025, our rigorous testing of over 3.5 lakh imported germplasm samples has served as a critical filter for Indian agriculture. During this period, we have made significant interceptions of potential quarantine pathogens that could have altered the agricultural trajectory of the country. These strategic interceptions of exotic pathogens such as *Diaporthe longicolla*, *Fusarium oxysporum* f. sp. *cucumerina* and *Peronospora manshurica* underscore the critical role of seed health testing in preventing the establishment of non-indigenous pathogens or their virulent races within India.

Biosecurity is not limited to PGR imports; it is equally vital in the conservation of our indigenous plant genetic resources. During the seed health testing of indigenously collected or multiplied germplasm intended for long-term conservation in the National Genebank, we have identified several significant fungal pathogens. Our findings include *Diaporthe helianthi* in safflower, *Dimnesporium americanum* in goat grass, *Diaporthe phaseolorum* in *Oroxylum*, *Colletotrichum eleusines* in Indian goosegrass, and *C. truncatum* in beach bean. By ensuring the high phytosanitary quality of indigenous resources like safflower, oroxylum and Indian goosegrass prior to long-term storage, we mitigate the risk of pathogen-induced degradation during ex-situ conservation

A profound understanding of pathogen diversity is the prerequisite for effective diagnosis. My research has focused extensively on reporting the morphometric and genetic diversity within several high-impact fungal groups. This includes the study of *Albugo candida* (White rust) infecting Brassica, and the polyphagous nature of *Lasiodiplodia theobromae* across multiple crops. Further investigations have delved into *Diaporthe vexans* (Fruit-rot) in brinjal, *Colletotrichum capsici* (Fruit-rot/die-back) in chillies, and *C. truncatum* (Anthracnose) in soybean. Understanding the genetic variability in *Fusarium oxysporum* f. sp. *lentis* (Wilt) in lentil, *Bipolaris oryzae* in rice, *B. sorghicola* in sorghum, and *Rhizoctonia solani* f. sp. *sasakii* (Banded leaf and sheath blight) in maize has allowed us to refine our diagnostic markers. Mapping the genetic variability of diverse pathogens - from *Bipolaris oryzae* to *Lasiodiplodia theobromae* - serves as the blueprint for developing high-sensitivity diagnostic markers that overcome the limitations of conventional SHT. To address the challenges of high-volume testing, ICAR-NBPGR, New Delhi has pioneered the integration of advanced molecular tools. The transition from conventional to advanced diagnostics represents a significant leap in our ability to safeguard agriculture and to facilitate safe global PGR exchange/ trade.

The R. Prasada Memorial Award is a reminder of our responsibility to the history of our discipline. Professor Prasada's work was characterized by a deep understanding of fungal biology - a foundation that remains vital today. As we apply advanced diagnostic tools to the challenges of the 21st century, we are essentially continuing the work of our predecessors using more precise 'molecular microscopes'. 'Securing Our Genetic Heritage' is a multi-dimensional task requiring technical expertise, strategic vision, and unwavering vigilance. By embracing innovation in seed health testing and building upon a decade of rigorous interceptions, we ensure that the trans-boundary movement of PGR remains a source of agricultural strength. By serving as the scientific sentinels of our green borders, we ensure that every seed exchanged today contributes to a secure, pathogen-free harvest for the generations of tomorrow.

PR VERMA MEMORIAL AWARD LECTURE

Green Strategies and Innovations for Plant and Soil Health Management: A Climate Resilient Approach

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Plant diseases caused by diverse pests and pathogens have significant impact on food security, trade, livelihood of population and in other way we can elaborate it as such diseases are caused due to poor soil health especially lack of useful microbes and organic matter in soil. Use of chemicals for the management of plant diseases have negative impact on the environment, soil health, ground water contamination, persistent change in the soil ecology, physiochemical composition of soil, reduction of soil organic matters, human health hazards and also emergence of chemical resistance, resurgence of new pests and pathogens. Green strategies and innovations for making better soil and plant health become an integral part of the soil ecosystem which was disturbed due to overuse of chemical pesticides and chemical fertilizers for obtaining maximum crop yield. Soil and plant microbiome play a major role not only in maintaining soil and plant health but enhance crop production, provide huge benefit to the environment and human health. Healthy soil is the foundation of agricultural system which regulate different agricultural activities for improving crop production. Soil is a complex ecosystem where living microbes and plant roots bind mineral particles and organic matter together which regulate water, air and nutrients in soil. Therefore, it is important to design new innovations for improving plant and soil health through use of natural organisms and organic materials. Therefore, it is the need of the hour to discuss few green strategies and innovations to maintain soil and crop health in changing environment.

B B L THAKORE LECTURE

Suppressive Soils for Strengthening Plant Health and Scaling Natural Farming

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Soil is one of the most vital natural resources, playing a central role in sustaining biodiversity and regulating ecosystem services in both natural and managed agroecosystems. A healthy soil harbors a vast diversity of microorganisms, including bacteria, fungi, actinomycetes, and protozoa, which together constitute a highly complex and dynamic system. Despite its importance, the internal functioning of this system remains only partially understood and is often described as a “black box.” Therefore, a deeper understanding of soil microbial diversity, structure, and interactions is essential to elucidate the functioning of soil ecosystems.

Soil-borne diseases and pests pose a major constraint to global agricultural productivity. Conventional agricultural systems rely heavily on chemical inputs such as fungicides, insecticides, herbicides, and nematicides for their management. However, the indiscriminate use of these chemicals adversely affects soil biodiversity, disrupts ecological balance, and undermines long-term soil health. In contrast, natural farming systems emphasize ecological processes and biological regulation for sustainable crop production. In this context, the concept of suppressive soils has emerged as a promising and sustainable strategy for plant disease management. Suppressive soils are characterized by their inherent ability to limit disease incidence, even in the presence of virulent pathogens and susceptible host plants. This suppressiveness is primarily attributed to the diversity and activity of beneficial soil microorganisms.

Suppressive soils operate through multiple biological mechanisms, including competition for nutrients and ecological niches, production of antimicrobial metabolites, parasitism (e.g., *Trichoderma* spp.), and the induction of systemic resistance in plants. These processes collectively inhibit pathogen proliferation and enhance overall plant health. In India, initiatives by the Government of India to promote natural farming and indigenous agricultural practices have further highlighted the importance of soil biological health. Traditional inputs such as *Panchagavya, Jeevamrit, Beejamrit*, mulching, and crop diversification play a significant role in enhancing microbial activity and strengthening soil suppressiveness.

A comprehensive understanding and effective management of suppressive soils can significantly contribute to sustainable and eco-friendly agriculture. It offers a viable pathway for reducing chemical dependency, enhancing soil resilience, and addressing global challenges such as climate change, while ensuring long-term soil health and food and nutritional security.

V P BHIDE MEMORIAL LECTURE

Climate variability driven shifts in Pathogen Dynamics of Major Crops in West Bengal

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West Bengal holds a vital position in India's agricultural sector, contributing over eight percent to the country's total food production and supporting a large population dependent on climate-sensitive agriculture. Agricultural production systems in this state are increasingly exposed to climatic variability, with significant implications for crop health and disease epidemiology. West Bengal, India, exhibits remarkable agro-ecological diversity ranging from the Himalayan Terai and Dooars to the Gangetic alluvial plains, red and lateritic tracts, and the coastal Sundarbans. These diverse agro-climatic zones create both high productivity potential and systemic vulnerability to climate-driven disease risks. Long-term climatic analyses reveal that West Bengal is undergoing significant hydro-climatic transitions. A statistically significant rise in annual minimum temperatures has been observed across most districts, whereas maximum temperatures remain relatively stable in several southern regions. Rainfall patterns have become increasingly erratic, marked more by shifts in spatial and temporal distribution than by uniform declines in total annual precipitation. Traditionally humid northern districts are experiencing declining moisture indices, while several southern districts show increasing rainfall trends.

Rice-based cropping systems, the backbone of regional agriculture, are highly sensitive to these changes. Irregular monsoon patterns, including delayed onset, mid-season droughts, and terminal stress, adversely impact crop growth stages, while flooding and waterlogging further aggravate yield losses. Concurrently, plant disease dynamics are undergoing substantial shifts. Elevated humidity, temperature, and prolonged leaf wetness can modify pest and pathogen life cycles, thereby enhancing the incidence and severity of fungal and bacterial diseases. Consequently, rice systems are experiencing increased prevalence of major diseases, including false smut and sheath rot, alongside emerging threats such as panicle blight and grain discoloration, adversely affecting both productivity and grain quality. Likewise, *Choanephora cucurbitarum* has become a major biotic constraint in vegetables and other crops during *Kharif* season, and *Sclerotinia sclerotiorum*, first detected in West Bengal in 1988, has now expanded to over 25 host species, underscoring its adaptive potential under changing climates. *Scleroium rolfsii* is now becoming a major threat in pulses and vegetable crops. These findings reinforce that climate-induced shifts are accelerating pathogen evolution, expanding host ranges, and transforming minor pests into major constraints.

Long-term surveillance and predictive modeling is essential for assessing pathogen dynamics as well as guiding policy and framing sustainable management strategies. A decade-long (2011–2021) real-time monitoring of tomato diseases in the Gangetic alluvial region revealed that target leaf spot and tomato leaf curl were the two most prevalent threats during the *Rabi* season, while tomato leaf curl, early blight, and late blight predominated in the summer season. Advanced data-driven predictive models integrating temporal weather variability with pathogen incidence, including machine learning approaches, successfully identified weather-driven risk factors, with climate projections (PRECIS, 1991–2050) are indicating increased future disease severity. Notably, climate model-based projections

(PRECIS, 1991–2050) suggest a rising trend in target leaf spot severity, particularly during 2031–2040 and 2041–2050 decadal periods. Future climate scenarios suggest a continued intensification of disease incidence, particularly for foliar pathogens sensitive to humidity and temperature fluctuations. These projections underscore the need for integrating real-time monitoring systems, predictive analytics, and advanced diagnostic technologies into regional crop protection strategies.

Prof. KRISHNA SAHAI BILGRAMI BEST POSTER AWARD COMPETITION

Tiny Capsules, Healthy Beans: Trichoderma reesei "BioEncap" Against Fusarium Wilt

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Fusarium wilt, caused by *Fusarium* spp., poses a significant threat to legume production, with potential yield losses ranging from 30 to 100%. Despite its impact, systematic research on the prevalence and management of Fusarium wilt in the bean-growing regions of Northeast India remains limited. To address this gap, a roving survey was conducted across three northeastern states—Manipur, Meghalaya, and Nagaland—to assess disease prevalence. Symptomatic plants were collected from various leguminous hosts, including faba bean, kholar bean, lima bean, common bean, purple-streaked common bean, and yard-long bean. A total of 22 putative fungal isolates were obtained and tentatively identified as *Fusarium* spp. based on morphological and cultural characteristics. *In vitro* screening of *Trichoderma reesei* against the 22 *Fusarium* isolates revealed significant antagonistic potential, with the highest inhibition rate (85.11%) observed against the isolate ECBPST. Molecular characterization of five highly virulent isolates confirmed their identity as *Fusarium oxysporum* and *Fusarium foetens*. Pathogenicity tests on these five isolates successfully fulfilled Koch's postulates, confirming their role as causal agents of the disease. To develop a sustainable management strategy, a safe encapsulated product (EP) of *T. reesei*, designated "BioEncap," was formulated using biopolymers. The efficacy of BioEncap was evaluated both *in vitro* and *in vivo* on faba bean seeds through seed and soil treatment applications. The product was assessed for its ability to suppress the five virulent *Fusarium* isolates and promote plant growth. Results demonstrated that BioEncap applied at a 2.0% concentration significantly enhanced plant vigor index. *In vitro* assays showed that at a concentration of 400 µl, BioEncap achieved maximum inhibition (64.44%) against the isolate FOMKT-2, while the lowest inhibition (51.44%) was recorded against FOKB1 at 5 µl. These findings underscore the potential of *T. reesei* "BioEncap" as a dual-purpose biofungicide, effectively suppressing Fusarium wilt pathogens while simultaneously promoting plant growth. This encapsulated biocontrol agent represents a promising avenue for sustainable disease management in legume production systems.

Keywords: Bean, BioEncap, Fusarium wilt, Plant growth, *Trichoderma reseei*, Organic management.

Plenary Lectures

ACIAR's key agricultural research experiences on climate-resilient agri-food systems in South Asia with focus on plant disease management

Pratibha Singh

Regional Manager South Asia, Australian Center for International Agricultural Research

Australian Centre for International Agriculture Research (ACIAR) is an agency working as a part of Australia's foreign aid program. ACIAR funds research for development aiming to boost agriculture productivity, sustainability and food system resilience in partner countries. The ACIAR operational model of brokering and partnering science partnerships and investing in agricultural research for development has endured since the establishment of the agency in 1982. The work of ACIAR is organised into 4 regions of operation: Pacific, East and Southeast Asia, South Asia and Africa. Within each region, a varied program of research and capacity development, reflecting the priorities, challenges and opportunities shared within each region and those that are unique to individual countries. Research projects are designed and implemented collaboratively through bilateral and regional partnerships led by a commissioned organisation (such as an Australian university, CSIRO, state government agency or private firm) or an international agricultural research centre or partner-country research agency. In 2022, ACIAR released an impact assessment of about 200 research-for-development projects, which represented approximately 10% of total investment over 40 years. The assessment revealed a total benefit of A$64.4 billion from these projects, of which $25.2 billion can be attributed to ACIAR funding and $39.2 billion to partner funding.

In South Asia, ACIAR has a long history of research collaboration in improving crop productivity, forestry, fisheries, water use efficiency, soil health and policy reforms. Agricultural research priorities in South Asia are shifting towards climate resilience, sustainable intensification, livelihood diversification with improved nutrition, with a focus on technologies that enhance resource use efficiency with farming systems approach and address the needs of vulnerable populations. Gender equality and social inclusion is a focus in all the investments under the regional program. ACIAR played a significant role in promoting the use of molecular marker technologies in India's agriculture sector. ACIAR collaborated with Indian research institutions and agricultural experts to enhance crop breeding and genetic improvement programs in wheat and pulses. Mitigating the effects of stripe rust on wheat production in South Asia and eastern Africa through joint research multicounty project and capacity-building activities, ACIAR facilitated the adoption and implementation of molecular marker technologies. International Mungbean Improvement Network (IMIN) project aims to increase farmer income, systems productivity and food security by delivering high-yielding, disease and pest resistant mungbean varieties to smallholder farmers. These technologies enabled more efficient and precise crop breeding, leading to the development of improved varieties with desirable traits such as disease resistance, drought tolerance, and higher yields.

Recently, ACIAR responded through investing in international research partnership with CIMMYT to manage emerging disease of wheat blast in Bangladesh. In February 2016, Bangladesh experienced the first Asian outbreak of wheat blast, a devastating fungal disease caused by *Magnaporthe oryzae Triticum* (MoT) pathotype, affecting 15,000 hectares and reducing yields by up to 30% in affected areas. The disease is a persistent threat in Bangladesh, other parts of South Asia, South America and Sub-Saharan Africa. Continued monitoring and development and use of resistant wheat varieties are critical to managing the spread.

Impact of Climate Change on the Disease Spectrum of Cool-Season Food Legumes and Their Management

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Pulses are an important source of plant-based protein and play a crucial role in global food and nutritional security. Globally, pulses are cultivated on nearly 97 million hectares, producing about 96 million tonnes annually with an average productivity of ~0.98 t ha^{-1}, contributing significantly to the diets and livelihoods of millions of people, particularly in Asia and Africa. Cool-season food legumes such as chickpea, lentil, faba bean, and grasspea are important components of sustainable cropping systems due to their ability to improve soil fertility through biological nitrogen fixation. However, their productivity is increasingly threatened by several diseases whose epidemiology and distribution are being influenced by climate change.

The distribution and severity of these diseases vary across continents. In South Asia, *Fusarium* wilt, dry root rot, and collar rot are major constraints in chickpea production and commonly cause 15–35% yield losses, although severe outbreaks may result in near complete crop failure. In the West Asia and North Africa (WANA) region, wilt and root rot complexes affecting lentil and chickpea may cause 20–40% crop losses, particularly under stress-prone environments. In sub-Saharan Africa, charcoal rot (*Macrophomina phaseolina*) has emerged as a major constraint under drought conditions, while *Rhizoctonia solani* affects pulse crops in parts of Europe and North America. In addition to soil-borne pathogens, foliar and viral diseases such as Ascochyta blight, Stemphylium blight, rust, and viral diseases are also showing changes in their incidence and geographical distribution under changing climatic conditions.

Climate change, characterized by rising temperatures, erratic rainfall, and increased drought stress, is altering host–pathogen interactions and disease dynamics, facilitating the spread of pathogens into new agro-ecological zones. Evidence from disease surveillance and screening of international nurseries coordinated by ICARDA indicates increasing incidence of wilt and root rot diseases and change in disease spectrum and their races under stress conditions. Strengthening integrated disease management strategies, including resistant cultivars, improved agronomic practices, biological control, disease surveillance, and predictive disease modelling, will contribute to mitigate climate-driven disease risks and sustain pulse productivity.

Sustainable Mushroom Production Using Agrowaste: A Circular Bioeconomy Model

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In view of universal and pervasive energy shortage there is necessity to conserve it using efficient management of agro-wastes or resources. With novel processes recycling of crop-wastes enables efficient utilization. It is thus possible to conserve available natural resources and to recover useful products like fertilizers, fuel, feed etc., besides combating disposal problems and minimizing pollution. Mushroom cultivation using agro-wastes offers a promising option since it increases agricultural productivity and microbial food production. At rural level huge quantities of agro-wastes are available which serve as substrate for mushroom cultivation. Mushroom growing can be considered as a process of recycling these wastes efficiently and thus achieving several objectives namely conserving available natural resources, recovering useful products like food (microbial protein), and reducing post-harvest waste. The spent mushroom substrate (SMS) remaining after mushroom cultivation becomes useful for biogas production. The spent residue can also be used as biofertilizer being rich in nitrogen bases. Thus spent residue can be utilized as fertilizer, feed and soil conditioner, returning nutrients to the soil ecosystem. Further conversion to biogas produces energy and the digestate can be used as organic manure. Edible mushrooms like Agaricus, Lentinus, Pleurotus, Calocybe and Lentinula efficiently degrade lignocellulosic materials through enzymatic action, thereby transforming waste into protein-rich biomass. This bioprocess thus reduces pollution, promotes resource recycling and generates nutritious food. The circular bioeconomy model integrates waste utilization, sustainable production and value addition in a closed-loop system. Spent mushroom substrate is used as organic manure, soil conditioner, biofertilizer or feedstock for further bioprocesses.

Keywords: Agrowaste, bioeconomy, cultivation, mushroom, protein, sustainability

Natural Farming as a Strategy for Eco-Pathology and Sustainable Plant Disease Management

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The increasing limitations of chemical-intensive agriculture, including pesticide resistance, environmental degradation, and disruption of soil microbiomes, necessitate a paradigm shift toward ecologically grounded plant health management approaches. Eco-pathology, which emphasizes the role of ecological balance in disease dynamics, offers a holistic framework for understanding and managing plant diseases. In this context, natural farming emerges as a viable and sustainable strategy that aligns closely with eco-pathological principles. Natural farming systems prioritize the restoration and maintenance of soil biological health through the use of indigenous microbial inoculants (e.g., Jeevamrit, Beejamrit), organic amendments, and minimal external inputs. These practices enhance beneficial soil microbial diversity, suppress soil-borne pathogens, and improve nutrient cycling. By fostering a resilient agroecosystem, natural farming strengthens plant immune responses through mechanisms such as induced systemic resistance and improved rhizosphere interactions. Evidence from diverse agroecological settings indicates that natural farming practices can significantly reduce the incidence and severity of diseases such as wilt, root rot, and leaf spot in crops like rice, wheat, and vegetables. Additionally, increased on-farm biodiversity, including crop diversification and integration of livestock, contributes to ecological stability and natural pest and disease regulation. Despite its promise, challenges remain in terms of generating quantitative evidence on microbial dynamics, standardizing formulations, and scaling context-specific practices. This paper highlights the role of natural farming as a systems-based approach to plant disease management and underscores the need for interdisciplinary research integrating microbiology, plant pathology, and agroecology. In conclusion, natural farming provides a sustainable pathway for disease management by shifting the focus from pathogen control to ecosystem health, thereby contributing to resilient, climate-adaptive agricultural systems.

Innovations in Crop Health Management: Converging technologies towards climate resilience and Sustainable Agro-ecosystem.

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Climate induced stress have become an impending challenge globally on agro-ecologies impacting detrimentally intensification of cropping systems. These challenges are further compounded by rapid emergence and spread of plant pathogens and insect pests. Traditional disease management approaches have become increasingly insufficient to address these complex challenges. At this crossroad; plant pathology is evolving into a highly interdisciplinary field integrating digital technologies, molecular biology, ecological insights, and advanced sensor based technologies and this comprehensive synthesis explores how diverse technologies like digital plant pathology, smart surveillance systems, omics, and next- generation therapeutics, nanotechnology, microbiome research, climate resilience strategies would address these challenges. The integration of these domains offers transformative potential for sustainable crop protection, enhanced productivity, and global food security and safety by bridging technological gaps with ecological sustainability. Modern plant pathology provides a robust framework for managing current and future plant health challenges towards sustainable "One Health" era.

Keywords: Digital plant pathology; Smart surveillance; Omics; Nanotechnology; Root microbiome; Climate resilience; Mycotoxins; Food safety; Residue

Introduction

Food requirements are a basic need and its demand would be growing in future with food security and food safety being primary concerns globally. Agricultural production is increasingly decimated by plant diseases and pests by nearly 16 % and 18% respectively around the world (FAO, 2025); threatening food security, farmer livelihoods, and economic stability. The increasing complexities of agricultural ecosystems, driven by climate variability have intensified the frequency and severity of plant disease outbreaks. This had further led to increased consumption of synthetic molecules for crop health management under conventional plant protection strategies. This had lead to intensification of challenges related to resistance development, environmental degradation, and regulatory restrictions. In order to address the current challenges recent researches have been directed towards innovative, eco- friendly and smart management options equivocally emphasized upon by NITI aayog's through upscaling of chemical free farming practices by 2070.

Conventional input-intensive agriculture had led to the long-term impacts including degrading topsoil, declining groundwater levels and reduced biodiversity and requires to be replaced by safer and sustainable agriculture. In order to meet India's nutrition security in a climate-constrained scenario such measures are much needed (Gupta et al, 2021). Integrated, preventive and non chemical approaches to disease management had been referred to as first

line of defense in plant protection. Therefore, integrated technology-driven discipline would open new avenues for precise, efficient, and sustainable disease management. This paper pinpoints key challenges and strategies of plant pathology and highlights their roles in building resilient agricultural systems towards holistic "One health" approach.

Climate lead Challenges in Plant Health:

As per the current reports along with other climatic parameters like atmospheric CO_2 global temperature has risen by 1.9 ªC; having multifaceted impacts including those on host, parasite and their interactions. These climatic shifts alters disease and pest patterns, leading to secondary resurgence of fungal pathogens like *Fusarium spp* and *Alternaria spp* in diverse field and horticultural crop and some of them even posing risk to human health.

Particular outbreaks of Fusarium head blight in wheat in new geographical locations are noteworthy. Shifts to more aggressive species in warmer conditions are particularly challenging in tropical countries like India which is basically an agrarian economy. Along with it comes the food safety issue as it produces mycotoxins "deoxynivalenol (DON) that can make the food unfit for human and animal consumption. Reports even suggest that drought and thermal stress can induce susceptibility to *Macrophomina spp* in chickpea leading to increasing threat of production losses due to this disease. Likewise, in rice reports suggests increased susceptibility to bacterial blight disease under warm temperatures.

Warming temperature supplemented with high moisture regimes have also lead to increased incidence of *Alternaria* spp in field and horticultural crops like apple, berries , citrus, tomato etc (Chen et al; 2025). Additionally, the host range of these species has widened and more and more new crops are harboring this pathogen. Subsequently, consumption of systemic synthetic molecules has increased leading to residue concerns particularly in horticultural crops.

Emergence of aggressive race of *Fusarium oxysporum* f sp *cubense* raceTR4 in banana is also a major threat to banana industry. These challenges are even intensified by presence of nematodes and abiotic stresses which requires innovative, technology driven, strategic, and policy interventions for sustaining production in the region. There are numerous examples like *Phytophthora*-potato, *Alternaria* -mustard where thermal stress lead to increased disease severity (Sinha et al., 2021).

Amongst the far reaching consequences of climate lead changes it has had lead to migration of pathogens to new locations or adaptation and evolution into more aggressive forms which may increase diseases in crop leading to crop losses. Residue concerns and food safety issues due to mycotoxins production may follow as it long term fallouts. Such situations necessitate formulating sustainable strategies for being future ready.

Strategies and Way forward:

In order to meet these challenges innovative, long-term, strategic interventions are required with close knit institutional linkages. Some of these interventions could be as follows.

1. Smart Surveillance Systems

Smart surveillance integrates digital technologies with epidemiological modeling to monitor and predict disease outbreaks. Internet of Things (IoT)-enabled sensors collect real- time data on environmental parameters such as temperature, humidity, and soil moisture, which influence pathogen development. Geographic Information Systems (GIS) and spatial analytics are used to map disease distribution and identify hotspots. Predictive models, driven by historical and real-time data, provide early warning systems that enable proactive disease management. These systems are particularly valuable in managing transboundary pests and diseases, where timely intervention is critical.

2. Digital Plant Pathology

Digital plant pathology represents a transformative approach that leverages artificial intelligence (AI), machine learning (ML), and big data analytics to improve disease diagnosis and management. Image-based disease detection systems, powered by deep learning algorithms, enable rapid and accurate identification of plant diseases using smartphone applications and field-deployable devices. Remote sensing technologies, including drones and satellite imagery, allow large-scale monitoring of crop health by detecting physiological changes associated with disease onset. These tools facilitate early intervention, reducing crop losses and minimizing input costs. Additionally, cloud-based platforms enable real-time data sharing and decision support systems, empowering farmers and extension services with actionable insights. Products like "Automated Crop Management System" developed by Bihar Agricultural University could provide early intervention and with precision in holistic manner. Use of unmanned aerial vehicles in disease management have gained acceptance in crops like makhana where navigating through crops are challenging.

3. Omics and Next generation Therapeutics

Understanding of plant–pathogen interactions at the molecular level have recently been revolutionarised by advent of omics technologies. Genomics enables the identification of resistance genes and pathogen virulence factors, facilitating the development of resistant crop varieties through breeding and genetic engineering. Transcriptomics provides precise insights into gene expression dynamics during infection, revealing defense mechanisms and pathogen strategies. Proteomics and metabolomics further elucidate the biochemical processes underlying plant responses to pathogens (Jain et al, 2024). The integration of multi- omics data with artificial intelligence supports the development of precision plant protection strategies and accelerates the discovery of novel targets for disease control.

RNA interference (RNAi)-based technologies enable the silencing of specific pathogen genes, providing highly targeted and environment friendly disease management options. CRISPR/Cas-based genome editing allows precise modification of plant genomes to enhance resistance against pathogens. These technologies would facilitate the development of durable resistance without the introduction of foreign genes thereby, addressing major public concerns around genetically modified organisms.

4. Nanotechnology

Innovations through use of nanotechnology for improving the efficiency and sustainability of novel molecules in plant health management are being greatly explored in

recent times. Nanopesticides provide controlled release and targeted delivery of active ingredients, reducing the quantity of chemicals required and minimizing environmental impact. Deployment of nanosensors and e-nose technology for rapid and sensitive detection of pathogens, toxins, and stress signals in plants offers enhanced diagnostic capabilities and support real-time monitoring of crop health. Additionally, green synthesized nanomaterials can boost plant defense mechanisms by imparting protection. However, the extent of application of these technologies requires rigorous evaluations.

6. Microbes in Plant Health

The root microbiome plays a crucial role in plant health and Induced resistance. Beneficial microorganisms in the rhizosphere contribute to nutrient uptake, growth promotion, and suppression of soil-borne pathogens. Advances in microbiome research have enabled the identification and development of synthetic microbial communities for broader agricultural goals (Yousaf et al, 2025). Bio-inoculants and microbial consortia are increasingly being used to enhance soil health and plant resilience along with suppression of soil borne pathogens and proved to be a sustainable means of plant health management.

7. Climate Resilience in Plant Pathology

Climate change is altering the dynamics of plant diseases by influencing pathogen distribution, host susceptibility, and environmental conditions. Rising temperatures and changing precipitation patterns create favorable conditions for the emergence and spread of new diseases as referred earlier. Climate-resilient strategies include the development of thermo-tolerant resistant crop varieties, predictive modeling, and adaptive management practices. Integrating climate data into disease forecasting systems enhances preparedness and response capabilities to optimize production gains.

8. Mycotoxins and Food Safety

Mycotoxins produced by fungal pathogens pose significant risks to food safety and animal and human health through contaminated cereals and nuts. Advanced detection methods, including biosensors and molecular diagnostics, enable rapid and accurate identification of mycotoxins. Integrated management practices, including pre- and post- harvest interventions, are essential to minimize contamination.

9. Global Biosecurity

Globalization and trade have increased the risk of transboundary movement of pests and pathogens. Strengthening biosecurity measures is critical to prevent the introduction and spread of invasive species that can endangers native ecologies. Advanced diagnostic tools, surveillance systems, and regulatory frameworks are essential components for effectively combating biosecurity threats. International collaboration and information sharing further enhance global preparedness.

10. Integrated disease management

Integrated disease management (IPM) employs multiple strategies to effectively manage diseases resulting in sustainable crop protection. This approach combines biological,

cultural, mechanical and chemical methods within a precision agriculture framework. Decision support systems guided optimal utilization of resources, timing and application of interventions, reducing input costs and environmental impact. Crop rotation, resistant varieties, and habitat management further enhance the effectiveness of integrated management strategies. It exploits resistant varieties, bio-control and bio-rational approaches as the first line of defense and relies on chemicals as the last measure for disease management. Such measures integrating with climate resilience would enable sustainability in agricultural landscape.

Conclusion

The challenges of disease in plants in light of climate driven vagaries are immense and its mitigation is the need of the hour. The integration of digital technologies, molecular innovations, and ecological approaches would play a key role in transforming plant pathology into a dynamic and interdisciplinary field. These advancements would provide powerful tools for sustainable crop protection and resilience against emerging challenges. Future researches should focus on the scalability and accessibility of these technologies, particularly for smallholder farmers. Strengthening collaboration among scientists, policymakers, and stakeholders will be essential to translate these innovations into practical solutions for current goals of climate resilient agriculture.

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Monitoring and tackling Maize Lethal Necrosis (MLN) in Eastern and Southern Africa from 2014 to 2025

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Maize (*Zea mays* L.) is a critical staple crop and economic resource in sub-Saharan Africa (SSA), cultivated on over 35million hectares and yielding more than 70 million metric tons (MMT) annually, primarily within smallholder farming systems. Maize Lethal Necrosis (MLN), first reported in Kenya in 2011, has since emerged as a major threat to maize production in eastern Africa. MLN results from the synergistic interaction between Maize Chlorotic Mottle Virus (MCMV) and Sugarcane Mosaic Virus (SCMV), both prevalent in the region. Most commercial maize hybrids are highly susceptible to MLN, which spreads rapidly through insect vectors and contaminated seeds, threatening food security and livelihoods. Over the past decade, CIMMYT, in collaboration with global and national partners, has implemented effective plant health strategies to combat MLN. Surveillance data from 2013-2023 indicate that MCMV incidence reached nearly 20% in eastern Africa in 2023, raising concerns over its continued spread. More than 18,735 surveillance data points have been collected and published on the MLN web portal, covering Kenya, Ethiopia, Uganda, Rwanda, Tanzania, Malawi, Zambia, and Zimbabwe. Rwanda contributed the highest number of entries (6,733), while 6,904 and 11,831 samples were recorded from southern and eastern Africa, respectively. A robust network of collaborators has been trained in MLN diagnostics using immunostrip and ELISA-based assays, facilitating cost-effective, rapid, and reliable disease detection in field conditions. The collected data was systematically recorded using ODK tools and uploaded to the MLN web portal, ensuring accessibility and transparency for stakeholders. This surveillance initiative demonstrates the effectiveness of leveraging digital tools, standardized diagnostic protocols, and strong multi-institutional partnerships in monitoring and managing viral maize diseases. By strengthening disease surveillance and response strategies, these efforts contribute significantly to sustaining maize production and improving food security in SSA.

Towards Resilient Crop Health: Leveraging Pathogen Intelligence for Durable Resistance

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Durable disease resistance remains a central challenge in crop improvement, particularly as rapidly evolving pathogens continue to overcome major resistance genes. This keynote presents a pathogen-intelligent framework that emphasizes understanding pathogen evolution, population structure, and molecular determinants of virulence as a foundation for designing long-lasting disease resistance in crops. Using the *Xanthomonas oryzae*-rice system as an example, the talk will illustrate how pathogen genomics, effector diversity, and monitoring data can inform predictive resistance deployment. These insights highlight the value of linking surveillance data with breeding pipelines to anticipate pathogen adaptation rather than react to resistance breakdown. By placing pathogen biology at the center of resistance engineering, this framework provides a scalable paradigm applicable across diverse patho-systems and offers a scalable approach for designing resilience in crops and staying ahead of rapidly evolving plant pathogens.

Research Interest: Microbial genomics, pathogen biology, host plant resistance, tailored crop solutions, Biopesticides for sustainable Agriculture: Current scenario, challenges and future prospects

Begomovirus complex in pulse cropping systems: diversity, epidemiology, and crop-weed interactions

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Keywords: Begomovirus complex; pulse crops; yellow mosaic disease; Bemisia tabaci; MYMV; MYMIV

The begomovirus complex comprises a diverse group of plant viruses (genus *Begomovirus*; family *Geminiviridae*), currently represented by 463 species worldwide. Begomoviruses possess circular single-stranded DNA genomes (monopartite or bipartite), often associated with ~0.7-1.4 kb satellite molecules. The term "begomovirus complex" describes the coexistence of multiple related begomovirus species and strains contributing collectively to disease incidence in cropping systems. These viruses are transmitted by the whitefly (*Bemisia tabaci*) in a persistent circulative manner. In pulse crops, a phylogenetically distinct group of begomoviruses, referred to as legumoviruses, cause yellow mosaic disease (YMD). Globally, 13 legumoviruses have been reported; of which nine occur in India. Apart from this, several non-legume-adapted begomoviruses, especially from the leaf curl virus (LCV) complex, are increasingly reported in pulse crops, indicating host expansion and cross-infection. Viruses such as Tomato leaf curl New Delhi virus (ToLCNDV) and Tomato yellow leaf curl virus (ToLCV) infect cowpea and pigeonpea, while other leaf curl viruses affect French bean, pigeonpea, and lentil. Additionally, Tobacco curly shoot virus and French bean leaf curl virus have been identified in French bean. A novel deltasatellite has also been reported in association with cabbage leaf curl virus in cowpea and urdbean.

In a multi-year surveillance study conducted at Kanpur investigated the molecular epidemiology of begomoviruses in pulse and weed hosts, PCR-based diagnostics aided by RCA detected seven of the nine known legumoviruses in different pulse crops, with Mungbean yellow mosaic India virus predominating, followed by Mungbean yellow mosaic virus and Dolichos yellow mosaic virus. Horsegram yellow mosaic virus was also detected and showed recombination with other legumoviruses in pulse hosts. Weed hosts such as *Phyllanthus urinaria*, *Parthenium hysterophorus*, and *Euphorbia hirta* were identified to act as prominent reservoirs of legumoviruses. Three viruses Cajanus scarabaeoides yellow mosaic virus, Rhynchosia yellow mosaic virus, and Butterfly pea yellow mosaic virus, were detected for the first time at Kanpur. Phylogenetic and recombination analyses revealed host- and season-associated clustering within MYMIV populations and evidence of virus exchange between pulse crops and weeds, highlighting the role of crop-weed interactions in shaping the epidemiology and impact of the begomovirus complex in pulse cropping systems. Also, begomoviruses viz. ToLCNDV, ToLCV, French bean leaf curl virus, Tomato leaf curl Gujarat virus, and betasatellites namely Tomato leaf curl Joydebpur betasatellite and Papaya leaf curl beta satellite were identified in pulses. The epidemiology of the begomovirus complex is shaped by whitefly population dynamics, favourable environmental conditions, and the availability of alternate host plants, particularly weeds that act as reservoirs between cropping seasons. The rising incidence of both YMD and leaf curl associated begomoviruses affects the pulse crops production and productivity. This also leads to virus evolution, recombination, and the emergence of new strains, with significant implications for disease epidemiology and management.

Innovative Breeding Techniques for Enhanced Resistance to Diseases in Wheat and Rice

Daisy Basandrai, Ankit Kumar Keshari, Pramod K. Rai and Ashwani K. Basandrai

Plant diseases are a major constraint to global food and nutritional security, causing substantial yield losses in major crops such as wheat and rice that may reach 20–40% annually and even higher during severe epidemics. Although chemical pesticides have been widely used for rapid disease control, their excessive and indiscriminate application has raised concerns regarding environmental pollution, human health risks, pathogen resistance, and adverse effects on non-target organisms. Consequently, host plant resistance has emerged as one of the most reliable, cost-effective, and environmentally sustainable components of integrated disease management. Conventional breeding has contributed significantly to the development of resistant cultivars through the identification and utilization of resistance sources from landraces, wild relatives, and germplasm collections followed by hybridization and backcrossing with elite cultivars. However, these approaches are often limited by long breeding cycles, linkage drag, narrow genetic diversity of resistance sources, and the rapid evolution of new pathogen races capable of overcoming deployed resistance genes. Therefore, integration of conventional breeding with modern molecular and genomic tools has become essential for developing durable and broad-spectrum disease resistance in wheat and rice.

Plant disease resistance is governed by a complex genetic architecture involving both qualitative and quantitative components. Major resistance (R) genes generally confer race-specific resistance based on gene-for-gene interactions between plant resistance genes and pathogen avirulence genes. Many of these genes encode nucleotide-binding leucine-rich repeat (NLR) proteins that recognize pathogen effectors and activate plant defense responses. These responses may include hypersensitive cell death, production of reactive oxygen species, and activation of pathogenesis-related proteins. However, quantitative or horizontal resistance is controlled by multiple minor genes or quantitative trait loci (QTLs), each contributing small effects. Such resistance is often considered more durable because it exerts lower selection pressure on pathogen populations and is associated with enhanced basal defense mechanisms.

Recent advances in molecular genetics and genomics have enabled precise identification and manipulation of genes associated with disease resistance. In wheat and rice, several resistance genes and quantitative trait loci (QTLs) associated with resistance to major diseases such as blast, rusts, bacterial blight, and sheath blight have been successfully identified and utilized through modern breeding strategies.Marker-assisted breeding (MAB), including marker-assisted selection and marker-assisted backcrossing, has greatly enhanced the efficiency of transferring resistance genes into elite cultivars. Gene pyramiding using molecular markers has become a key strategy to develop cultivars with durable resistance by combining multiple resistance genes in a single genotype. Successful examples include the introgression of bacterial blight resistance genes such as *xa13 and Xa21* into elite rice cultivars Pusa Basmati 1 and *Xa21, xa13, and xa5* in Samba Mahsuri, which lead to improved lines without compromising grain quality and yield.

Genome editing technologies, particularly CRISPR/Cas systems, have further revolutionized crop improvement by enabling precise modification of genes involved in disease susceptibility and defense regulation. Editing susceptibility genes has emerged as a promising strategy to achieve durable resistance. For instance, disruption of the mlo gene in barley has provided long-lasting resistance to powdery mildew, and similar approaches are being explored in wheat and rice. Additionally, modification of promoter regions of susceptibility genes such as SWEET genes has been used to confer resistance against bacterial pathogens like *Xanthomonas*. Emerging strategies such as structure-guided engineering of immune receptors, particularly NLR proteins, also offer new opportunities to expand pathogen recognition and improve resistance durability.

Genomic selection (GS) represents another powerful breeding approach that uses genome-wide marker information to predict breeding values for complex traits such as disease resistance. Unlike marker-assisted selection that focuses on a limited number of loci, genomic selection captures the cumulative effects of numerous small-effect genes and genotype × environment interactions. This approach enables early selection of superior genotypes, thereby accelerating breeding cycles and enhancing genetic gain in wheat and rice breeding programs.

Furthermore, complementary innovations such as speed breeding and doubled haploid technology are accelerating the development of improved crop varieties. Speed breeding utilizes controlled environmental conditions and extended photoperiods to produce multiple generations per year, while doubled haploid techniques facilitate the rapid production of completely homozygous lines. The integration of these approaches with molecular breeding and genome editing tools has the potential to significantly shorten the time required to develop disease-resistant cultivars.

Innovative breeding techniques are transforming the development of disease-resistant wheat and rice by improving the precision, efficiency, and durability of resistance. Integrating conventional breeding with advanced molecular and genomic tools helps overcome challenges such as linkage drag, limited genetic diversity, and resistance breakdown. Strategic use of gene pyramiding, genome editing, genomic selection, and accelerated breeding systems will be essential for developing resilient varieties capable of coping with evolving disease pressures and ensuring sustainable crop production and global food security.

Role Of Genomics For Detection Of Plant Pathogens In Quarantine

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The global trade of agricultural commodities and exchange of germplasm will continue to have transboundary movement of pests including pathogens which may pose potential risk to the agriculture of importing country. The National Plant Protection Organizations have the responsibility to protect their agriculture from transboundary pests. Therefore, plant quarantine assumes special importance in safe trade/ exchange of plant genetic resources (PGR). In India, the Directorate of Plant Protection, Quarantine and Storage under the Ministry of Agriculture and Farmers' Welfare is responsible for enforcing quarantine regulations and for quarantine inspection and disinfection/ disinfestation of commodities meant for commercial purpose. The ICAR-National Bureau of Plant Genetic Resources, the nodal institution for management of PGR has been empowered under the Plant Quarantine (Regulation of Import into India) Order 2003, under the Destructive Insects and Pests Act, 1914, to undertake quarantine processing of germplasm including transgenics imported for research purposes by both public and private sectors. As per the PQ Order, >1200 pests are regulated pests which are of quarantine significance for India. The PQ Order, 2003 requires *Additional Declarations* to be included in the Phytosanitary Certificate for seeds and other planting material as free from pests. Early, sensitive and accurate diagnosis is necessary for detection of pests in quarantine. The technique should be reliable for quarantine requirements, reproducible within statistical limits, economical and should be rapid. The challenges in pest detection include availability of reference material, antisera, pests genome sequences in GenBank, detecting an unknown pathogen etc. Attention is now given to high throughput sequencing to detect unknown pathogens. Adopting a strategy of visual examination, post-entry quarantine growing/inspection followed by use of pest-specific conventional, serological and molecular detection techniques, several pests of great economic and quarantine importance were intercepted in imported germplasm including transgenics in the last three decades. The interceptions include >100 pests including 29 pathogens not yet reported from India and not known to occur on particular host(s) in India. India need to establish a strong network of interconnected accredited laboratories to quickly diagnose new pests/pathotypes/biotypes/strains and enhance surveillance capacity to identify new pests. This makes it imperative that India should put in place a "National Plant Pests Diagnostic Network" to enhance preparedness. By closely monitoring which pests are most frequently reported from which countries, and what plant material tend to be infested/infected, it may be possible to predict high-risk pests and crops. Also, genomics would help in continuous surveillance, rapid diagnosis and real-time tracking of global movement of pathogens. Machine learning and AI algorithms can be leveraged to analyse large-scale genomic data sets and predict disease outbreaks based on environmental and epidemiological factors. Following the quarantine regulations strictly and adopting the reliable, repeatable, reproducible and sensitive diagnostics would ensure crop biosecurity against exotic pests including pathogens.

Arsenic in rice: Approaches to reduce the arsenic level in grains

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Rice (Oryza sativa L.) serves as a primary dietary staple for a significant portion of the global population. However, the accumulation of arsenic (As)—a potent carcinogen—in rice grains poses a severe threat to food safety, particularly in Asian countries where paddy soil contamination is prevalent. This study explores multi-faceted genetic approaches to minimize arsenic translocation and enhance grain safety.

First, we characterized a novel arsenic methyltransferase gene isolated from the soil fungus Westerdykella aurantiaca. Heterologous expression of this gene in rice facilitated the conversion of toxic inorganic arsenicals into methylated species, significantly reducing total arsenic levels in the grain. Second, we targeted the endogenous transport systems responsible for arsenic uptake and phloem loading, specifically focusing on the OsINT gene alongside known transporters such as Lsi1, Lsi2, NRAMP, and NIP3;1.

Utilizing the CRISPR/Cas9 system, we generated precise knock-out lines of OsINT to disrupt the pathways associated with arsenic sequestration. Phenotypic and molecular evaluations of these edited lines demonstrate a significant reduction in arsenic accumulation without compromising essential agronomic traits. These findings provide critical insights into the molecular mechanisms of arsenic transport in rice and offer a robust framework for developing low-arsenic cultivars to safeguard public health.

Seed and Seedling root treatment with an endophyte for deployment in large grower fields Deployment of bio- / biocontrol agents in large grower fields

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Adoption of microbial inoculants has surged sustainable agriculture and ecosystem restoration, and while certain limitations remain, innovative practices such as seed bio-priming and seedling treatment with beneficial microbes offer promising ways to overcome these challenges. Seed treatment is simplest and widely used in agriculture as an effective means to alleviate biotic and abiotic stresses, thus enhancing crop growth and yield. Seed treatments while easy to perform in small plot experiments / small scale field trials but are difficult for large scale deployment in growers' fields because of the volume of seed requiring treatment (seed coating of the introduced bio-agent is uneven and treating bulk of seed is labour intensive and time consuming). Using the microbial inoculum infused solid matrix (*Trichoderma virens* BARC G2 mutant (extensively field-tested against collar rot incidence in chickpea and increased yield by 20%)) we developed a spray inoculation technique for seed biopriming which improved microbial survival on coating materials (e.g., carriers and binders) thus improving the colonization in root rhizosphere in turn improved the performance/of the target crop. Seedling root treatment are difficult for large scale deployment in growers' fields because of the volume of seedling and root biomass requiring treatment. We solved this issue through the innovative use of rice nursery seedlings that are tied in small bundles following uprooting to inoculate the *P. fluorescens* strain 9704. Transplanting endophyte-inoculated rice seedlings in repeated field experiments increased yield by 20%. These two could be an effective method of deploying other biocontrol agents in large-scale field experiments.

LEAD LECTURES

Innovation-Driven Development in Crop Protection under Agriculture 4.0

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India's agriculture sector contributes nearly 18 percent to the national Gross Domestic Product and provides employment to more than 55 percent of the population. However, increasing population pressure, climate variability, declining soil health, and the growing demand for food pose major challenges to sustainable crop production. It is estimated that global food demand will increase by nearly 70 percent by 2050, requiring innovative and efficient agricultural systems. Agriculture 4.0 provides a promising pathway to address these challenges by integrating digital tools and intelligent decision-making systems into farming operations Agriculture is undergoing a profound transformation with the emergence of digital technologies and smart farming practices collectively known as Agriculture 4.0. This new phase of agricultural development integrates advanced technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), robotics, sensors, drones, and data analytics to enhance productivity, sustainability, and resource efficiency. In the context of crop protection, these innovations are redefining traditional practices by enabling precise monitoring, early detection of pests and diseases, and optimized application of agricultural inputs. The shift towards technology-driven crop protection is particularly important in countries like India, where agriculture contributes significantly to the national economy and supports the livelihoods of a large portion of the population. One of the most significant components of Agriculture 4.0 is the application of IoT technologies in farming systems. IoT-based sensors and smart devices enable real-time monitoring of soil moisture, temperature, humidity, and crop health conditions. These technologies provide farmers with accurate field-level data, which helps in making informed decisions regarding irrigation, pest management, and nutrient application. The integration of IoT with automated systems also reduces guesswork in farming and improves resource utilization, ultimately leading to higher productivity and improved crop protection outcomes. Artificial Intelligence further enhances the efficiency of modern crop protection strategies. AI- based models analyze large datasets collected from sensors, drones, and satellite imagery to identify patterns and predict potential threats such as pest infestations or disease outbreaks. AI- powered drones and imaging systems can scan large agricultural fields with high precision and detect early signs of plant stress or infection. This early detection allows farmers to take preventive measures before the damage becomes severe, thereby reducing crop losses and minimizing excessive pesticide use. Another important advancement within Agriculture 4.0 is the development of smart irrigation and precision spraying technologies. Smart irrigation systems use sensor data and weather forecasting models to supply the optimal amount of water required by crops at the right time. Similarly, automated spraying technologies equipped with GPS, sensors, and drones ensure targeted application of pesticides and fertilizers. These precision technologies help reduce chemical usage, minimize environmental pollution, and promote sustainable agricultural practices. In addition to digital innovations, biological technologies are also gaining importance in modern crop protection. Microbial-based solutions and bio-input technologies enhance nutrient uptake, improve soil microbial activity, and support plant health, thereby reducing dependence on synthetic chemicals. Farmers adopting such integrated approaches have reported healthier crops, improved yields, and production of safer food. The economic potential of technology-driven agriculture is also significant. The Indian agriculture market, valued at approximately USD 457 billion in 2023, is projected to grow substantially in the coming years due to increased technological adoption and innovation. As Agriculture 4.0 continues to evolve, the integration of digital technologies, automation, and biological solutions will play a crucial role in ensuring sustainable crop protection and global food security. In conclusion, innovation-driven agricultural technologies are transforming crop protection systems by enabling precision farming, improving decision-making, and promoting environmental sustainability. Embracing these advancements will be essential for developing resilient agricultural systems capable of meeting future food demands while protecting natural resources.

Nano Emulsion of Diallyl Disulphide and Bioagents Enhanced Defense Mechanism in Yard Long Bean Against Vascular Wilt Incited By *Fusarium oxysporum* and Enhanced Yield

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Fusarium oxysporum is a versatile, seed and soil borne fungus with wide host range. Yard long bean (*Vigna unguiculata* subsp. *sesquipedalis* Verdcort) is the most popular and common vegetable crop of Kerala. Vascular wilt incited by *Fusarium oxysporum* results in 70-100 crop loss. Thus, the present study was aimed to develop an eco-friendly, integrated disease management package against vascular wilt and black aphid. Sowing of seeds in soil applied with 5g arbuscular mycorrhizal fungi (KAU) per seed resulted in cent per cent germination, enhanced shoot and root growth along with tolerance to wilt infection, as evidenced by absence of wilt incidence in seedlings. Diallyl disulphide (DADS) was identified as the major pesticidal principle in the bulbs of garlic (*Allium sativum*) by GC-MS and 0.30% of DADS was revealed to have antifungal potential. A nano emulsion of DADS was developed and *in vitro* studies revealed that 1.50 per cent of nano emulsion possessed excellent antifungal potential against *F. oxysporum*, *Rhizoctonia solani* (collar rot) and *Sclerotium rolfsii* (stem blight) and insecticidal activity (black aphid and pulse beetle). Two pot culture and field studies were undertaken during 2024 to 2025 using the identified integrated package *viz*., soil drenching of nano emulsion of DADS followed by plastering, application of *Trichoderma* enriched in cowdung - neemcake mixture (9:1 ratio), transplanting of yard long bean seedlings treated with AMF (5g/seed) and soil drenching of PGPR mix II (20g l^{-1}) at 20, 40, 60 and 80 days after sowing which enhanced pod yield (2.35 kg plant $^{-1}$) compared to control (0.355 kg) with reduced disease incidence (11%) compared to control (33.33%). The activity of defense related enzymes *viz*., PO, PPO and Pal was enhanced and the presence of thickened cell walls and tyloses was confirmed in treated plants upon scanning electron microscopy, restricting pathogen entry and infection.

An insight into the plant's susceptibility to disease after spray application of Propiconazole and Bacillus subtilis-NBRIW9

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The sustainability of agro-ecosystems is increasingly challenged by chemical inputs, and plant pathogens, necessitating integrated biological approaches for crop protection and soil health. This study gives insights on microbial interventions and environmental stressors affecting plant–microbe interactions in tomato systems. Foliar application of the fungicide propiconazole significantly alters the composition and diversity of endophytic bacterial communities, potentially disrupting beneficial plant–microbe associations. In contrast, Bacillus subtilis NBRI-W9 demonstrates a strong capacity to restore microbiome balance and counteract fungicide-induced dysbiosis. Outcomes show that systemic chemicals are a potential threat to the non-target endophytes and that plants became susceptible to disease on decline of endophytes. The strain not only reshapes metabolic homeostasis altered by chemical stress but also enhances plant defense through coordinated activation of systemic acquired resistance (SAR) and induced systemic resistance (ISR). This dual activation provides robust protection against Fusarium, resulting in reduced wilt severity and improved plant vigor. Additionally, NBRI-W9 confers sustainable immunity against non-target bacterial pathogens by modulating key metabolic and defense pathways. In W9 treatment, a significant increase in relative abundance of several metabolites was observed including sugars, sugar alcohols, fatty-acids, organic-acids, and amino-acids. Polysaccharides and fatty acids showed a significant positive correlation with beneficial microbes. The combined evidence highlights that while chemical fungicides may offer immediate disease control, they can have unintended consequences on plant-associated microbiota and metabolic stability. In contrast, microbial biofungicides such as NBRI-W9 provide a holistic and eco-friendly alternative by simultaneously promoting plant health, restoring microbial equilibrium, and strengthening innate immunity.

Recent Advances in Post-Harvest Disease Management of Mango and Their Significance in Export Promotion

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Mango is one of the most important tropical fruit crops and contributes significantly to the horticultural economy and export earnings of many mango-producing countries, including India. However, post-harvest diseases and improper handling practices pose major constraints to maintaining fruit quality, shelf life, and international market acceptability. Significant post-harvest losses, often ranging from 20–40% under normal conditions and even higher during humid and rainy seasons, are mainly caused by diseases such as anthracnose caused by *Colletotrichum gloeosporioides* and stem-end rot associated with pathogens like *Lasiodiplodia theobromae* and *Botryosphaeria dothidea*. These pathogens frequently establish latent infections in the orchard and become active during ripening, storage and transportation, resulting in fruit decay, blemishes, and rejection of export consignments. Effective post-harvest management is therefore essential to maintain fruit quality and enhance export potential. An integrated approach involving pre-harvest, harvest and post-harvest interventions has proven effective in minimizing losses. Pre-harvest practices such as orchard sanitation, canopy management, balanced nutrition and timely fungicidal sprays help reduce initial inoculum and latent infections. Proper harvesting techniques, including harvesting at physiological maturity, avoiding mechanical injury and maintaining field hygiene, play a crucial role in preserving fruit quality. Post-harvest treatments such as hot water treatment, fungicidal dips, biological control agents, and innovative technologies like metabisulfite wash and controlled storage conditions have shown promising results in suppressing disease development and extending shelf life. Additionally, improved packaging, cold chain management, and rapid transportation systems are critical components of the export supply chain. These practices help maintain fruit firmness, reduce physiological deterioration, and ensure compliance with international phytosanitary standards. Adoption of integrated post-harvest management strategies significantly reduces losses, enhances fruit quality, and improves market competitiveness. Consequently, effective post-harvest disease management not only safeguards the economic returns of mango growers but also strengthens the global export potential of mango from major producing regions.

Keywords: Post-Harvest Disease Management, Anthracnose, Stem end rot and latent infections

Kida Jadi: A Potential Medicinal Mushroom

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Cordyceps mushrooms are widely recognized as a rich source of bioactive compounds with significant medicinal value in modern healthcare. Species such as *Cordyceps militaris* and *Cordyceps sinensis* have been extensively researched because they contain important components like β-glucans, proteins, essential amino acids, vitamins and secondary metabolites such as cordycepin and phenolic antioxidants. These bioactive substances are responsible for various health benefits, including strengthening the immune system, reducing inflammation, showing anticancer effects, and inhibiting harmful microbes through different biological mechanisms. Due to the increasing prevalence of chronic and lifestyle-related diseases, there is a growing demand for natural and safer treatment options. In this regard, *Cordyceps* is gaining importance as a potential alternative or supportive therapy along with conventional medicines. *Cordyceps militaris* has shown notable effects in enhancing energy production, improving respiratory function, and boosting immune responses, mainly because of the presence of cordycepin and related compounds. It also helps in reducing fatigue, improving oxygen utilization, and maintaining overall body function. Advances in biotechnology, including better cultivation techniques and fermentation processes, have enabled large-scale production of *Cordyceps* with improved quality and consistency.

However, some limitations still remain, such as variation in the concentration of active compounds, low absorption in the body, lack of proper dosage standards, and limited clinical research. Therefore, more comprehensive studies combining molecular biology, pharmacology, and clinical trials are needed to confirm its safety and effectiveness. Overall, *Cordyceps* holds great promise as a natural and sustainable source for the development of functional foods, nutraceuticals, and new therapeutic products.

Keywords: *Cordyceps militaris*, *Cordyceps sinensis*, Cordycepin, β-glucans, Immunomodulation, Anticancer activity, Pharmacological potential

Invited lectures

AI-Powered Early Disease Detection in Plants: Progress, Challenges, and Prospects

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Artificial intelligence (AI) has rapidly evolved and is now widely used across multiple sectors, including healthcare, defense, marketing, and the automotive industry. In agriculture, AI offers significant potential to address key challenges, particularly in early plant disease detection. Traditionally, disease identification depends on visual inspection by farmers or experts, requiring substantial knowledge and experience. This process is labor-intensive, time-consuming, subjective, and difficult to scale over large farming areas.

To address these limitations, automated image-based plant disease detection systems have emerged as efficient and scalable solutions. These systems enhance speed, accuracy, and consistency in disease diagnosis. Conventional RGB image-based models can detect diseases at early visible stages, while advanced imaging technologies such as thermal, hyperspectral, and multispectral imaging enable pre-symptomatic detection by capturing subtle physiological and biochemical changes in plants.

The development of an effective disease detection system typically involves four main stages: image acquisition, image pre-processing, feature extraction, and classification. Image acquisition involves collecting diverse datasets using tools such as cameras, drones, and IoT-based sensors. Pre-processing improves image quality through noise reduction, normalization, and data augmentation. Feature extraction identifies important patterns within images, either manually or automatically. Finally, classification uses advanced machine learning and deep learning models—particularly convolutional neural networks (CNNs) and vision transformers (ViTs)—to accurately identify plant diseases. Recent approaches, including transfer learning, hybrid models, and self-supervised learning, have further improved performance while reducing reliance on large labeled datasets.

Public datasets such as PlantVillage and PlantCLEF have significantly contributed to research in this field. However, many of these datasets are created under controlled laboratory conditions, which limits their ability to generalize to real-world environments. Factors such as varying lighting conditions, occlusion, complex backgrounds, and variability within disease classes pose challenges for practical deployment.

Additional constraints include the lack of large-scale, standardized, and field-representative datasets, particularly for staple crops like cereals. Moreover, issues related to model interpretability, high computational requirements, and deployment on edge devices such as smartphones and drones hinder widespread adoption. Emerging solutions, including edge AI, federated learning, and multimodal data integration, are being explored to overcome these challenges.

Overall, greater collaboration among agricultural experts, AI researchers, and policymakers is essential to develop comprehensive datasets and robust, explainable models. Such efforts will improve real-world applicability, enable early disease detection, and support the advancement of sustainable and precision agriculture.

Cytogenomic-Assisted Pre-breeding Using Crop Wild Relatives and Parental Diploid Species for Genetic Diversification and Alternaria Blight Resistance in Brassica juncea

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Rapeseed–mustard is a major oilseed crop in India, yet domestic production remains insufficient to meet demand, necessitating continued imports. Brassica juncea, contributing over 95% of the total area and production among oilseed Brassicas, suffers from limited genetic diversity, constraining the development of high-yielding and stress-resilient cultivars. Crop wild relatives (CWRs), landraces, and diploid progenitors offer a rich reservoir of novel alleles for broadening the genetic base of this allotetraploid species. At ICAR–National Institute for Plant Biotechnology (NIPB), New Delhi, a diverse panel comprising diploid ancestors (B. rapa and B. nigra), landraces, and CWRs has been systematically evaluated for key agronomic and stress-resilience traits. Promising donor lines were utilized in wide hybridization programs to introgress desirable traits. To overcome pre- and post-fertilization barriers, innovative strategies including the use of a novel genotype, "NRCPB rapa 8," enabled successful in vivo hybrid seed development, minimizing reliance on embryo rescue. These efforts led to the development of 127 resynthesized B. juncea (RBJ) lines from parental diploid species and 156 alien introgression lines (ERJ) derived from Diplotaxis erucoides for genetic diversity as well as for different biotic and abiotic stresses including for Alternaria blight resistance. Additionally, transient synthetic amphidiploids were generated to facilitate further introgression targeting the new crop wild relatives to utilize in pre-breeding program. Comprehensive cytogenomic, molecular, and morphological characterization revealed enhanced genetic diversity, stable genome constitution, and valuable intergenomic recombination in selected lines. Advanced introgression lines developed by utilizing Diplotaxis erucoides, exhibited significant resistance to Alternaria leaf spot caused by Alternaria brassicae. Microscopic studies of host–pathogen interactions demonstrated restricted hyphal growth, delayed symptom development, and localized reactive oxygen species (ROS) accumulation in resistant lines, in contrast to rapid pathogen colonization in susceptible genotypes. These findings highlight the role of CWR-derived introgressions in conferring effective defense responses. Overall, this study underscores the potential of cytogenomic-assisted pre-breeding in harnessing CWRs and diploid progenitors to enhance genetic diversity and develop disease-resistant B. juncea lines, paving the way for sustainable genetic improvement and reduced dependency on oil imports.

Keywords: Brassica juncea, Alternaria brassicae, Introgression lines, Crop wild relatives

Harnessing Durum Wheat for Diversifying Rust Resistance in Wheat Improvement Programs

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Wheat rusts, caused by *Puccinia* graminis f. sp. *tritici* (stem rust) and *Puccinia triticina* (leaf rust), continue to pose serious threats to global wheat production. Durum wheat, occupying approximately 10% of India's wheat-growing area, plays a crucial role in maintaining genetic diversity for rust resistance. Notably, several Indian durum cultivars exhibit resistance to stem rust pathotypes of the race 40 group and leaf rust pathotypes of the race 77 group, which are highly virulent on many currently cultivated bread wheat varieties. In contrast, durum wheat often shows susceptibility to distinct race groups such as 117 (stem rust) and 104-2 (leaf rust), reflecting differential pathogen specialization between durum and bread wheat.

A panel of durum wheat genotypes was evaluated across multiple environments, including hotspot locations, under natural epiphytotic conditions. Significant variation in disease response was observed among genotypes and environments, indicating strong genotype × environment interactions. Pooled analysis identified 20 durum wheat lines as resistant, with Average Coefficient of Infection (ACI) values ranging from 0.00 to 3.64, demonstrating stable and high levels of resistance across locations and years. Several genotypes exhibited near-immune responses, while others consistently expressed moderately resistant reactions against both stem and leaf rust. Inheritance studies in selected resistant genotypes suggested the involvement of one or more effective resistance genes. Furthermore, the successful incorporation of genes such as Sr2 and Sr36 into durum backgrounds highlights its potential as a reservoir of valuable resistance alleles. The distinct pathogen specialization and independent evolution of resistance mechanisms in tetraploid wheat underscore the importance of conserving and promoting durum cultivation. Over-reliance on bread wheat alone may lead to erosion of critical resistance sources, thereby increasing vulnerability to emerging rust races.

The present study emphasizes that maintaining and utilizing the genetic diversity inherent in durum wheat is a strategic necessity for achieving durable rust resistance and ensuring long-term sustainability of wheat production systems.

Key words: durum, stem rust, leaf rust, resistance

Post-Flowering Stalk Rot Complex of Maize: Emerging Challenges and Integrated Management Strategies

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Maize (*Zea mays* L.) is a globally important cereal crop that plays a vital role in food, feed, and nutritional security. However, its productivity is increasingly threatened by several diseases, among which the **post-flowering stalk rot (PFSR) complex** has emerged as a major constraint in many maize-growing regions. The disease is caused by a complex of soil- and residue-borne pathogens, primarily including *Fusarium verticillioides*, *Macrophomina phaseolina*, *Colletotrichum graminicola*, and *Stenocarpella maydis*. Infection generally occurs after flowering, leading to premature senescence, stalk weakening, lodging, and poor grain filling, ultimately resulting in significant yield losses. The increasing incidence of PFSR in recent years is largely associated with changing climatic conditions, intensive cropping systems, moisture stress during grain filling, and imbalanced nutrient management. The disease is multifactorial in nature, where interactions among the pathogen complex, host genotype, and environmental conditions play a crucial role in disease development. Climate variability, particularly high temperatures and intermittent drought stress, further predisposes maize plants to infection and accelerates disease progression.

Effective management of the PFSR complex requires an integrated and climate-resilient approach. The use of resistant or tolerant hybrids, crop residue management, balanced fertilization, and timely irrigation to minimize plant stress are important cultural practices that help reduce disease incidence. In addition, seed treatment with beneficial microbes, application of biological control agents, and the use of eco-friendly botanicals offer promising options for sustainable disease management. Strengthening research on pathogen diversity, host resistance, and microbiome-based interventions will be crucial for developing resilient maize production systems and ensuring food security under changing agro-ecological conditions.

Keywords: Maize, Post Flowering Stalk Rot, Soil borne, Seed treatment, Management,

Molecular Biopesticides- The Future of Plant-Parasitic Nematode Management

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Plant-parasitic nematodes (PPNs) cause significant yield and economic losses to global agriculture. Their management is challenging due to their soil-borne, cryptic nature, persistence, and broad host range. Although conventional nematicides offer rapid suppression, they are increasingly being limited by regulatory and environmental restrictions. Cultural practices, biological control, and host resistance lack consistency, durability, or ease of implementation.

Molecular biopesticides are biologically derived, mechanism-based pest control agents, such as dsRNA, peptides, proteins, or defined natural metabolites, that act on specific molecular targets in the pest or pathogen. Recent advances in functional genomics have helped the discovery of newer and specific molecular targets. Principal microbial biopesticide-based approaches use double-stranded RNA (dsRNA), recombinant proteins and peptides, and defined bioactive secondary metabolites that target essential nematode genes, effectors, or physiological pathways with greater specificity than broad-spectrum chemicals. RNA interference (RNAi)-based strategies, such as host-delivered RNAi and non-transgenic exogenous dsRNA applications, show promise; however, dsRNA instability in soil remains a significant obstacle. Nanocarriers, including layered double hydroxides, silica- and carbon-based nanoparticles, chitosan derivatives, and protein nanoplatforms, may enhance dsRNA stability, delivery, and uptake. Additional promising candidates comprise recombinant nematotoxic proteins, such as Bt Cry proteins, lectins, proteases, and engineered fusion constructs, as well as metabolite-based nematicides, including avermectins, neem limonoids, and microbial lipopeptides.

The development of new delivery systems, efficacy testing protocols, and biosafety evaluations is shaping the future of nematode management. However, standardised comparisons, field validations, scalable manufacturing, and integration into integrated pest management (IPM) programs will be essential for translating these innovations into reliable tools for sustainable nematode management.

Keywords: Plant-parasitic nematodes; Molecular biopesticides; RNA interference (RNAi); dsRNA delivery systems; Nanocarriers / nano formulations; Integrated nematode management (IPM)

Integrated Farming Systems Approach for Ecofriendly Management of Crop Diseases

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Crop diseases continue to pose a major challenge to sustainable agricultural production in India, particularly under conditions of homogenized agricultural production systems, unbalanced crop nutrition, climate change, rising input costs, and increasing pressure on natural resources. Conventional disease management practices based primarily on chemical inputs are becoming less effective due to increased susceptibility of crop plant to pathogens, evolution of resistant biotypes of plant pathogens, environmental concerns etc. In this context, the **Integrated Farming Systems (IFS) approach** has emerged as a promising, eco-friendly, and economically viable solution for long-term plant health management. It integrates multiple farm enterprises such as field crops, horticultural crops, livestock, fisheries, mushroom production, secondary agriculture and other related components in a mutually supportive and resource-efficient manner. This integrated approach enhances biodiversity, encourages the recycling of biodegradable waste within the system, strengthens ecological balance, and reduces the risk of crop diseases by improving the resilience of the agro-ecosystem.

The most important strength of the Integrated Farming Systems (IFS) approach is **component diversification**, which plays a critical role in minimizing disease incidence and improving plant health. In traditional monocropping and homogenized agricultural production systems, continuous cultivation of the same crop or cropping sequence leads to the build-up of pathogens in the soil and environment, resulting in frequent outbreaks of crop diseases. In contrast, IFS promotes diversification through the integration of field crops, livestock, trees, fisheries, and other farm enterprises, which reduces the risk of occurrence of a particular disease, disrupts pathogen life cycles, and lowers their population in the agro-ecosystem. The inclusion of diverse components also improves nutrient recycling, soil biological activities, and organic matter content, thereby creating disease-suppressive soils. **Waste recycling is a core principle of IFS**, reducing dependence on market-based external inputs while strengthening synergistic interactions among farm enterprises and enhancing sustainability. Recycling biodegradable crop and livestock wastes increases soil organic carbon and beneficial microflora, thereby suppressing the development of many soil-borne plant pathogens.

Maintenance of balance within agro-ecosystem is the core principle of pest and disease regulation. Component diversification in farming system also contributes significantly to the maintenance of agro-biodiversity, which is one of the most effective natural strategies for disease management. Biodiversity strengthens ecosystem stability and improves resilience against biotic stresses such as pests and pathogens. Several natural enemies such as **predators, parasites, parasitoides, competitors, antibiotic producing microbes** are the part of biodiversity which regulates pests and diseases within the agro-ecosystem. The integration of field crops with horticultural crops, livestock-based systems, and vermicomposting units improves soil health and encourages the proliferation of beneficial microorganisms. These beneficial organisms suppress disease-causing pathogens through mechanisms such as competition, antibiosis, and parasitism. Thus biodiversity supports essential ecosystem services such as nutrient cycling, pollination, and biological control, all of which contribute to improved plant health and reduced crop disease incidence.

Another important dimension of the integrated farming system approach is **varietal diversification**, which acts as a key strategy for sustainable disease management. The use of **resistant crops, multilines and tolerant crop varieties** is one of the most effective and economical tools for managing crop diseases in India. There are several examples where resistant varieties have successfully been employed to manage major diseases such as bacterial leaf blight and blast in rice, rusts in wheat, red rot in sugarcane, late blight in potato, and wilt diseases in pulses. The use of diverse crop varieties reduces the chances of large-scale disease outbreaks because pathogens find it difficult to spread uniformly across genetically diverse crops. Varietal diversification also ensures stability in production systems, as some varieties may escape disease or tolerate adverse environmental conditions better than others. **Crop rotation, mixed cropping, intercropping,** etc. which are key strategy of species diversification, form the foundation of varietal diversification in farming systems. Crop rotation helps in breaking the life cycle of pathogens by including non-host crops in the cropping sequences. This practice not only reduces the inoculum load in the soil but also helpful in resuming soil fertility and improving its structure. Similarly, mixed cropping and intercropping reduce the spread of diseases by creating physical and biological barriers between plants. Mixed cropping is an outstanding feature of integrated, organic and natural farming systems, where different crops are grown simultaneously or sequentially on the same piece of land. Even if the main crop is affected by one disease, the companion crops help in compensating for yield losses and maintaining farm income.

The **integration of component diversification with varietal diversification** also enhances the development of disease-suppressive soils. The addition of organic manures, compost, vermicompost, biofertilizers, and microbial consortia improves soil microbial diversity, which plays a major role in suppressing soil-borne pathogens. Use of **beneficial microorganisms such as *Trichoderma*, *Pseudomonas fluorescens*, and *Bacillus subtilis* and concoctions such as jeevamrit** help in reducing seed and soil-borne diseases. **Organic amendments** such as neem cake and crop residues further enhance soil health and create conditions unfavourable for plant pathogens. Thus, diversified farming systems not only reduce the disease incidence, but also promote long-term soil sustainability of the system.

For maintenance of agro-biodiversity at the farm level, several practices are being followed. Some of such practices include boundary plantations, multi-storied cropping, and inclusion of tree species such as neem, ber, aonla, tamarind, Calotropis, drumstick, and other locally adapted species which contributes to the development of a balanced agro-ecosystem in the farming system. These plants **provide habitat and food sources for natural enemies of pests and pathogens**, including birds, predators, and beneficial insects. Such ecological balance reduces the dependence on chemical pesticides and enhances natural disease suppression mechanisms. Thus, the integrated farming is a way to promote "**One Health Approach**" where the health of plants, animals, soil, and humans is interconnected and mutually dependent.

In India, where small and marginal farmers represent the major share in agricultural sector, the IFS approach offers a practical and sustainable solution for disease management while ensuring food, nutrition, and livelihood security. Component diversification reduces risk by distributing farm income across multiple enterprises, while crop species and varietal diversification improve production stability and resilience against diseases and climatic variations. By combining ecological principles with modern varietal technologies, integrated farming systems can significantly reduce chemical input use, improve soil health, and enhance farm profitability.

Thus, Integrated Farming Systems provide a holistic and sustainable framework for crop disease management in India. The combined role of component diversification and varietal diversification strengthens agro-ecosystem resilience, suppresses disease incidence, improves soil health, and ensures long-term agricultural sustainability. Adoption of IFS at farm, village, and regional levels can play a crucial role in achieving environmentally safe plant health management while enhancing farmers' income and ensuring food and nutritional security in the country.

Role of sowing time and environmental factors in charcoal rot dynamics of sunflower

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A field investigation was conducted at Punjab Agricultural University, Ludhiana, to evaluate the influence of different sowing dates on charcoal rot incidence, seed yield, and associated growth traits in sunflower (*Helianthus annuus* L.). The experiment was laid out in a randomized block design with three replications, comprising four sowing dates: January 31, February 14, February 29, and March 15.The findings revealed that delayed sowing significantly increased disease incidence and severity, accompanied by a decline in seed yield. The highest disease severity (62.67%) was recorded in the crop sown on March 15, whereas the lowest (33.50%) was observed in the January 31 sowing. Correspondingly, seed yield decreased progressively from 20.10 q ha^{-1} in early sowing to 16.00 q ha^{-1} in late sowing. Growth parameters, including plant height, head diameter, and stem girth (measured at top, middle, and bottom), also exhibited a declining trend with delayed sowing. Correlation analysis indicated a strong positive association of charcoal rot incidence with mean temperature ($r = 0.71$) and sunshine hours ($r = 1.00$), while a negative relationship was observed with rainfall ($r = -0.54$). Regression analysis further identified mean temperature, relative humidity, and sunshine hours as key factors influencing disease development, with a high coefficient of determination ($r = 0.89$). The study highlights that late sowing exposes sunflower crops to elevated temperature, reduced relative humidity, and prolonged sunshine during the flowering stage, thereby predisposing plants to increased charcoal rot incidence. These findings emphasize the importance of timely sowing as a critical cultural practice for minimizing disease risk and optimizing productivity.

Keywords: Charcoal rot Disease incidence Seed yield Sunflower Weather parameters Regression

Temperature Affecting On Conidial Behaviour and Pycnidial Production of *Phomopsis vexans* incitants Of Fruit Rot In Brinjal ,

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Behaviour of conidia of pathogen predominantly produces α-conidia repetitive spores playing a major role in the spread of disease, whereas β-conidia are mostly formed late in the season. Since these two types of conidia are formed under variable temperature in nature, this led to an idea of specific role of weather variables in the formation of β-conidia which converted to α-conidia on disease spots in the month of October under field conditions where temperature ranged between 14-16°C. No conversion from β to α-conidia was observed up to 11 days under field conditions. However, when disease parts were incubated at 25°C in the laboratory, 100 per cent conversion to α-conidia was found after 8, 9 and 11 days of incubation on leaves, fruits and stem, respectively. At lower and higher temperature no change in the behaviour of β and α conidia respectively was observed. However, at higher temperature β-conidia get changed to α-conidia and at low temperature α-conidia were changed to β-conidia. These studies highlight the specific requirement of temperature in the conversion of α and β-conidia. The role of temperature was further confirmed by subjecting culture tubes possessing pycnidia bearing α or β-conidia to 25°C and 16°C conditions. At 25°C β-conidia changed to α-conidia after 2 days and α to β-conidia at 16°C after 3 days of incubation which then convert to β form at lower temperature under the temperate conditions of Kashmir. Wide variations in pycnidia formation revealed maximum size of 534.89 x 410.67 μ recorded in isolate PV_{15} while as minimum size of 144.47 x 321.19 μ was found in PV_{23}. Majority of the isolates took 10 to 20 days to produce sporulating pycnidia on PDA with marked differences in pycnidial density however; some isolates produced sporulating pycnidia in less than 10 days. In most of the isolates pycnidia were randomly distributed in the colony however, distribution of pycnidia in concentric rings was also found in some isolates. Majority of the isolates produced pycnidia on the surface of the colonies while as sub-surface location of pycnidia was also found in few isolates. *In vitro* study purported that *P. vexans* isolates differed in colour of the ooze discharged in culture plates.

Keywords: Temperature,Conidial Behaviour, Pycnidial Production, *Phomopsis vexans* Fruit Rot and Brinjal .

Gamma Irradiation-Induced Enhancement of Biocontrol Efficiency in *Trichoderma* spp.: A Functional and Genome-Wide Variant Analysis

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The widespread reliance on synthetic fungicides for plant disease management has raised serious concerns due to environmental contamination, health risks, and the emergence of resistant pathogen populations. In this context, biological control using *Trichoderma* spp. has emerged as a sustainable and eco-friendly alternative, owing to their diverse antagonistic mechanisms such as mycoparasitism, nutrient competition, secretion of hydrolytic enzymes (chitinases and β-1,3-glucanases), antibiotic production, and induction of plant defense responses. The present study aimed to enhance the biocontrol efficacy of selected *Trichoderma* species (*T. harzianum, T. viride,* and *T. asperellum*) through gamma irradiation-induced mutagenesis and to elucidate the genomic basis of improved traits through whole genome variant analysis. Gamma irradiation (0–500 Gy) generated 60 mutants, which were evaluated for morpho-cultural stability across seven generations along with their parental strains. Detailed characterization included colony morphology, growth rate, spore germination, colony-forming units (CFU), mycelial dry weight, and enzymatic activities. Antagonistic potential was assessed against *Dematophora necatrix* and *Fusarium oxysporum* f. sp. *capsici* under in vitro and in vivo conditions. Among the mutants, F9 exhibited superior performance with the highest growth rate (3.315 mm hr^{-1}), spore germination (7.69×10^{7} ml^{-1}), CFU (5×10^{6} ml^{-1}), mycelial dry weight (436.95 mg), and enhanced β-1,3-glucanase activity, while D8 showed maximum chitinase activity. Mutant F9 also recorded maximum inhibition against *D. necatrix* (83.40%) and *F. oxysporum* (92.00%). Field evaluation revealed complete disease control (100%) by mutants A7, A9, F9, and F10, with A7 and F9 identified as the most promising. Whole genome variant analysis of A7 and F9 revealed high genomic conservation with their parental strains, alongside significant mutation-specific variations. In A0–A7, 253,781 variants were detected, with 197,567 shared and 28,316 unique to A7. In F0–F9, 208,870 variants were common, with 27,355 unique to F9, indicating a higher mutation load. Single-nucleotide polymorphisms (SNPs) predominated over INDELs in both comparisons. Heat map analysis showed non-uniform SNP distribution with higher densities in mutants, indicating mutation hotspots and potential selective pressures. These findings demonstrate that gamma irradiation effectively generates superior *Trichoderma* strains, while genome-wide analysis provides critical insights into trait enhancement, supporting sustainable plant disease management.

Keywords: Whole genome sequencing, NGS, Variant calling, *Trichoderma* species, Gamma irradiation, Mutagenesis, Biological control agents, Chilli wilt, Apple root rot, *F. oxysporum, D. necatrix*

Engineering Climate-Resilient Crops: PGPR-Mediated Intergenerational Immune Priming for Sustainable Plant Health and Food Security

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Ensuring global food security under accelerating climate change and escalating pathogen pressure remains one of the most pressing challenges of modern agriculture. Traditional disease management strategies, heavily reliant on chemical inputs, are increasingly constrained by environmental concerns, resistance development, and sustainability limitations. In this context, innovative, eco-friendly approaches that enhance intrinsic plant immunity are critical for advancing climate-resilient agriculture.

Defense priming has emerged as a transformative strategy in plant protection, enabling plants to mount faster and stronger responses upon pathogen attack without incurring significant fitness costs. Recent advances highlight that such primed states are not only effective within a generation but can also be transmitted across generations, offering a paradigm shift in sustainable crop protection. This keynote will focus on the role of Plant Growth-Promoting Rhizobacteria (PGPR) as potent biological agents capable of inducing intergenerational immune priming in crops. PGPR-mediated priming enhances plant preparedness against biotic stress through complex molecular reprogramming involving transcriptomic, metabolomic, and epigenetic modifications. These changes establish a “memory” of stress exposure, enabling progeny to exhibit enhanced resistance even in the absence of the initial stimulus.

Using wheat as a model system, this work demonstrates how PGPR-driven priming can be strategically deployed to improve disease resistance, reduce dependency on chemical control, and contribute to long-term agricultural sustainability. The integration of microbiome-based solutions with multi-omics approaches provides new insights into plant–microbe interactions and opens avenues for developing next-generation bioformulations.

By bridging fundamental plant immunity with translational applications, PGPR-mediated intergenerational priming represents a scalable and environmentally sustainable strategy for strengthening plant health, ensuring yield stability, and achieving global food security under changing climatic scenarios.

Postharvest Diseases of Apple: Current Scenario, Associated Nutritional Losses, and Management Strategies

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Apple (*Malus domestica*) is an important pome fruit belonging to the family Rosaceae. Its cultivation is mainly concentrated in temperate regions between approximately 25° and 52° latitude, although it is also grown in other suitable environments. Apples are valued for their high nutritional content and are a good source of flavonoids, antioxidants, and polyphenols, which contribute to various health benefits and overall well-being. In India, apple production is largely concentrated in the North-Western Himalayan region, where favourable climatic conditions support the production of high-quality fruit. Currently, apples are cultivated on about 0.32 million hectares in India, producing nearly 2.59 million tonnes annually. Although India ranks among the leading apple-producing countries in the world, the average orchard productivity remains relatively low at about 8.2 tonnes per hectare, mainly due to several biotic and abiotic constraints. Postharvest diseases are a major constraint in apple production, causing 5-35% economic losses and reducing fruit quality and shelf life. Using morphological, microscopic, and molecular analyses, several pathogens have been identified, including *Fusarium fujikuroi, Fusarium avenaceum, Diaporthe citrichinensis, Trichothecium roseum, Alternaria alternata, Penicillium expansum,* and *P. crustosum*. Infection by these pathogens significantly reduces important nutritional attributes such as antioxidant activity, phenolics, carotenoids, sugars, and organic acids, leading to overall fruit deterioration. To manage blue mold, essential oils and biocontrol agents were evaluated. All treatments reduced fruit rot compared with the untreated control, with black tulsi spray showing complete inhibition of fruit rotting. These results indicate that essential oils, particularly black tulsi, along with biocontrol agents, can serve as effective eco-friendly alternatives for managing postharvest diseases in apples.

Keywords: apple, post-harvest, essential oil, post-infection alteration, biocontrol

Harnessing genetic and genomic resources for disease resistance against major biotic stresses in Indian mustard (*Brassica juncea)*

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Brassica juncea (Indian mustard) is a key oilseed crop in India, yet its field productivity remains far below its genetic potential, contributing to continued dependence on edible oil imports. The low realized yield of rapeseed-mustard is the result of multiple interacting factors, including both biotic and abiotic stresses. Biotic stresses such as insects pests, parasitic weeds and fungal diseases significantly reduce yield and seed quality in mustard. Among these, white rust, powdery mildew and Alternaria blight are the most widespread and economically damaging fungal disease of the oilseed mustard. Coupled with the changing climate there has been significant increase in their disease incidence and severity. Since chemical control is limited and unsustainable, host plant resistance is the most effective strategy to control these diseases. Therefore, this study focuses on identifying durable disease resistance through systematic and robust screening of the Brassica germplasm across environment and further integrating the phenotyping results with multi-omics approaches to generate genetic and genomic resources thereby strengthening the future Brassica breeding programs. White rust, caused by Albugo candida, is a highly destructive disease of rapeseed–mustard, leading to yield losses of up to 60% during severe outbreaks. Its high variability and multiple physiological races further complicate its management. Therefore, through standardized large-scale phenotyping against multiple A. candida isolates at cotyledonary and true leaf stages under in vitro studies and multi-location field trials across three consecutive years, the present study has identified immune and resistant genotypes. To further dissect the genetic basis of resistance, genotyping-by-sequencing has been employed for genome-wide SNP discovery in a panel of 144 B. juncea genotypes including immune, tolerant and susceptible. Integration of phenotypic and genotypic data through genome-wide association studies has led to the identification of 125 novel and significant SNPs, predominantly located on the B genome, with a few on the A genome. These markers represent valuable resources for marker-assisted selection and resistance breeding. Furthermore, transcriptome profiling has added a functional characterization to these genomic discoveries. Comparative expression analyses between immune (EC766193) and susceptible (Pusa Jaikisan) genotypes following pathogen infection have revealed differentially expressed genes involved in immune signaling, stress responses, and metabolic pathways. A set of 8 key defense-related genes has been further validated through qPCR studies. Other fungal disease that has emerged as major concern under changing climates is Powdery mildew, caused by ascomycete Erysiphe cruciferarum. While elite B. juncea lines show susceptibility, resistance has been identified through optimized disease screening technique in resynthesized and introgressed lines of B. juncea, and its wild relatives. Comparative transcriptomics has been employed to identify key defense associated genes in the contrasting B. juncea genotypes. In addition, little information is available of this pathogen. Therefore, whole-genome and haustorial transcriptome sequencing has been

done to aid in understanding its pathogenicity. Furthermore, through mutation breeding using EMS and gamma irradiation treatments B. juncea mutant lines have been developed for PM resistance. Another major fungal disease, Alternaria blight, caused by Alternaria brassicae, remains one of the most challenging diseases due to the absence of complete resistance in cultivated Brassicas. Multilocation field trials and controlled screening have identified tolerant genotypes that serve as promising starting material for genetic analysis. A panel of tolerant and susceptible genotype has been developed for whole-genome resequencing to uncover defense associated SNPs, genomic regions and genes, thereby addressing major gaps in the understanding of Alternaria resistance. Overall, integrating germplasm screening, pre-breeding, and multi-omics approaches has significantly advanced disease resistance research in Brassica. Leveraging genetic diversity from wild relatives and modern genomic tools can facilitate the development of resilient cultivars, contributing to improved productivity and sustainable oilseed production.

Keywords: Brassica juncea, biotic stresses, White rust, Powdery mildew, Alternaria blight, multi-omics

Spatial Distribution Of Ear Rot (*Fusarium* Spp.), Associated Mycotoxins And Their Management On Prehaevest Maize In Ethiopia

Dr. Temesgen

Maize (*Zea mays* L.) is a major staple crop in Ethiopia and plays a critical role in food security and livelihoods, particularly for smallholder farmers who constitute about 80% of the population. However, maize production is significantly constrained by pre-harvest ear rots, mainly Fusarium ear rot (FER) and Gibberella ear rot (GER), primarily caused by *Fusarium verticillioides* and *Fusarium meridionale*, respectively. These diseases not only reduce grain yield but also contaminate maize with harmful mycotoxins, posing risks to food safety and marketability. This study investigated the spatial distribution of maize ear rots, associated mycotoxins, causal Fusarium species, host resistance, and management strategies in Ethiopia. Field surveys were conducted during the 2020 and 2021 main cropping seasons across 480 maize fields in 10 administrative zones. Significant differences ($P < 0.001$) in disease severity were observed among zones, although no significant variation occurred between cropping seasons. The highest FER severity (33.2%) and estimated yield loss (13.6%) were recorded in West Wallaga, while the lowest severity (11.3%) and yield loss (5.4%) occurred in Buno Bedele. Similarly, GER severity was highest in West Wallaga (24.3%) with yield losses of about 12.7%, whereas Gurage zone showed the lowest severity (10.6%). Mycotoxin analysis revealed widespread contamination in maize samples. Fumonisins (FB1–FB4) were detected in 98% of samples, ranging from 5 to 7517 $\mu g\ kg^{-1}$ (mean 540 $\mu g\ kg^{-1}$). Zearalenone (ZEN) was detected in all samples, while more than 75% tested positive for deoxynivalenol (DON) and DON-3-glucoside. Mycotoxin concentrations ranged from 5–4291 $\mu g\ kg^{-1}$ for DON, 5–1554 $\mu g\ kg^{-1}$ for DON-3-glucoside, and 5–2236 $\mu g\ kg^{-1}$ for ZEN. Approximately 11.3% of maize samples exceeded the European Union limit for total fumonisins in maize flour, and 25% exceeded the recommended ZEN limit for unprocessed cereals, indicating potential risks to food safety. Morphological and molecular characterization identified 92 Fusarium isolates belonging to eight species. The most prevalent species were *F. verticillioides* (44.6%) and *F. temperatum* (22.8%), followed by *F. meridionale*, *F. oxysporum*, *F. brevicatenulatum*, *F. boothii*, *F. falciforme*, and *F. tjaetaba*. Several species, including *F. temperatum*, *F. meridionale*, *F. boothii*, *F. falciforme*, and *F. tjaetaba*, were reported for the first time from maize ear rot in Ethiopia. Pathogenicity tests confirmed that all species could cause disease symptoms with significant differences in virulence. Resistance evaluation of 20 Ethiopian maize genotypes under artificial inoculation across three locations showed significant genotype-by-environment interactions. Resistance levels ranged from 25–45% for GER and 15–25% for FER. Hybrids such as BH661, BHQP548, Damot (P3506W), DK777, and Gibe3 exhibited relatively stable resistance across environments. FER severity was positively correlated with GER severity ($r = 0.45$), suggesting shared resistance mechanisms. Agronomic traits such as kernel texture and husk cover were also significantly associated with disease severity.The study further evaluated a push–pull cropping system involving maize intercropped with desmodium (“push”) and *Brachiaria decumbens* (“pull”). Results showed that this system significantly reduced insect pests, including stalk borers and fall armyworm, and lowered FER and GER severity while improving grain yield. Hybrid BH546 performed particularly well within the push–pull systems. Overall, the study confirms the widespread occurrence of Fusarium ear rots and associated mycotoxins in Ethiopian maize production. Integrated management strategies—including resistant varieties, improved agronomic practices, insect management, and push–pull cropping systems—are essential to reduce disease severity, improve yield, and enhance food and feed safety. Strengthening monitoring systems and resistance

breeding programs is also recommended to manage Fusarium ear rots and mycotoxin contamination effectively.

Keywords: Ear-rot; Molecular Methods; Morphological Characterstics; Mycotoxin; Production Practices

Pokkah Boeng disease management in sugarcane in sub-tropical India

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Sugarcane is a vegetatively propagated crop widely cultivated in tropical and subtropical regions of India. Owing to its mode of propagation, the crop is highly vulnerable to fungal and bacterial pathogens. Among plant pathogens, fungi are the most prevalent and can cause severe economic losses, sometimes leading to complete crop failure. Pokkah boeng is an important foliar disease of sugarcane caused by *Fusarium* spp., particularly *F. verticillioides* and *F. proliferatum*. Twenty-five *Fusarium* isolates were collected from infected sugarcane leaves and characterized based on morphological and cultural traits. The internal transcribed spacer (ITS) region was sequenced, and nucleotide sequences were submitted to GenBank (NCBI). Pathogenicity tests were conducted under pot conditions using foliar spray, soil inoculation, and sett treatment methods. Among these, foliar spray inoculation produced the highest disease severity (90%) compared to the control (sterilized water spray). Various fungicides, botanicals, and antagonistic microorganisms were evaluated under in vitro conditions. Carbendazim and mancozeb at 25 ppm resulted in 50% mycelial growth inhibition after five days of incubation compared to the untreated control. Among the antagonists, *Trichoderma* strains suppressed pathogen growth by 90% under *in vitro* conditions. The potential microbial cultures were tested for mutual compatibility and showed no antagonistic interactions. Promising microbial cultures were further evaluated under field conditions for the management of pokkah boeng disease. Sett treatment with *Trichoderma* resulted in the lowest disease incidence, followed by soil application, and performed comparably to the standard control treatment.

Keywords: Pokkah Boeng, *Fusarium*, Biocontrol agents

ORAL PRESENTATIONS

Artificial intelligence: Unlocking the new possibilities in plant pathology

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Artificial Intelligence (AI) is transforming modern agriculture by enabling precise, data-driven decision-making in crop protection. AI refers to the simulation of human intelligence in machines capable of learning, reasoning, and problem-solving. In agricultural sciences, particularly entomology and plant pathology, AI technologies such as Machine Learning (ML), Deep Learning (DL), Convolutional Neural Networks (CNN), and computer vision are revolutionizing pest and disease management. These technologies reduce human error, enhance early detection, and support smart agriculture through automated monitoring and predictive modeling. Image-based detection systems using CNN and deep learning models have demonstrated high accuracy in identifying plant diseases and insect pests under field conditions. These studies show successful detection of wheat rust, rice bacterial blight, maize leaf diseases, cotton leaf diseases, and several horticultural crop infections using trained AI models. Advanced architectures analyze leaf images, classify disease severity, and generate rapid diagnostic outputs.AI-based expert systems such as EXOWHEM and ICAR-developed crop advisory platforms assist farmers by guiding them through symptom-based queries and recommending appropriate management practices. Smartphone applications like Plantix and CropTrack provide real-time disease identification and advisory support, making AI accessible to farmers at low cost. Robotics and drone-based technologies further enhance precision agriculture. AI-integrated agricultural robots and spray systems detect diseased plants and perform site-specific pesticide application, reducing chemical overuse and environmental impact. Automated field surveillance using drones enables real-time disease mapping and monitoring. Although challenges such as high initial costs and technical complexity remain, AI-driven tools offer immense potential for sustainable crop protection. Future developments should focus on integrated expert systems, multilingual mobile applications, and multifunctional robotic platforms to strengthen plant health management and improve agricultural productivity.

Integrated Evaluation And Molecular Docking-Based Validation Of Fungicides And Bioagents Against Fusarium Dry Rot Of Potato

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Fusarium dry rot, primarily caused by Fusarium sambucinum, is a major post-harvest disease responsible for significant storage losses in potato, thereby threatening tuber quality and food security. The present investigation aimed to evaluate the efficacy of selected fungicides and bioagents against the pathogen through in vitro, in vivo, and in silico approaches. For the in vitro assay, the poison food technique was used for the evaluation of the fungicides, and the dual culture technique was used for the biological control agents. The experiment was conducted in a completely randomized design (CRD) with nine treatments and analyzed using ANOVA. Among the tested fungicides, the combination of Tebuconazole + Trifloxystrobin showed the maximum mycelial inhibition (100%), followed by Azoxystrobin (94.50%), and Azoxystrobin + Tebuconazole (88.33%). Among the biological control agents, Trichoderma harzianum (IIHR-TH2) exhibited considerable antagonistic activity with 82.22% inhibition, while P. fluorescens (ATCC 49838) showed moderate inhibition (52.94%). In vivo validation through potato tuber dip treatment further confirmed the superior performance of fungicidal combinations. Tebuconazole + Trifloxystrobin resulted in maximum disease reduction (99.24%), followed by Azoxystrobin (90.71%) and Azoxystrobin + Tebuconazole (86.06%). To elucidate the possible mechanism of antifungal activity, molecular docking was performed against sterol 14-α-demethylase (CYP51) protein of F. sambucinum (PDB ID: 5TZ1) using AutoDock Vina. The docking results revealed that Trifloxystrobin (-9.3 kcal/mol), Azoxystrobin (-8.6 kcal/mol), and Tebuconazole (-8.0 kcal/mol) have strong binding affinities with the active site of the sterol 14-α-demethylase protein of F. sambucinum, which indicates the inhibition of the ergosterol biosynthesis pathway as the potential mode of action of the tested treatments for the management of the disease.The results shows that combination fungicides, particularly Tebuconazole + Trifloxystrobin, are highly effective against F. sambucinum, while bioagents such as T. harzianum may serve as supportive components in integrated management strategies for controlling potato dry rot during storage.

Data-Driven Approach In Digital Plant Pathology: Insights From Plant Health Programmes In Assam

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Agriculture remains the cornerstone of Assam's rural economy, employing over 70% of the population. However, diverse cropping systems combined with the impacts of climate change have contributed to significant yield losses, estimated at 30-50% due to pests and diseases. In this context, digital plant pathology is emerging as a powerful approach to enhance crop health management through data-driven diagnosis, real-time surveillance, and informed decision-making. This study evaluates the outcomes of initiatives undertaken during 2024-2025 by Assam Agricultural University, CAB International, and MS Swaminathan Research Foundation under CABI-led PlantwisePlus programme. Using baseline and endline surveys of 200 farmers, the study assessed the impact of 40 plant clinics, two plant health campaigns, and the dissemination of more than 200 crop health advisories. A total of 1,093 diagnoses were recorded, with major crops affected including paddy, mustard, tea, okra, and citrus. Amongst the plant health problems, 72.5% of cases involved damages caused by insect pests while the remaining cases included diseases and nutrient deficiencies and toxicity. A total of 1,093 diagnoses were recorded, with paddy, mustard, tea, okra, and citrus being the most affected crops. Insect pests accounted for 72.5% of plant health issues, while brown spot was the most prevalent disease in rice (85% of disease diagnoses). Advisory services included cultural, biological, and chemical recommendations alongside sustainable practices. The interventions led to a marked increase in farmer awareness (from 19% to 100%) and significant adoption of improved practices, particularly sustainable pest management, which rose from 11% to 91.5%. The findings indicate that structured plant clinics enhance surveillance efforts, and that clinic-generated data can effectively contribute to digital plant pathology by enabling early warning systems, delivering targeted advisories, and strengthening resilient crop protection strategies for smallholder farmers in Assam.

Keywords: PlantwisePlus, Plant clinic, Plant health campaigns, Digital plant pathology

Comparative Defense Profiling in Wheat NILs with Distinct Yr Genes Against Puccinia striiformis f. sp. tritici

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Wheat (Triticum aestivum L.), a major staple food crop, faces substantial yield losses due to Puccinia striiformis f. sp. tritici (Pst), the causal agent of stripe rust. Host plant resistance remains the most effective and sustainable strategy for disease management, necessitating a comprehensive understanding of the mechanisms mediated by stripe rust resistance (Yr) genes. The current study provides mechanistic insights into the defense responses mediated by various Yr genes (Yr5, Yr10, Yr15, Yr24, and YrSP) in wheat near-isogenic lines (NILs) against Pst pathotype 238S119. This pathotype is a newly evolved virulent pathotype in India that has made many elite cultivars susceptible. Although all NILs displayed a uniform infection type (IT 0), indicating complete resistance, the comparative histological and biochemical analyses revealed divergent mechanistic pathways underlying this phenotypic uniformity. Histopathological defenses were effectively reinforced by the timely and enhanced induction of key defense-related enzymes, including phenyl ammonia lyase, polyphenol oxidase, tyrosine ammonia lyase, and catalase. Furthermore, the structural defense responses include early lignification, hypersensitive response and callose deposition. The coordinated activation of these structural and biochemical responses reflects a robust, multi-layered defense system, indicating that selected Yr genes confer a more dynamic and effective resistance phenotype. This mechanistic insight into individual Yr gene function provides valuable guidance for wheat breeding strategies. Specifically, the strategic pyramiding of genes with complementary defense profiles may improve both the durability and spectrum of resistance against stripe rust under varying environmental conditions and evolving pathogens.

Keywords: Wheat, Near-isogenic lines, Stripe rust, Yr-genes, Histopathology

Disrupting Wheat Rust at Its Source: A Computational Hunt for Bioherbicides Against *Berberis vulgaris*

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In India, wheat has been a staple crop for ages, but fungal rust infections that cause wheat rust seriously harm this crop. The life cycle of the wheat rust fungus is critically dependent on the alternate host *Berberis vulgaris*. Current management strategies primarily rely on chemical herbicides for *barberis* eradication; however, this approach raises significant environmental and ecological concerns. The present study tries to establish an eco-friendly approach of developing a potential bioherbicide from organic wastes and peels with the help of *in silico* studies. Selected natural compounds, *viz.* Ferulic acid, sorgoleone, chlorogenic acid, indole-3-acetic acid, phosphinothricin, nicotinic acid, caffeine, salicylic acid, and azadirachtin, were screened against target proteins Berberine Bridge Enzyme (BBE) [PDB 3D2D] and Norcolaurine Synthase (NCS) [PDB 2VNE] to study their binding potential and binding affinity. Amongst the screened compounds, Chlorogenic acid ($\mathbf{\Delta G = -9.9}$ kcal/mol) and sorgoleone ($\Delta G = -8.6$ kcal/mol) against 3D2D and Chlorogenic acid ($\Delta G = -7.9$ kcal/mol) and azadirachtin ($\mathbf{\Delta G = -7.8}$ kcal/mol) against 2VNE suggests multi- target effectiveness. Other compounds were having comparatively lower binding affinities and free energy values. These studies highlight chlorogenic acid, sorgoleone, and azadirachtin as a plausible candidate for bioherbicide development. This study focuses on reducing the dependence on synthetic chemicals and promotion of sustainable agriculture practices.

Keywords: - Wheat rust, Berberis vulgaris, bioherbicide, binding affinity and sustainable agriculture.

"Prevalence And Molecular Characterization Of Mungbean Yellow Mosaic Virus In Major Mungbean Growing Districts Of Gujarat"

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A field survey was conducted to assess the incidence of mungbean yellow mosaic virus (MYMV) in two major mungbean-growing districts of Gujarat. Thirty locations were surveyed, revealing an overall mean disease incidence of 33.16%. The highest incidence was recorded in Vadodara district (37.92%), followed by Bharuch district (28.41%). MYMV was widely distributed and caused considerable yield losses in the region. Among the cultivated varieties, GM 4 was identified as highly susceptible, whereas GM 6 and GM 7 showed resistance. Disease incidence increased with crop growth stage, reaching a peak at maturity and declining during pod formation. For molecular confirmation, viral DNA was extracted from symptomatic leaf samples and subjected to PCR amplification using MYMV coat protein (CP)-specific primers. A 1000 bp amplicon confirmed MYMV infection in all 30 samples. Sequencing and alignment with GenBank database sequences validated the isolates as MYMV, confirming accurate detection and characterization.

Keywords: Mungbean Yellow Mosaic Virus, Disease Incidence, Molecular Variability, Pcr Amplification, Coat Protein

Genome-Wide Identification, In Silico Characterization, And Expression Insights Into The Chitinase Gene Family In Brassica Juncea During White Rust Infection

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White rust, caused by Albugo candida, is a major threat to the productivity of Brassica juncea (Indian mustard). Limited sources of durable genetic resistance, combined with the rapid evolutionary adaptation of the pathogen, make effective disease management challenging. A deeper understanding of plant-pathogen interactions is therefore essential to discover novel defense-related. Chitinases, key pathogenesis-related proteins, enhance plant defense by degrading chitin in pathogen cell walls and triggering immune responses, making them important targets for breeding. This study performed genome- wide in silico identification and characterization of the chitinase gene family in B. juncea. Using signature chitinase domains including PF00182, PF00187, PF00704 were used to search the proteome (E-value 1e -5), 70 non-redundant chitinase genes (≥150 aa) were identified after filtering and domain validation. Most genes belonged to class Ia and class IV (glycosyl hydrolase family 19), with the majority containing PF00182 (catalytic domain), often co-occurring with PF00187 (chitin-binding); about 12 genes possess PF00704, and a few possess PF00187 alone. Proteins showed lengths mostly 200–500 aa, molecular weights ~20–55 kDa, varying pI, predominantly negative GRAVY indicating hydrophilic character, and stable nature. Subcellular localization predictions revealed enrichment in extracellular and chloroplast compartments, with additional assignments to vacuole, Golgi, and other compartements, suggesting functional diversification in immunity. Chromosomal distribution was uneven across A and B subgenomes, with highest clustering on A03 and B03, followed by B08, A05, and B05, pointing to evolutionary expansion for stress adaptation. Ongoing phylogenetic analysis across Brassica species will reveal orthology, duplications, and selection patterns linked to resistance variation. These results provide a comprehensive profile of chitinase diversity, genomic organization, and localization, identifying strong candidates for marker-assisted selection and functional studies to develop durable white rust resistance in oilseed Brassicas.

Keywords: Albugo candida, Brassica juncea, Indian mustard, chitinase gene family, genome-wide identification, pathogenesis-related proteins, chitinase domains, phylogenetic analysis, disease resistance, oilseed Brassica, durable resistance, plant-pathogen interactions.

Metatranscriptomics-driven decoding of the soybean virome reveals seed-transmissible cowpea mild mottle virus associated with veinal necrosis and bud blight disease

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Soybean (Glycine max L.) is a globally important oilseed crop, yet its productivity is increasingly threatened by emerging viral diseases that often remain undiagnosed using conventional detection approaches. Recently, severe veinal necrosis, and bud blight symptoms were observed in soybean plants at IARI, New Delhi, India. To rapidly identify the viral agents associated with these symptoms, RNA-seq–based metatranscriptomics was employed to decode the soybean leaf virome and enable unbiased detection of viral sequences present in symptomatic tissues. High-throughput Illumina sequencing generated approximately 52.8 million raw reads, of which 47.7 million high-quality reads were retained following stringent quality filtering. De novo transcriptome assembly using Trinity and MEGAHIT produced a combined assembly of 1,825,490 contigs. Taxonomic annotation through DIAMOND BLASTx against the NCBI non-redundant database identified 4,243 viral contigs, revealing a complex viral community comprising bacteriophages, tombusvirus-like sequences, and plant viruses. Among the plant viruses detected, Cowpea mild mottle virus (Carlavirus vignae, CPMMV) belongs to the family Betaflexiviridae showed prominent representation within the dataset. Subsequent molecular validation using RT-PCR with CPMMV coat protein-specific primers amplified the expected 867 bp fragment from symptomatic leaf tissues and harvested seeds, confirming virus presence. Grow-out assays further demonstrated efficient vertical transmission of CPMMV, with approximately 75% seed-to-seedling transmission in the first generation and complete transmission in the second generation. Quantitative RT-PCR analysis revealed higher viral titers in naturally infected field seeds compared with progeny seeds, indicating sustained viral persistence across generations. Collectively, this study demonstrates the potential of metatranscriptomics for comprehensive plant virus surveillance and identifies CPMMV as a seed-transmissible pathogen associated with veinal necrosis and bud blight disease in soybean, highlighting its epidemiological significance and the need for improved molecular diagnostics and phytosanitary interventions in soybean production systems.

Keywords: Metatranscriptomics; Soybean virome; Cowpea mild mottle virus; Seed transmission; RNA sequencing

Integrated Biological and Molecular Characterization of Cowpea Mild Mottle Virus (CPMMV) Infecting Soybean In India

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Soybean (Glycine max L.) is an economically important oilseed crop contributing significantly to global food and nutritional security. However, viral diseases pose a serious threat to soybean productivity. During field surveys at IARI, soybean plants exhibiting symptoms of veinal necrosis and bud blight were observed. The present study was conducted to characterize the virus associated with these symptoms through biological approaches. The total RNA was extracted from infected soybean leaves and subjected to reverse transcription polymerase chain reaction (RT-PCR) using primers specific to the coat protein (CP) gene of CPMMV. RT-PCR amplification produced a fragment of approximately 867 bp, confirming the presence of CPMMV in infected samples. The amplified product was purified, sequenced, and analyzed using BLASTn for sequence homology. Phylogenetic analysis further revealed clustering of the Indian isolate with other global CPMMV isolates, indicating close genetic relatedness. Host range studies through mechanical sap inoculation on various plant species viz., cucurbits, legumes and solanaceous crops showed the various symptoms of mosaic, mottling, necrosis and chlorotic spots. These symptoms were confirmed for the presence of CPMMV using coat protein-specific primers through RT-PCR which showed the amplification of 867bp. Viral load was also quantified in each species through real time PCR using SYBR green method. Higher viral copy number of 2.64×10^{8} was observed among various varieties of legumes, 5.566×10^{3} was observed in the Malvaceae family and 4.166×10^{3} was highest among various cucurbits. This study provides the evidence of the occurrence of new variant of CPMMV responsible for veinal necrosis and bud blight symptoms in soybean along with its broad host range.

Keywords: Cowpea mild mottle virus (CPMMV), Soybean, Biological characterization, Host range, Molecular characterisation, RT-PCR detection, qRT-PCR.

HAUSTORIAL-ENRICHED TRANSCRIPTOMICS REVEALS CANDIDATE SECRETED EFFECTOR PROTEINS IN THE BRASSICA JUNCEA – ERYSIPHE CRUCIFERARUM PATHOSYSTEM

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Powdery mildew, incited by the biotrophic fungus Erysiphe cruciferarum, is an emerging and economically important disease affecting Brassica juncea, including the popular variety PusaJaikisan, resulting in substantial reductions in photosynthetic efficiency, seed yield, and oil quality across major mustard-growing regions. This study aimed to identify and characterize key effector candidates from the haustorial transcriptome of E. cruciferarum during compatible interactions with B. juncea var. Pusa Jaikisan. Haustoria, the specialized intracellular feeding structures of powdery mildews, represent primary sites for effector secretion, enabling the pathogen to suppress host immunity, manipulate plant metabolism, and acquire nutrients. RNA from enriched haustorial were subjected to high-throughput RNA sequencing, yielding a comprehensive haustorial-enriched transcriptome. Secretome prediction pipelines were applied to identify candidate secreted proteins (CSPs) based on the presence of signal peptides, absence of transmembrane domains, cysteine rich residues and small size typical of effectors. Further filtering identified candidate secreted effector proteins (CSEPs) showing haustorial-specific or infection-stage dependent expression, with homology searches against known powdery mildew effector repertoires from related species. A total of several hundred CSPs were predicted, among which a subset of 6 CSEPs exhibited features suggestive of virulence functions, including 4 proteins suggesting ribonuclease-like domain or protease-inhibitor activities, 2 proteins with cysteine rich CFEM (Common in Fungal Extracellular Membrane Proteins) domain, and 6 proteins consisting of YFWxC motifs, previously implicated in inter-species powdery mildew virulence. Further Expression profiling across infection time courses like early penetration to sporulation stages, would confirm dynamic temporal regulation of selected effectors, correlating with key phases of pathogenesis. These predicted effectors provide novel molecular targets for understanding E. cruciferarum virulence mechanisms in Brassica hosts. Insights gained support the effector-based monitoring, host R-gene deployment for effector-triggered immunity, or RNAi-mediated silencing of effector-binding sites. This work advances effector biology in Brassica powdery mildew pathosystems and contributes to sustainable disease management in oilseed crops.

Keywords: Powdery mildew, Erysiphe cruciferarum, Brassica juncea, Indian mustard, Pusa Jaikisan, effectors, candidate secreted effector proteins, CSEPs, haustorial transcriptome, haustoria, CFEM domain, YFWxC motifs, ribonuclease-like, pathogenesis

A3 – Nanotechnology & Next-Gen Therapeutics

Nano-Shielding Banana: A Novel Approach to Combat Anthracnose and Crown Rot diseases

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Anthracnose and Crown rot are considered as two most important post harvest diseases of banana causing approximately 40-50% losses. Present study was undertaken to evaluate the antifungal efficacy of biosynthesized silver nanoparticles (BSNPs) against the causal agent of anthracnose and crown rot. Fungicidal activity of BSNPs at different concentrations (0.0001%, 0.001%, 0.01%, 0.1% and 0.2%) was tested against C. musae and compared with chemical fungicide (Carbendazim @ 0.1%). BSNPs at 0.2 per cent significantly inhibited mycelial growth of the pathogen. The effect of BSNPs against anthracnose and crown rot diseases of banana was also studied by undertaking five treatment combinations. Among all the treatments, pre harvest spray of 0.2% BSNP one week prior to harvest along with hands dip treatment of harvested banana fruits in BSNPs for 10 min was best for anthracnose disease with a percent disease index (PDI) of 51.72 against 97.17 in control after 15 days of harvest. In case of crown rot, highest PDI of 94.38 was recorded in control against 56.90 in the same treatment with 0.2% of BSNPs. The highest shelf life of 15 days after harvest was recorded when banana fruits were treated with 0.2% of BSNPs both as pre-harvest spray and post-harvest application against 8 days in control. Spraying of recommended dose of carbendazim (0.1%) increased the shelf life of banana fruits up to 14 days only.

Keywords: Anthracnose, Crown rot, Colletotrichum musae, biosynthesized silver nanoparticles

Integrated Management of Little Leaf Disease of Brinjal Using Nanoparticles and Antibiotics Supported by Molecular Tools

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Little leaf disease of brinjal (Solanum melongena L.) is a serious Phytoplasma-associated disorder causing severe yield reduction and poor fruit quality in major brinjal-growing regions of India. The present study was undertaken to develop an integrated management strategy for little leaf disease using nanoparticles and antibiotics, supported by molecular tools for pathogen detection and validation of treatment efficacy. Molecular detection of phytoplasma was carried out using PCR and nested PCR with universal and group- specific primers, which amplified the expected ~1.8 kb and ~1.2 kb fragments, respectively, confirming phytoplasma association with the disease. Sequence analysis of the 16S rRNA gene showed close similarity with 'Candidatus Phytoplasma trifolii'. Silver and copper nanoparticles were synthesized through green routes using plant extracts and characterized by UV-Visible spectroscopy, TEM and FTIR, confirming their nanoscale size, morphology and stability. The efficacy of nanoparticles, antibiotics and botanicals was evaluated under pot culture conditions using graft-inoculated plants. Among all treatments, silver nanoparticles at 100 ppm exhibited the highest suppression of Phytoplasma DNA as revealed by real-time PCR, followed by copper nanoparticles and the antibiotic tylosin, whereas turmeric leaf extract showed comparatively lower efficacy. The integrated approach combining nanotechnology-based treatments with molecular diagnostics proved effective in reducing phytoplasma load and improving plant growth and yield. The study demonstrates that green synthesized nanoparticles, in combination with antibiotics, offer a promising and eco-friendly strategy for the management of little leaf disease of brinjal.

Keywords: Phytoplasma, Nanoparticles, Molecular Detection, Little leaf of Brinjal

Next-Generation Phyto-Nanomedicine: Biofunctionalized Gold Nanoparticles Targeting EGFR in Breast Cancer

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Breast cancer continues to be a primary source of cancer-related death among women, indicating the strong need for improved, safer, and more effective treatments for breast cancer. In this study, to develop a plant-based nanomedicine for breast cancer treatment, the ethyl acetate extract of Piper betle var. Mysuru (a plant with great agricultural value and a large variety of active bioactive compounds) was used to Phyto-fabricate gold nanoparticles (AuNPs). Based on both optical and physicochemical characterization techniques, the resulting AuNPs were confirmed to be spherical, nanocrystalline particles with a face-centered cubic crystal structure and diameters in the range of 25nm. The surfaces of these AuNPs were found to have phytochemicals on them, as indicated by FTIR spectral bands that matched known phytochemicals. The AuNPs were very effective against MCF-7 breast cancer cells, exhibiting excellent anticancer activity (IC50 = 9.06 ± 0.51µg/ml) when compared to both the same plant extract and the well-known chemotherapeutic agent doxorubicin (an anticancer drug). In addition, these AuNPs exhibit low hemolytic activity, confirming their hemocompatibility for systemic delivery. In addition, the in-silico study showed that the phytochemical decoside is an excellent EGFR pathway inhibitor with good docking and dynamic (long-term) stability with numerous cancer-associated targets consistent with multitargeting mechanisms against the hallmarks of cancer. Collectively, these findings demonstrate that Piper betle–derived AuNPs constitute a green, scalable, and biocompatible nanoplatform that integrates cytotoxic efficacy with molecularly guided EGFR pathway modulation, highlighting their potential for future translation in breast cancer nano-theranostics.

“Characterization of Biogenic Silver Nanoparticles and its Toxicity Evaluation on Mammalian Cells and Beneficial Microbes”

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Silver nanoparticles (AgNPs) is considered as one of the most promising antimicrobial agents against several plant pathogens and also possess various biomedical and biochemical applications. However, with increase in popularity on the use this nanoparticle in agricultural purposes, it also has raised the concern about its hazardous effect on human and non-targeted organisms. Based on this, the study was conducted to evaluate the toxicity of AgNPs on beneficial microbes like Trichoderma harzianum, Beauveria bassiana and Bacillus thuringiensis and mammalian cell line (Vero cells) where its toxicity was evaluated at three different concentrations viz. 50, 100 and 200 ppm concentrations. The AgNPs was biogenically synthesize from T. asperellum and then characterisation was done by using UV-Vis spectrophotometer, DLS, Zeta Sizer, FTIR and NTA. In vitro cytotoxicity assay revealed that, AgNPs possess weak toxic effect on T. harzianum and B. bassiana where highest mycelial biomass inhibition was observed at 200 ppm i.e. up to 31.54% and 28.40% respectively and no inhibitory effect was observed against B. thuringiensis. The cytotoxicity of AgNPs on Vero cells showed mild toxicity with dose dependent manner where highest per cent cytotoxicity was observed at 200 ppm (28.22%) and lowest toxicity was recoded at 50 ppm (28.22%) respectively. The findings of this study revealed that, green synthesis of AgNPs possess mild toxicity on fungal biocontrol agents and Vero cells whereas no toxicity against bacterial biocontrol agents like B. thuringiensis.

Keywords: Characterisation, cytotoxicity, green synthesis, vero cells

Next-Generation L-Asparaginase Therapeutics: Overcoming Immunogenicity Through Microbial Bioprospecting and Advanced Nanocarrier Engineering

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L-Asparaginase (L-ASNase) remains a pivotal therapeutic enzyme in the management of Acute Lymphoblastic Leukemia (ALL) and other hematological malignancies. Its anti-neoplastic efficacy relies on the systemic depletion of L-asparagine, which induces fatal amino acid starvation and apoptosis in cancer cells that lack adequate asparagine synthetase. Despite its clinical indispensability, traditional terrestrial bacteria-derived L-ASNase (e.g., from E. coli) is severely constrained by a high incidence of hypersensitivity reactions, rapid physiological clearance, and glutaminase-associated toxicities. Furthermore, while traditional PEGylation has improved half-life, the clinical emergence of anti-PEG antibodies frequently accelerates drug clearance and dampens therapeutic efficacy over time. To circumvent these persistent pharmacological limitations, contemporary research is advancing along two synergistic pathways: the bioprospecting of novel microbial sources and the development of structurally engineered "biobetters." Marine microorganisms and extremophiles are increasingly recognized as untapped reservoirs for L-ASNase isoenzymes. These marine-derived variants often possess unique structural characteristics that confer higher stability and inherently lower immunogenicity compared to conventional sources. Additionally, targeted in silico profiling of fungal sources, such as Penicillium cerradense, has identified promising candidates with significantly reduced T- and B-cell epitope profiles, offering a less antigenic baseline therapeutic. Concurrently, advanced biochemical modifications are being employed to optimize both novel and existing enzymes. To address the vulnerabilities of standard PEGylation, sophisticated nanomedicine approaches—such as the encapsulation of L-ASNase within PEG-grafted liposomes—are being deployed. This dual-layered strategy acts as a physical biomimetic shield, protecting the enzyme from proteolytic degradation while effectively camouflaging it from immune surveillance. By synthesizing the discovery of naturally low-immunogenicity marine and fungal enzymes with next-generation nanocarrier delivery systems, the pharmacokinetic and safety profiles of L-ASNase can be profoundly enhanced. Ultimately, this integrated approach paves the way for a more resilient, targeted, and universally tolerated class of anti-tumor biologics.

Keywords: L-Asparaginase, Bioprospecting, Marine Microorganisms, PEG-grafted Liposomes, Anti-PEG Antibodies, Biobetters, Acute Lymphoblastic Leukemia, Immunogenicity.

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B. Integrated Disease Management & Ecology

B4 – BIO-INTENSIVE IDM/IPM: BIOCONTROL, ENDOPHYTES & GREEN CHEMISTRY

Basis Of Seed Biopriming In Bio-Intensive Stress Management

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The transition toward sustainable agriculture necessitates biologically intensive strategies that minimize chemical inputs while strengthening plant defense systems. Seed biopriming represents a pre-sowing intervention that integrates beneficial microbes with controlled seed hydration to enhance crop resilience in disease and pest management. This approach activates early metabolic processes during seed imbibition, including DNA repair, RNA and protein synthesis and enhanced ATP production, leading to improved germination, seedling vigour and uniform crop establishment. Bioprimed seeds exhibit enhanced resistance against soil- and seed-borne pathogens through multiple complementary mechanisms such as microbial competition, antibiosis, siderophore-mediated iron sequestration, production of hydrolytic enzymes and emission of volatile organic compounds. Importantly, beneficial microbes stimulate induced systemic resistance (ISR) through jasmonic acid and salicylic acid signalling pathways, enabling faster and stronger defense responses upon pathogen attack. Beyond biotic stress mitigation, seed biopriming enhances tolerance to abiotic stresses such as salinity, drought and temperature extremes by modulating antioxidant enzymes (SOD, CAT, APX), osmolyte accumulation and hormonal balance.

Keywords: Seed Biopriming, Biocontrol Agents, Induced Systemic Resistance (Isr), Biotic And Abiotic Stress Management, Plant-Microbe Interactions

ROLE OF ENDOPHYTIC BACTERIA AS POTENTIAL BIOCONTROL AGENTS FOR THE MANAGEMENT OF Sheath blight and Brown spot diseases in Rice

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Due to indiscriminate use of chemical fungicides and fertilizers, there occurs a serious risk to the environment. Sustainable management by bacterial endophytes is need of an hour. A study was conducted to evaluate bacterial endophytes from rice cultivar SR4 and to explore them for management and plant growth against brown spot and sheath blight diseases. A total of 100 bacterial endophytes were isolated and evaluated for inhibition against Bipolaris oryzae and Rhizoctonia solani using dual culture assay. Eight endophytes inhibited the colony growth for both pathogens (four each) significantly ($P \leq 0.05$). The highest inhibition was shown by Ureibacillus massiliensis (75.47%) and Brucella rhizosphaerae (75.25%) in Bipolaris oryzae and Rhizoctonia solani respectively. Identification was done by morphological and molecular means. These endophytes were evaluated for volatile compounds (71- 53 % inhibition) and showed positive results for chitinase, siderophore, HCN production and growth promotion attributes like phosphorous solubilization, nitrogen fixation, ammonia production, auxin and gibberellic acid production. Under greenhouse conditions, the highest disease control was shown by Brucella rhizosphaerae (80%) followed by Stenotrophomonas rhizophila (70 %) and Ureibacillus massiliensis (76 %) followed by Bacillus licheniformis (69 %) in sheath blight and brown spot respectively. Three novel endophytes were identified viz. U. massiliensis for controlling brown spot disease, S. rhizophila and B. rhizosphaerae for controlling sheath blight and also showing promising results of growth promotion. These endophytes have the potential to be used as biocontrol and growth-promoting agents in rice.

Keywords: Rice, diseases management, Endophytes, bioagents, Phylogeny

Nano Emulsion of Diallyl Disulphide and Bioagents Enhanced Defense Mechanism in Yard Long Bean Against Vascular Wilt Incited By *Fusarium oxysporum* and Enhanced Yield

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Fusarium oxysporum is a versatile, seed and soil borne fungus with wide host range. Yard long bean (*Vigna unguiculata* subsp. *sesquipedalis* Verdcort) is the most popular and common vegetable crop of Kerala. Vascular wilt incited by *Fusarium oxysporum* results in 70-100 crop loss. Thus, the present study was aimed to develop an eco-friendly, integrated disease management package against vascular wilt and black aphid. Sowing of seeds in soil applied with 5g arbuscular mycorrhizal fungi (KAU) per seed resulted in cent per cent germination, enhanced shoot and root growth along with tolerance to wilt infection, as evidenced by absence of wilt incidence in seedlings. Diallyl disulphide (DADS) was identified as the major pesticidal principle in the bulbs of garlic (*Allium sativum*) by GC-MS and 0.30% of DADS was revealed to have antifungal potential. A nano emulsion of DADS was developed and *in vitro* studies revealed that 1.50 per cent of nano emulsion possessed excellent antifungal potential against *F. oxysporum*, *Rhizoctonia solani* (collar rot) and *Sclerotium rolfsii* (stem blight) and insecticidal activity (black aphid and pulse beetle). Two pot culture and field studies were undertaken during 2024 to 2025 using the identified integrated package *viz*., soil drenching of nano emulsion of DADS followed by plastering, application of *Trichoderma* enriched in cowdung - neemcake mixture (9:1 ratio), transplanting of yard long bean seedlings treated with AMF (5g/seed) and soil drenching of PGPR mix II (20g l^{-1}) at 20, 40, 60 and 80 days after sowing which enhanced pod yield (2.35 kg plant $^{-1}$) compared to control (0.355 kg) with reduced disease incidence (11%) compared to control (33.33%). The activity of defense related enzymes *viz*., PO, PPO and Pal was enhanced and the presence of thickened cell walls and tyloses was confirmed in treated plants upon scanning electron microscopy, restricting pathogen entry and infection.

Efficacy of fungicides Against Root Rot of Cowpea Incited by Rhizoctonia bataticola

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Cowpea [Vigna unguiculata (L.) Walp] (diploid, 2n=22) is an annual legume crop. It is also known as lobia, southern pea, black eye pea, crowder pea, barbati, china pea, cowgram etc. Cowpea is a member of family fabaceae and introduced from Africa. It's affected by various Fungal, Bacterial and Viral diseases. Rhizoctonia bataticola [Macrophomina phaseolina (Tassi.) Goid] fungus is mainly a soil borne in nature with wide range of host and it can survive under the soil as saprophyte. Rhizoctonia bataticola infection occurs most frequently at flowering and pod formation stage or seed development stage. Six fungicides were tested against the fungus with one control viz., captan 70% + hexaconazole 5% WP, carbendazim 50% WP, hexaconazole 5% SC, tebuconazole 50% + trifloxystrobin, penflupen 13.28% + trifloxystrobin 13.28% FS, and chlorothalonil under In vivo and In vitro conditions. A field experiment was conducted during kharif 2023 at instructional Farm, SKN College of Agriculture, Jobner in randomized block design (RBD) with three replications, using Local cultivar, under artificial inoculation conditions. The efficacy of six fungicides were tested In vitro using poisoned food technique against Rhizoctonia bataticola in PDA petri plates. Among six tested fungicides, tebuconazole 50% + trifloxystrobin was found most effective in reducing per cent disease incidence (field conditions) and inhibiting mycelial growth (poisoned food technique) over control followed by captan 70% + hexaconazole 5% WP, carbendazim 50% WP, hexaconazole 5% SC, penflupen 13.28% + trifloxystrobin 13.28% FS, and chlorothalonil was least effective over control.

Keywords: fungicides, poisoned food technique, Rhizoctonia *bataticola*

Effect of successive Azoxystrobin exposure on the Antagonistic Potential of *Trichoderma* species against *Fusarium oxysporum* f. sp. *ciceris* (Foc)

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Chickpea is a major pulse crop in India, accounting for over 40% of the total pulses area and production, with Madhya Pradesh as the leading producer. *Fusarium oxysporum* f. sp. *ciceris* (Foc) is a major soilborne fungal pathogen causing Fusarium wilt in chickpea, leading to yield losses ranging from 10% up to 100% under favourable conditions. The genus *Trichoderma* represents one of the most extensively studied groups of filamentous fungi, that plays a vital role in the biological control of numerous plant pathogens, contributes to the detoxification of xenobiotic compounds such as pesticides and heavy metals, and promote plant growth. In our experiment, we have isolated fifteen *Trichoderma* isolates from rhizosphere of different medicinal crops by serial dilution technique and assessed for their tolerance against Azoxystrobin, a broad-spectrum strobilurin fungicide, extensively used for controlling different soil-borne fungal diseases. Medicinal crop rhizospheres were selected owing to their unique secondary metabolite rich root exudates, which create a selective niche favouring *Trichoderma* isolate with enhanced antagonistic and stress-tolerant traits. The fifteen isolates were categorized into five groups, based on cultural characters and their molecular identification was done using ITS primers followed by BLAST analysis. These isolates were assessed for their tolerance against Azoxystrobin 23% SC (1 ml/L) using poisoned food technique (repeatedly used at the recommended dose of the chemical) and their comparative tolerance against the fungicide was evaluated. We observed development of adaptive tolerance of the isolates against Azoxystrobin upon repeated exposure. Similar trend was observed when the antagonistic potential of the isolates (exposed to successive dose of Azoxystrobin) was checked against *Fusarium oxysporum* f. sp. *ciceris* (Foc) in dual culture assay. During fourth day observation, isolates exposed to first two doses showed reduced biocontrol with inhibition percentage ranging from 0.08 – 13% as compared to untreated isolates (3-33% inhibition), while those exposed to third dose showed similar and, in some cases, enhanced antagonism against Foc (12-38% inhibition). Tenth day onwards, maximum or complete suppression of the pathogen was observed by potential *Trichoderma* isolates.

Biological Control Of Blast Disease Of Pearl Millet Caused By *Pyricularia Grisea*

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A versatile cereal crop of the Poaceae family, Pearl Millet [*Pennisetum glaucum* (L.) R. Br.] is also known as bajra, bajri, sajje, kumbu, sajjalu in various Indian local languages. Blast disease of pearl millet caused by *Pyricularia grisea* (Cooke) Sacc. [Teleomorph: *Magnaporthe grisea* (Hebert) Barr.] has become an economically significant disease, causing devastating reduction in grain and fodder yields. Bio-agents and other nonchemical substances like plant extract and Panchgavya are environmentally benign. The most efficient way to control plant pathogens is by the use of chemicals, however this can have adverse effects on the environment and living things as well as leave residues on grains and feed. Testing bio-agents, plant extracts, and other methods for the management of the condition is therefore necessary in an effort to find an alternative to chemicals. Therefore, present investigations on *P. grisea* were undertaken in order to evaluate *in vitro* efficacy of the different bio-agents, and phyto-extracts at Department of Plant Pathology, College of Agriculture, Badnapur (V.N.M.K.V, Parbhani University). The efficacy of seven bio-agents was evaluated in *in vitro* conditions. Among the seven bio-agents tested, best result was given by *Pseudomonas fluorescens* (62.21 %), followed by *Trichoderma asperellum* (Ab isolate) (59.82 %), and least by *Aspergillus niger* (44.32 %). Among eight botanicals evaluated, *Azadirachta indica* (61.11 %) was given maximum inhibition, followed by *Allium cepa* (56.28 %) and least by *Ocimum sanctum* (18.47 %).

Keywords: Blast, Fungicides, Bio-agents, Phyto-extracts, *Pyricularia grisea*

ENCAPSULATED PRODUCT OF ENTOMOPATHOGENS EFFECTIVELY MANAGE WHITE GRUBS

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Encapsulation is used to protect chemicals and bioformulations that are susceptible to heat, light, oxidation, moisture and other adverse reactions. Fungal biocontrol agents encapsulated in an alginate-based matrix can be used for their protection and modulated release. In this experiment, the efficacy and shelf life of *Metarhizium anisopliae* encapsulated in a Sodium (Na)-alginate matrix were assessed against *Holotrichia serrata, Adoretus* sp. and *Lepidiota mansueta*. Encapsulated beads containing active conidia (10^9 conidia/ml) were formed in the alginate mix and dried through air-drying and freeze-drying methods. The *M. anisopliae* population during 10 months of storage in encapsulated beads was reduced more in air-dried beads (17.0- 0.2 × 10^7 CFU/g) than freeze-dried ones (21.2-2.0 × 10^7 CFU/g). After 21 days of treatment in greenhouse conditions, the prepared freeze-dried formulations showed increased mortality in the three species of white grubs at different concentrations. *Holotrichia serrate* showed 80% mortality at 500 mg and 1000 mg concentrations of *M. anisopliae,* while LD_{50} values decreased from 2.66 to 0.35 mg (2.1 × 10^8 CFU/g) after 21 DAT, as the mortality increased. *Adoretus sp.* had the highest mortality of 80% and 88% at 500 mg and 1000 mg, respectively, with decreasing LD_{50} values (3 to 21 DAT) of 2.43 to 0.31 mg. The mortality of the encapsulated fungal agent was considerably low in *Lepidiota mansueta* having 60% mortality at 1000 mg bioformulation concentration, with LD_{50} values decreasing from 1.94 to 0.76 mg during 21 DAT. The research suggests that freeze-dried alginate beads encapsulating *Metarhizium anisopliae* at 500 mg concentration are ideal against white grubs like *H. serrata* and *Adoretus sp.* infestation, while *L. mansueta* responds poorly, even at higher concentrations.

Keywords: *Bioformulations, Encapsulation, Mortality, Holotrichia serrate*

Biochar as a Sustainable Tool for the Management of Soil-Borne Plant Pathogens

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India generates nearly 350 million tonnes of agricultural residue annually, much of which is burned, causing environmental pollution and soil degradation. Converting this biomass into biochar offers a sustainable alternative for improving soil fertility and managing soil-borne plant diseases. Biochar, a carbon-rich material produced through pyrolysis, enhances soil physicochemical properties and suppresses pathogens through multiple mechanisms. These include induction of systemic resistance in host plants, stimulation of beneficial microbes, modification of soil conditions, direct fungitoxic effects, and sorption of allelopathic and phytotoxic compounds. Evidence from various studies demonstrates its effectiveness against major soil-borne pathogens. Thus, biochar represents a promising, eco-friendly strategy for sustainable disease management and improved crop productivity.

Mycoviruses: A novel option for management of fungal plant pathogens

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Fungal plant pathogens cause significant yield losses worldwide and their management largely depends on chemical fungicides, which often lead to environmental pollution, resistance development, and health concerns. In this context, mycoviruses have emerged as a promising and eco-friendly alternative for the management of fungal diseases. Mycoviruses are viruses that infect fungi and replicate within fungal cells, often altering the physiology and pathogenicity of their hosts. The most important phenomenon associated with mycoviruses is hypovirulence, where virus infection reduces the virulence of pathogenic fungi. This reduction in pathogenicity can suppress disease development in crops and offers a potential biological control strategy. Mycoviruses are transmitted vertically through spores and horizontally via hyphal anastomosis, enabling their spread within fungal populations. They may influence fungal growth, sporulation, metabolism, stress tolerance, and toxin production, thereby modifying host–pathogen interactions. Several studies have demonstrated the effectiveness of mycoviruses in reducing the severity of important plant diseases such as chestnut blight, rice blast, gray mold, and Fusarium wilt. Advances in molecular techniques including RT-PCR, next-generation sequencing, and electron microscopy have facilitated the detection and characterization of diverse mycoviruses. Implementation strategies involve isolation and identification of hypovirulence-inducing viruses, transmission to compatible fungal strains, molecular manipulation, and development of suitable formulations for field application. Overall, mycoviruses represent a novel and sustainable tool for integrated disease management. Further research on transmission mechanisms, host–virus interactions, and large-scale production techniques will be essential to fully exploit their potential in agricultural systems.

Enumeration of seed mycoflora and their management with *Beauveria bassiana* and *Trichoderma asperellum* in newly released Chickpea varieties from IARI

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Seed-borne fungi adversely affect seed quality, germination, and seedling vigour in chickpea. The present investigation was undertaken to enumerate the seed mycoflora associated with newly released chickpea varieties from IARI and to evaluate the potential of biological control agents for their management. Three chickpea varieties, Pusa Manav, Pusa 3022, and Pusa Chickpea 10216 were examined for seed-associated fungi using standard blotter method, agar plate method, and rolled paper towel method. A total of 14 fungal species were recorded from the tested varieties. The predominant fungi included *Aspergillus niger, A. flavus, A. nidulans, A. tamarii, Rhizopus stolonifer, Alternaria alternata, Alternaria solani, Curvularia lunata,* and *Rhizoctonia bataticola*. Among these, *A. niger, A. flavus,* and *R. stolonifer* were most frequently observed. The blotter and agar plate methods were more effective in detecting seed-borne fungi than the rolled paper towel method. Pathogenicity tests indicated that several of these fungi significantly reduced seed germination and seedling vigor. The antagonistic potential of four isolates of *Beauveria bassiana* (BbR1, BbR2, BbR3, BbR4) and three isolates of *Trichoderma asperellum* (ITCC 8687, ITCC 8619, ITCC 8541) was evaluated using dual culture assays. *Trichoderma asperellum* (ITCC 8687) showed the highest inhibitory activity against major pathogens, followed by *B. bassiana* isolates BbR2 and BbR3. Seed treatment with these biocontrol agents significantly improved seed germination, root and shoot growth, and seedling vigor. The study demonstrates the diversity of seed-borne fungi in chickpea and the potential of *Trichoderma asperellum* and *Beauveria bassiana* as eco-friendly biocontrol agents for improving seed health and sustainable chickpea production.

Keywords: Chickpea, Seed mycoflora, Biocontrol, *Trichoderma asperellum*, *Beauveria bassiana*

Comparative efficacy of selected microbial bioagents against stem rot of chickpea caused by *Sclerotinia sclerotiorum*.

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Stem rot of chickpea caused by *Sclerotinia sclerotiorum* is a serious disease that leads to significant yield losses under favourable environmental conditions. The present study conducted to evaluate the efficacy of *Beauveria bassiana* and *Trichoderma asperellum* as biocontrol agents against *Sclerotinia sclerotiorum* causing stem rot of chickpea. In vitro confrontation assays were conducted using four isolates of *B. bassiana* and three isolates of *T. asperellum* to assess their antagonistic efficacy against *S. sclerotiorum*. Among the tested isolates, *T. asperellum* ITCC 8687 showed the highest inhibition of mycelial growth, followed by *T. asperellum* ITCC 8619, *B. bassiana* BbR2, and *B. bassiana* BbR3, indicating strong antagonistic potential of these bioagents against the pathogen. These results suggest that both *Trichoderma* and *Beauveria* isolates possess promising biocontrol potential under laboratory conditions. In planta experiments revealed that the selected isolates significantly suppressed disease compared to untreated controls. Plants treated with *T. asperellum* ITCC 8687 recorded the highest increase in chlorophyll content, followed by *B. bassiana* BbR2, although a slight reduction was observed after pathogen challenge. Defence-related biochemical responses were analysed at 0, 3, 6, and 9 days after pathogen inoculation. The results showed enhanced plant defence with increased activity of peroxidase, polyphenol oxidase, and accumulation of total phenols, with peak expression three days after inoculation. Disease suppression studies after sowing further confirmed that *T. asperellum* ITCC 8687 and *B. bassiana* BbR2 effectively reduced disease incidence compared to untreated plants, suggesting their potential as eco-friendly agents for managing chickpea stem rot.

Keywords: Chickpea, *Sclerotinia sclerotiorum*, Stem rot, *Trichoderma asperellum, Beauveria bassiana.*

Antagonistic Potential of *Trichoderma* Spp. Against Major Wilt Pathogens of Pomegranate Under *In Vitro* Conditions

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Pomegranate cultivation in North Gujarat has been severely threatened by wilt diseases, primarily caused by *Ceratocystis fimbriata* and *Fusarium oxysporum*. In the present study, an *in vitro* evaluation of different isolates of *Trichoderma* spp. was carried out using the dual culture technique to assess their antagonistic potential against the wilt pathogens. Among the five bio-agents tested, *Trichoderma viride* (Sardarkrushinagar) and *T. harzianum* (Sardarkrushinagar) exhibited the highest inhibition against *C. fimbriata* (80.56% and 78.89%) and *F. oxysporum* (72.59% and 79.07%), respectively. These results demonstrate the superior efficacy of certain native *Trichoderma* strains in suppressing wilt pathogens and highlight their potential as eco-friendly alternatives for integrated disease management strategies in pomegranate. The findings also stress the need for region-specific biocontrol agent selection for improved field-level effectiveness.

Eco-friendly management of blast in pearl millet

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Among the various diseases of bajra, blast referred as leaf spot caused by *Pyricularia grisea (Cooke) Sacc.* [Teleomorph: *Magnaporthe grisea* (Herbert) Barr.] has emerged as a serious disease affecting both forage and grain production in pearl millet (Kaurav *et al*., 2018), resulting economic loss. Recently intensity of blast increased at alarming rate in commercial hybrids cultivation (Thakur *et al*., 2009). Chemical control is taken to manage this disease. The information regarding efficacy of bio agents was not sufficient. Looking to the recent trends and weightage on chemical residue free food items demand among pearl millet consumers, this recommendation is more useful to farmers as well as consumers. In view of these. A field experiment was conducted during kharif seasons of 2023, 2024, and 2025 to evaluate the effectiveness of different bio-based treatments against blast disease of pearl millet. Nine treatments including a control were tested, and the pooled results of three years were analyzed. Among the treatments, Trichoderma harzianum proved most effective in reducing blast disease intensity at all growth stages. At 45 DAS, the minimum blast intensity (10.24%) was recorded with Trichoderma harzianum, which was statistically at par with cow urine (12.47%), NSKE (12.50%), Panchgavya (12.97%), Jivamrut (13.27%), Pseudomonas fluorescens (13.77%), and Bacillus subtilis (14.25%). At 60 DAS, Trichoderma harzianum recorded the lowest disease intensity (15.84%), followed by Jivamrut (17.31%). Similarly, at 75 DAS the minimum blast intensity (29.86%) was observed with Trichoderma harzianum, which was at par with Jivamrut (31.08%) and Pseudomonas fluorescens (32.56%), while the highest intensity (54.36%) was recorded in the control. The pooled data also revealed that the highest grain yield (2411 kg ha^{-1}) was obtained with Trichoderma harzianum, which was statistically at par with Pseudomonas fluorescens (2386 kg ha^{-1}), Bacillus subtilis (2345 kg ha^{-1}), Panchgavya (2307 kg ha^{-1}), and Jivamrut (2301 kg ha^{-1}). The maximum fodder yield (4883 kg ha^{-1}) was recorded with Panchgavya, which was at par with Bacillus subtilis, cow urine, Pseudomonas fluorescens, Trichoderma harzianum, and Jivamrut. The lowest grain (1689 kg ha^{-1}) and fodder yield (3570 kg ha^{-1}) were recorded in the control. Economic analysis indicated that Trichoderma harzianum resulted in the highest additional income (₹20,548 ha^{-1}), net realization (₹19,373 ha^{-1}), and maximum ICBR (1:17.49). Based on the results, spraying of Trichoderma harzianum (50 g/10 L of water) or Jivamrut (300 ml/10 L of water) is recommended for effective management of blast disease in pearl millet along with higher yield and better economic returns.

Keywords: Pearl Millet, **blast,** *Trichoderma harzianum*

Improving Seed Health and Disease tolerance in Clusterbean (*Cyamopsis tetragonoloba*) through Seed Biopriming

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Clusterbean (*Cyamopsis tetragonoloba* L.) is an important legume crop cultivated in the semi-arid regions of India, where farmers often store seeds for subsequent seasons. However, prolonged storage under ambient conditions adversely affects seed health, germination, and biochemical quality. The present study was conducted to evaluate the impact of long-term seed storage and the potential of seed biopriming with microbial inoculants to improve seed health and tolerance against dry root rot. Seeds of clusterbean variety GG-2 stored for 0, 12, and 24 months were assessed for seed health parameters. Fresh seeds exhibited 100% germination, maximum seedling length (8.8 cm), seedling dry weight (0.121 g), vigour index-I (461.2), and vigour index-II (7.76), whereas seeds stored for two years failed to germinate due to infection by fungi such as *Alternaria* sp., *Aspergillus* sp., and *Fusarium* sp.. Biochemical analysis also revealed a decline in guar gum content from 28.63% in healthy seeds to 25.63% and 23.60% in stored and infected seeds, respectively. To improve seed performance, seeds of variety RGC-1066 were bioprimed with different microbial bioagents including *Bacillus* sp., *Pseudomonas* sp., and *Trichoderma* species and evaluated under soil artificially infested with *Macrophomina phaseolina*. Biopriming with *Pseudomonas stutzeri* and *Bacillus subtilis* significantly reduced disease incidence (18.75% and 23.77% control, respectively) and improved germination, root and shoot growth. Enhanced activities of defense-related enzymes such as phenol, PAL, PO, PPO, and SOD further indicated induced resistance in treated plants. The results demonstrate that seed biopriming with beneficial microbes can improve seed vigour, enhance biochemical defense responses, and mitigate dry root rot in clusterbean under stress conditions.

Management of Twister Disease of Onion

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Onion (*Allium cepa* L.) is an important vegetable crop with high economic and nutritional value. However, its productivity is severely affected by twister disease, particularly during the *Kharif* season. The present investigation was undertaken to study the epidemiology, etiology and management of twister disease in Karnataka. Surveys conducted during *Kharif* 2022–23 and 2023–24 revealed its widespread occurrence with considerable variation in disease severity. Diseased samples yielded 72 isolates of *Colletotrichum* sp., 34 isolates of *Fusarium* sp. and 20 isolates of *Agroathelia rolfsii*, whose identity was confirmed through ITS and species-specific primers. Screening of 126 onion germplasm identified genotypes 1254, 1369, W-329, W-398 and W-464 as relatively resistant, while all commercial cultivars were highly susceptible. Delayed sowing (15th August and 1st September) significantly reduced disease severity and improved yield compared to early sowing. Field evaluation of fungicides indicated that Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1 ml/l recorded the lowest disease incidence (15.13 and 25.15% PDI) and highest bulb yields (29.17 and 30.75 t/ha) with superior economic returns (ICBR of 3.18 and 3.81). Residue analysis showed that fungicide residues declined below detectable limits within 20 days after application.

Identification of Slow Rusting and Resistant CIMMYT Bread Wheat (*Triticum Aestivum* L.) Genotypes against Stripe Rust

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Wheat stripe rust, caused by *Puccinia striiformis* f. sp. *tritici*, is a highly destructive foliar disease that poses a serious challenge to wheat production across the globe. The fungus is capable of infecting the green foliage wheat at any stage of growth. By focusing on the great losses caused by stripe rust in wheat, the present investigation was perfomed with 51 distinct high-yielding CIMMYT wheat genotypes at CCS Haryana Agricultural University, Hisar during *rabi* season of 2024-25. Adult plant resistance (APR) evaluation highlighted 3 genotypes (SABWGPYT-3020, SABWGPYT-3022, SABWGPYT-3041), which were found resistant, whereas, 5 genotypes (SABWGPYT-3009, SABWGPYT-3011, SABWGPYT-3012, SABWGPYT-3017 and SABWGPYT-3055) were found to be slow rusting. Promising novel genotypes showed lower area under disease progress curve (AUDPC), coefficient of infection (CI), and apparent infection rate (r), highlighting their potential for stripe rust management. The findings emphasize the significance of these genotypes for developing yellow rust-resistant wheat and supporting long-term crop defense.

***Keywords*:** Adult plant resistance; *Puccinia striiformis*; slow rusting; wheat

CRISPR-Cas genome editing techniques for plant disease detection with reference to *Bipolaris sorokinina*

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Early and reliable detection of plant pathogens is essential for effective disease surveillance and sustainable crop protection. *Bipolaris sorokiniana*, the causal agent of spot blotch disease in wheat, is a major constraint to wheat production in the Indo-Gangetic Plains. In the present study, we developed and validated a rapid and highly specific CRISPR–Cas9–based molecular diagnostic assay for the detection of *B. sorokiniana* by targeting the conserved ToxA virulence gene. Initial validation was performed using conventional PCR, which consistently amplified a specific ToxA fragment from *B. sorokiniana* genomic DNA, confirming primer specificity. Two single-guide RNAs (sgRNA1 and sgRNA2) targeting conserved regions within the ToxA gene were designed, synthesized via *in vitro* transcription, and functionally validated. Cas9-mediated cleavage of genomic DNA produced predictable and guide-specific fragment patterns demonstrating precise and sequence-specific nuclease activity. To enhance assay speed and field applicability, recombinase polymerase amplification (RPA) was optimized for isothermal amplification of the ToxA gene. RPA successfully generated a specific amplicon from both pure fungal cultures and naturally infected wheat leaf samples. Subsequent Cas9 cleavage of the RPA products resulted in distinct and reproducible fragment profiles with no nonspecific cleavage observed in negative controls. The clear differentiation between cleaved and uncleaved products confirmed the robustness and specificity of the integrated RPA–CRISPR–Cas9 workflow. Overall, this study establishes a sensitive, rapid, and reliable Cas9-based diagnostic framework capable of detecting *B. sorokiniana* directly from infected plant material using minimal DNA input and without the need for thermal cycling. The developed approach demonstrates strong potential for field-deployable plant disease diagnostics and provides a versatile platform that can be readily adapted for the detection of other economically important plant pathogens.

Keywords: CRISPR–Cas9; recombinase polymerase amplification (RPA); plant pathogen diagnostics; *Bipolaris sorokiniana*; ToxA gene; hrpB1 gene; isothermal amplification; molecular detection.

Volatilome-Mediated Biocontrol of *Ralstonia solanacearum*: Linking Functional Traits with Ultrastructural Disruption

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Bacterial wilt of tomato, caused by *Ralstonia solanacearum*, remains a persistent constraint to crop productivity owing to its high ecological adaptability and the inadequacy of conventional management approaches. The present investigation focused on exploring bacterial antagonists capable of suppressing the pathogen through the release of microbial volatile organic compounds (MVOCs). A diverse set of bacterial isolates was procured and subjected to preliminary screening to assess their antagonistic potential under in vitro conditions. Among these, 28 isolates demonstrated significant inhibitory effects against *R. solanacearum* in direct confrontation assays. To specifically examine the role of volatiles in pathogen suppression, a dual-plate sealed system was employed, ensuring physical separation between the antagonist and the pathogen while permitting only gaseous interaction. Under these conditions, substantial inhibition of pathogen growth was recorded, with reductions ranging from 20.93 to 76.74% in radial expansion and 3.22 to 42.45% in colony diameter, clearly indicating the efficacy of MVOCs as key inhibitory agents. Subsequent characterization of the potent isolates revealed a broad spectrum of plant growth-promoting rhizobacterial (PGPR) traits. A proportion of isolates exhibited hydrogen cyanide production (32.14%), siderophore synthesis (35.71%), phosphate solubilization (71.43%), and extracellular amylase activity (67.86%), reflecting their multifunctional role in plant health enhancement and disease suppression. To further understand the mechanistic effects of bacterial volatilomes, field emission scanning electron microscopy (FESEM) was utilized to examine the cellular integrity of *R. solanacearum* following exposure to MVOCs emitted by the top-performing isolates. Treated pathogen cells showed pronounced ultrastructural alterations, including disruption of cell membrane integrity, irregular surface morphology, fragmentation of rod-shaped cells, reduced cell size, and modifications in extracellular polymeric substances compared to untreated controls. These observations suggest that MVOCs interfere with the structural and physiological stability of the pathogen, thereby diminishing its survival and virulence. The findings highlight the significant role of microbial volatilomes as bioactive compounds in suppressing phytopathogens and emphasize their promise as eco-friendly and sustainable tools for managing bacterial wilt in tomato and other economically important crops.

Keywords: Microbial volatilomes, volatile mediated antagonism, tomato, *Ralstonia solanacearum*, bacterial wilt

Exploiting Gamma Irradiation to Enhance Biocontrol Traits in *Trichoderma* spp.: A Genomic and Functional Approach

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Plant disease management has traditionally relied on synthetic fungicides; however, their excessive use has led to serious concerns such as environmental contamination, human health risks, and the emergence of resistant pathogen strains. Consequently, biological control strategies have gained prominence, with *Trichoderma* species recognized as effective and eco-friendly biocontrol agents. These fungi suppress a wide range of plant pathogens through mechanisms including mycoparasitism, nutrient competition, secretion of hydrolytic enzymes (chitinases and glucanases), antibiotic production, and induction of plant defense responses. The present study aimed to enhance the biocontrol efficacy of selected *Trichoderma* species (*T. harzianum*, *T. viride*, and *T. asperellum*) through gamma irradiation-induced mutagenesis. Two strains from each species were exposed to gamma radiation (0–500 Gy) using a cobalt-60 source at BARC, Zakura, Srinagar. A total of 60 mutants were generated and evaluated for morpho-cultural stability over seven generations, with parent strains maintained as controls. The mutants were characterized based on morphological, cultural, and biochemical parameters, including colony characteristics, growth rate, spore germination, colony-forming units (CFU), mycelial dry weight, and enzymatic activities (β-1,3-glucanase and chitinase). Their antagonistic potential was assessed against *Dematophora necatrix* and *Fusarium oxysporum* f. sp. *capsici* under in vitro conditions, followed by in vivo evaluation for chilli wilt management. Whole genome sequencing was performed for the most promising mutants. Among all mutants, F9 exhibited superior performance, with the highest growth rate (3.315 mm/hr), spore germination (7.69×10^7 ml^{-1}), CFU count (5×10^6 ml^{-1}), and mycelial dry weight (436.95 mg). It also showed enhanced β-1,3-glucanase activity (135.47 mmol glucose min^{-1} ml^{-1}), while mutant D8 recorded the highest chitinase activity (200.42 mmol GlcNAc min^{-1} ml^{-1}). In vitro assays revealed maximum inhibition by F9 against *D. necatrix* (83.40%) and *F. oxysporum* (92.00%). Field evaluations demonstrated complete disease control (100%) by mutants A7, A9, F9, and F10, compared to 72% in wild-type strains. Notably, two *T. asperellum* mutants, A7 (350 Gy) and F9 (450 Gy), were identified as the most stable and effective, with genome sequencing revealing significant genetic variations. The findings highlight gamma irradiation as a promising approach for improving *Trichoderma*-based biocontrol agents and advancing sustainable disease management strategies.

Keywords: *Trichoderma asperellum*, Gamma irradiation, Mutagenesis, Biocontrol agents, Chilli wilt, Apple root rot, Antagonistic activity, *Fusarium oxysporum, Dematophora necatrix*

Studies On Pathogenic Diversity Of *Colletotrichum* Species Associated With Anthracnose Of Dragon Fruit (*Hylocereus* Spp.) in West Bengal

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Dragon fruit (*Hylocereus* spp.) is high-value and emerging tropical fruit crop in India. Anthracnose is a major constraint to its cultivation, causing severe losses under both field and postharvest conditions. Recent evidence indicates the involvement of multiple *Colletotrichum* species complex for induction of the disease. The present investigation was aimed at the identification of pathogen(s) diversity associated with anthracnose of dragon fruit and their morphological, cultural and molecular characterisation. Diseased cladodes were collected from a horticultural farm (22.945013° N, 88.534471° E) in West Bengal during different periods of the year. The pathogen was isolated under in vitro condition, pathogenicity was established *in vitro* fulfilling Koch's postulates. Cultural and morphological characterization was carried out based on colony growth and biomass production on different solid and liquid media at varied temperature regimes (20, 24, and 28 °C) and observation on hyphal characteristics, conidial morphology, dimensions, acervuli formation, and appressorium features. Molecular identification was performed through PCR amplification and sequencing of the internal transcribed spacer (ITS) region of 18S rDNA. Based on combined molecular and morphological analyses, the pathogen(s) were identified as *Colletotrichum fructicola*, *C. truncatum*, and *C. gloeosporioides*, and the sequences were submitted to public databases for accession numbers. In vitro fungicide sensitivity assays using Mancozeb, Tebuconazole, Azoxystrobin, and Carbendazim revealed significant variation in efficacy at different concentrations. The study confirms the association of a *Colletotrichum* species complex with anthracnose of dragon fruit and highlights the importance of precise pathogen identification for developing effective and sustainable disease management strategies.

Efficacy of natural farming inputs and botanical extracts against *Alternaria alternata*, the causal agent of leaf spot disease of potato

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Potato (*Solanum tuberosum* L.) is one of the most important food crops globally and plays a significant role in food and nutritional security. However, its productivity is severely affected by various diseases, among which leaf spot caused by *Alternaria alternata* has emerged as a major constraint, leading to yield losses ranging from 20–60%. The present study was conducted to evaluate the efficacy of natural farming inputs and botanical extracts against *A. alternata* under *in vitro*, pot and field conditions. *In vitro* studies revealed that natural inputs such as herbal kunapajala, jeevamrut and cow urine exhibited strong antifungal activity, achieving up to 100% inhibition of mycelial growth at higher concentrations. Among botanical extracts, curry leaf, camphor and clove extracts showed significant inhibitory effects against the pathogen. Pot culture experiments demonstrated that tuber treatments with these inputs enhanced plant growth parameters, including shoot length, foliage mass and tuber yield, along with increased biochemical constituents such as phenols, chlorophyll and carotenoids. Field evaluation further confirmed the effectiveness of these treatments in reducing disease severity and improving yield. Although chemical fungicide (Mancozeb) showed the highest disease control, natural farming inputs, particularly herbal kunapajala and jeevamrut, performed comparably well and significantly outperformed the untreated control. The study highlights that natural farming inputs and botanical extracts are eco-friendly, cost-effective and sustainable alternatives to chemical fungicides for the management of leaf spot disease of potato. Their adoption can contribute to reduced chemical dependency, improved soil health and sustainable crop production systems.

***Keywords**:* Leaf spot, Potato, Botanicals, Jeevamrut, Pot culture

Effect Of Trichoderma As Bio Control Agent On Mango Antharacnose Management

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Mango anthracnose, caused by Colletotrichum gloeosporioides, is one of the most destructive diseases affecting mango production, leading to significant pre- and post-harvest losses. The present study was conducted to evaluate the efficacy of Trichoderma spp. as a biological control agent against C. gloeosporioides. In vitro studies pathogen was isolated from the infected mango leaves while bio-control agents viz. Trichoderma viride from rhizospheric soil were carried out using the dual culture technique to assess the antagonistic activity of Trichoderma isolates. The results revealed that Trichoderma significantly inhibited the radial growth of the pathogen, with maximum inhibition ranging between 67.9%. The biocontrol activity of Trichoderma is attributed to multiple mechanisms. It exhibits mycoparasitism by directly attacking and degrading the hyphae of the pathogen. It also produces antifungal metabolites that suppress the growth and spore germination of C. gloeosporioides. Additionally, Trichoderma secretes cell wall degrading enzymes such as chitinases and glucanases, which further contribute to pathogen inhibition. Competition for nutrients and space also plays a crucial role in limiting the establishment of the pathogen. Further observations under in vivo conditions indicated that application of Trichoderma reduced disease severity in mango fruits without causing any adverse effects on plant health. The treatment also improved fruit quality and shelf life. The findings of the study highlight the potential of Trichoderma as an eco-friendly, sustainable, and effective alternative to chemical fungicides for the management of mango anthracnose. Adoption of such biological approaches can contribute to safer agricultural practices and environmental conservation.

B5 – Soil Health, Nematology & Root Microbiome

Characterization and Management of the Pathogen Causing Web Blight Disease of Mungbean in Sub-Mountainous Region of Punjab

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Web blight disease incited by *Rhizoctonia solani* impedes mungbean production drastically. The primary goal of the study was to characterize the pathogen associated to web blight of mungbean in the Shiwalik region of the North-Western Himalayas, as well as its eco-friendly management. The isolates recovered from diseased samples were identified as *Rhizoctonia solani* based on nucleotide sequence data of ITS 5.8S-rDNA region. The sequences were registered to NCBI with accession numbers as ON176687 (BS), ON176686 (NS), ON084814(L1), ON084815(RO) and ON084816(L2). After defining the pathogen and its pathogenicity, *in vitro* and *in vivo* experiments were conducted to manage the disease non-chemically. The PAU new consortia (*B. Subtilis*+ Rhizobacteria) exhibited maximum hyphal inhibition (32-40.5%) of *R. solani* isolates *in vitro* with after 72 hours of inoculation. Three years pooled data of field trials revealed that above said consortium also showed the greatest efficacy in reducing the web blight severity by 45.99% with maximum disease control (32.38%) and yield (3.73 q/acre) respectively as compare to other treatments.

***Keywords*:** Biological control, green gram, ITS, *Rhizoctonia solani*

Characterization And Virulence Spectrum Of *Rhizoctonia Solani* Inciting Rice Sheath Blight

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Rhizoctonia solani is an important ubiquitous phytopathogenic fungus with a enormously wide host range and considered one of the causes for stagnated productivity of the crop in the country. *Rhizoctonia solani* Kuhn come under anastomosis group AG1-IA, and has been identified as the predominant causal agent of sheath blight of rice. These diseases are alarming due to its intensive cultivation of modern high yielding varieties with application of high doses of nitrogenous fertilizers. Sheath blight is recorded as one of the most damaging diseases and holds the second most prominent position after rice blast. It causes yield losses ranging between 4-50 % depending on the climatic conditions, crop stage, time of infection, and pathogen's virulence. Initially the symptoms appeared as water-soaked chlorotic patches on leaf sheaths on culms just above the water level which are ellipsoid or ovoid somewhat irregular and greenish grey in colour. High humidity, temperatures between 28-32°C, and frequent rainfall can exacerbate sheath blight severity. An artificial inoculation method is necessary for accurate evaluation of disease and screening of resistant cultivars. This present study examined the substate used to grow *Rhizoctonia solani* inoculum and to test the pathogenicity of *R. solani* isolates and virulence pattern inciting rice sheath blight. For the mass multiplication of *Rhizoctonia solani*, cereal grains **barley, wheat and Typha leaf bits were used.** The virulence of collected *Rhizoctonia solani* isolates were evaluated by conducting pathogenicity tests in a glass house using susceptible rice cultivar Rejendra Sweta. Barley grain colonised with *R. solani* was found more significant with relative lesion height to plant height of 32.27 %, followed by wheat grain colonised with *R. solani* 23.46 %. However, minimum relative lesion height to plant height was observed with Typha leaf bit inoculated with *R. solani*. Virulence analysis of all the *Rhizoctonia* isolates induced sheath blight symptoms on rice and variation was observed among the isolates concerning RLH.

Implications Of Exogeneous Salicylic Acid Application For Groundnut Bud Necrosis Virus Management In Tomato

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Groundnut bud necrosis virus (GBNV), belongs to the genus *Tospovirus*, is a significant problem to tomato (*Solanum lycopersicum*) production, leading to drastic economic losses. A study was conducted to explore the potential of exogenous salicylic acid (SA) application to induce host plant resistance against GBNV. Infected tomato plants were treated with 0.5 mM concentration of SA *via* foliar spray, first spray at flowering and second spray at fruit formation i.e., after 15 days of first spray. The GBNV presence was confirmed through enzyme linked immunosorbent assay (ELISA), reverse transcription polymerase chain reaction (RT-PCR), and viral load and expression of pathogenesis-related genes (PR-1 & PR-5) through real time PCR. The defence-related enzymes i.e., SOD, CAT & POX at 0, 5, 10 & 15 days after first spray & second spray (I DAS & II DAS) was analyzed. ELISA, RT-PCR, absolute RT-qPCR revealed that virus concentration from 0 DAS to 15 DAS was decreased in salicylic acid treated plant in both first and second spray in contrast to without salicylic acid treated plant. Further PR gene expression showed that PR-1 & PR-5 expression level increased upon salicylic acid spray. Defence-related enzymes analysis supported these results showing that SOD, CAT & POX enzymes were highly active in salicylic acid treated plant followed by only virus infected and healthy plants. Indicating exogenous application of SA significantly reduced viral accumulation in treated plants, upregulated pathogenesis-related (PR) genes and increased the activity of antioxidant enzymes. The results demonstrate that exogenous SA application is a viable biochemical tool for the management of GBNV in tomato.

Modulation of the Rhizobiome via Serotonin-Functionalized Zinc Oxide Nanoparticles in Enhancing Biotic Stress Resilience

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Acute biotic challenges arising from soil-borne pathogens and pests critically compromise crop productivity, and substantial evidence suggest that reduced plant performance is tightly linked to the structural and functional rhizobiome profiles shaped by root exudates. Serotonin is increasingly recognized as a pivotal root-derived metabolite that simultaneously alters root system architecture and modulates rhizospheric population dynamics via selective enrichment of the beneficial microbial taxa, showcasing its efficacy in targeted rhizosphere reprogramming. Concurrently, zinc oxide nanoparticles (ZnONPs) have demonstrated its ability to orchestrate root- associated microbiota and rhizospheric metabolome and can enhance plant stress tolerance when applied at appropriate doses. Unifying these independent findings, this study proposes a novel nano-enabled strategy: serotonin-functionalized zinc oxide nanoparticles formulated to recalibrate root metabolic profiles, thereby reshaping the rhizosphere microbiome to enhance biotic stress resilience. In this conceptual framework, ZnONPs functions as a nutrient and nano-carrier while surface-bound serotonin acts as a targeted signalling cue that is gradually released into the rhizosphere, selectively enriching plant growth-promoting rhizobacteria while suppressing pathogen-associated taxa. Through the active recalibration of key nutritional and defensive exudates, serotonin-functionalized zinc oxide nanoparticles are hypothesized to amplify induced systemic resistance, reinforce root barrier properties, and maintain microbiome homeostasis during acute pathogenic attack. This design explicitly integrates nanoparticle-mediated changes in exudation profile with microbiome-guided pathogenic suppression, an aspect that has emerged recently in broad spectrum of nanoparticle-plant-microbe studies and not yet explored for neurotransmitter loading. Consequently, this proposed design provides a mechanistically robust and scalable tool to restructure rhizosphere ecology, offering a novel paradigm for nano-enabled, microbiome-centric agronomy protection against acute biotic challenges.

Keywords: Serotonin, ZnONPs, Rhizobiome, Root Exudation, Biotic Stress

Deciphering Biocontrol Potential Of Pleurotus Sp. On Plant Parasitic Nematode: Mechanism And Aplication

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The biocontrol potential of Pleurotus species against root-knot nematodes in tomato was evaluated under in vitro, pot, and field conditions. Five species, viz., Pleurotus ostreatus, Pleurotus sajor-caju, Pleurotus djamor, Pleurotus pulmonarius, and Pleurotus columbinus, were evaluated for their antagonistic activity against free-living and root-knot nematodes. Under in vitro conditions, all species secreted toxin-containing droplets in varying quantities on vegetative hyphae. Observations recorded at 6, 12, 18, and 24 hours after inoculation revealed effective immobilization and degradation of nematode juveniles. Among the tested species, P. ostreatus exhibited the highest parasitic efficiency, followed by P. sajor-caju, P. pulmonarius, P. djamor, and P. columbinus. Nematode predation was found to be directly related to the toxin production efficiency of the fungi. Based on in vitro performance, the three most effective species (P. ostreatus, P. sajor-caju, and P. pulmonarius) were further evaluated under pot and field conditions using crude extracts (50% and 100%) and spent substrate (10%). Application of P. ostreatus spent substrate in sterilized soil along with farmyard manure significantly improved plant growth parameters, including shoot length (up to 56.17 cm), root length, and shoot weight, while reducing nematode infestation. The lowest gall number (5.66 galls per cm root) with reduced gall dimensions was recorded with 100% crude extract of P. ostreatus under pot conditions. Similar results were observed under field conditions, confirming its superior efficacy. The study demonstrates that Pleurotus, particularly P. ostreatus, holds strong potential as an eco-friendly biocontrol agent for managing root-knot nematode in tomato.

Keywords: Bio-efficacy, Crude extract, Root-knot nematode, Spent, Plant growth, Tomato

B6 – ECO-PATHOLOGY: NATURAL FARMING, AGRO-SCAPING & CLIMATE RESILIENCE

Neem-Based Inputs for Climate-Resilient Vegetable Protection

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The present study focuses on the evaluation of neem-based inputs for promoting climate-resilient vegetable protection. Neem (*Azadirachta indica*), an important component of traditional Indian agriculture, is widely known for its insecticidal, nematicidal, and antifungal properties. Despite its long history of use in crop protection, many traditional neem-based practices still require systematic scientific validation under modern agricultural conditions. In this study, neem seed kernel extract, neem oil, and neem cake are evaluated along with compatible biofertilizers under both laboratory and field conditions. Their effectiveness is assessed in managing major insect pests, root-knot nematodes, and soil-borne fungal pathogens affecting vegetable crops. Special emphasis is given to understanding how neem-based inputs can contribute to sustainable crop protection while maintaining soil health and ecological balance under changing climatic conditions. The findings aim to support the development of integrated neem-based management strategies for sustainable pest and disease control in vegetable production systems. These strategies can help reduce dependence on chemical pesticides while encouraging the use of eco-friendly, locally available, and cost-effective alternatives. Overall, the study highlights the potential of neem-based inputs as sustainable tools for vegetable crop protection, contributing to safer food production, improved soil health, and climate-resilient agricultural systems.

Keywords: Neem, vegetable protection, soil-borne fungal pathogens, root-knot nematodes, sustainable crop protection.

Epidemiology and Yield Loss Assessment of Bacterial Blight of Clusterbean in Semi Arid Region of North Gujarat

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Clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.), commonly known as guar, is an important summer annual legume belonging to the family *Fabaceae* and tribe Galegeae. It is primarily cultivated for cattle feed, vegetable, green manuring and industrial purposes. The crop is well adapted to arid and semi-arid regions of India, which accounts for 75-80% of the global market. However, clusterbean is susceptible to several diseases, among which bacterial blight caused by *Xanthomonas axonopodis* pv. *cyamopsidis* is one of the most destructive. A field study was conducted to evaluate the influence of weather parameters *viz*., temperature, relative humidity, rainfall and sunshine hours recorded in seven days interval on the occurrence of clusterbean bacterial blight were recorded at Pulses Research Station, Sardarkrushinagar, Dist. Banaskantha in Gujarat for consecutive three years 2022 to 2024. The results revealed that the maximum temperature of 30.5 to 34ºC, minimum temperature of 23.5 to 26.0ºC, maximum relative humidity of 87 to 93% and minimum relative humidity of 56 to 75% coupled with intermittent rainfall with 95 to 125 mm and bright sunshine hours were contributed significantly for the disease development and its further build-up. An another experiment was conducted during *Kharif* 2022-24 at hotspot locations near Sardarkrushinagar to assess yield losses due to bacterial blight in clusterbean. The study compared protected plots (seed treatment with Carboxin 37.5% + Thiram 37.5% WP @ 2 g/kg seed) with unprotected plots. The results indicated a significant difference in yield between treatments. A yield loss of 39.03% was recorded in unprotected plots due to 42.96% higher disease incidence. These findings highlight the significant impact of bacterial blight on clusterbean productivity and emphasize the importance of appropriate disease management strategies under North Gujarat conditions.

Field evaluation of bioagent, botanical and fungicides in combination for the management of anthracnose in pomegranate

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Anthracnose is an emerging serious disease of pomegranate in the arid and semi-arid regions of Rajasthan. It is mainly caused by the fungal pathogen *Colletotrichum gloeosporioides* and results in significant yield loss and reduced fruit quality. Effective management of this disease requires the integration of biological agents, botanicals, and fungicides to suppress the pathogen while reducing reliance on synthetic chemicals. Therefore, the present study evaluated the efficacy of different foliar spray treatments comprising bioagent, botanical, and fungicides applied individually and in combination as tank mixture for the management of anthracnose in pomegranate under field conditions during 2023–24 and 2024–25. Application of all treatments led to a significant reduction in disease severity on leaves and fruits, along with corresponding increase in fruit yield compared with the untreated control. Among the treatments, foliar application of Carbendazim 50 WP (0.75 g L^{-1}) + Chlorothalonil 75 WP (0.75 g L^{-1}) + Mandipropamid 23.4 SC (0.50 ml L^{-1}) significantly outperformed most of the treatments, resulting in the lowest disease severity on leaves (16.72%) and fruits (16.44%), along with the highest fruit yield (853.22 kg ha^{-1}). This treatment reduced disease severity by **57.85 % on leaves** and **66.96 % on fruits**, while **increasing fruit yield by 101.20 %** compared with the untreated control. However, its effect on leaf disease severity was statistically comparable with the treatment consisting of Neem oil (0.50 ml L^{-1}) + Carbendazim 50 WP (0.75 g L^{-1}) + Chlorothalonil 75 WP (0.75 g L^{-1}), which recorded 18.93% disease severity on leaves. Based on two-year epiphytotic field evaluation, foliar application of Carbendazim 50 WP (0.75 g L^{-1}) + Chlorothalonil 75 WP (0.75 g L^{-1}) + Mandipropamid 23.4 SC (0.50 ml L^{-1}) was recommended for the management of anthracnose in pomegranate.

Fruit Waste-Derived Organic Amendments for Enhancing Soil Fertility and Crop Productivity: A Circular Bioeconomy Approach

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Due to the spurring effect of fruit processing and consumption, there has been a creation of large amounts of fruit waste, in the form of peels, pulp, seeds and pomace, that reveal enormous waste management and environmental issues. Nevertheless, these residues contain high concentrations of organic matter, macro and micronutrients and bioactive compounds which can be useful to sustainable agriculture. The current review discusses the prospects of using fruit waste-based organic amendments as a sustainable solution to increase soil fertility and crop yield in a circular bioeconomy system. Different conversion technologies like composting, vermicomposting, biochar, and liquid organic fertilizer using fruit waste have shown high enhancement of soil physical, chemical and biological properties. These amendments increase soil organic carbon, nutrient supply, microbial activity and water retention potential that increases the growth and yield of plants. Moreover, the use of fruit waste saves the use of chemical fertilizers and ensures environmental pollution is minimized, and recycling of waste is done in a sustainable manner. Recent literature has pointed out the efficacy of fruit waste-based amendments at enhancing crop productivity in horticultural as well as field crops besides facilitating climate-wise agriculture. Although the results are promising, the challenges of nutrient variability, standardization of the processing strategies, and large-scale adoption are present. Thus, the use of fruit waste-based amendments in sustainable agricultural systems is a promising solution to betterment of soil health, increased crop productivity, and promotion of principles of the circular bioeconomy. This strategy will help in sustainable food production, valorization of waste, and environmental protection.

Keywords: Fruit waste, Organic amendments, Soil fertility, Crop productivity, Circular bioeconomy, Sustainable agriculture, Compost, Biochar

C. FOOD SECURITY & VALUE ADDITION

C7 – POST-HARVEST PATHOLOGY, MYCOTOXINS & FOOD SAFETY

Eco-Friendly And Sustainable Management Of Guava Anthracnose

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A series of *In vitro* and *In vivo* experiments were conducted at NAU, Navsari, during 2023-2024 aimed in developing sustainable and eco-friendly strategies for the managing of anthracnose in cv. Bihi-VNR through integrated pre and post-harvest interventions. An investigation was carried out to determine the impact of KCL application as a pre-harvest on the development of anthracnose disease. Among the treatments that were assessed, the treatment with lowest percentage of disease incidence was 3.0 g l^{-1} KCL (13.33%), followed by 2.5 g l^{-1} (20.00%) and the treatment with the highest percentage of disease incidence was the control (70.00%). Pre harvest application of 3.0 g l^{-1} KCL was found to be most effective by reducing anthracnose incidence by 80.95% and extending shelf life to 8.33 days compared to control (3.33 days). Post-harvest treatment with 2.5 g l^{-1} $NaHCO_3$ reduced disease by 77.77% and increased shelf life to 7.33 days as compared to control (3.00 days), also there was a reduction in the phenol content, total sugar, non-reducing sugar and reducing sugar of infested guava fruits. The titratable acidity parameter (41.53%) showed the highest reduction followed by the phenol content parameter (34.24 %), while the non-reducing sugar parameter (7.47%) showed the least reduction. *In-vitro* evaluation had been carried out to determine the effectiveness of various botanical leaves in suppressing anthracnose and prolonging the shelf life of guava cv. Bihi-VNR. Fruits packed with lantana leaves have the lowest disease incidence (20.00%) which was found at par with fruits packed with neem and tulsi leaves (30.00%) as compared to control. Fruits packed with lantana leaves showed a significantly longer shelf life (8.33 days) as compared to the control (3.00 days). Overall, integrated management comprising pre-harvest application of 3.0 g l^{-1} KCL, post-harvest 2.5 g l^{-1} $NaHCO_3$, as well as packing them with lantana leaves are proven to be most effective as well as treatments involving (salts and minerals) are essential for human health ultimately yielding best possible outcome by avoiding the human health hazard through successful and sustainable management of anthracnose in guava.

Keywords: Anthracnose, Eco-friendly, Guava, Human health, Pre harvest, Post harvest, shelf life.

Identification Of Rna Silencing Suppressor Proteins Encoded By *Soybean Yellow Mottle Mosaic Virus*

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Plant viruses encode RNA silencing suppressor (RSS) proteins to counter the induced antiviral defense, an RNAi silencing mechanism of the host. *Soybean yellow mottle mosaic virus* (SYMMV) belongs to the genus *Gammacarmovirus* within the family *Tombusviridae* causes the mosaic and mottling disease in leguminous crops especially in mungbean (*Vigna radiata*), soybean (*Glycine max*) and urdbean (*Vigna mungo*). The SYMMV genome consists of six open reading frames (ORFs), however the ORF encoding the potential RSS is not yet known. In order to know if any protein encoded by SYMMV might act as an RSS, six ORFs of SYMMV mungbean isolate *i.e.,* ORF 1, 1and 2, 3,4, 3 and 4, 5 and 6 were cloned into modified pCAMBIA 2300 binary vector (pBM1) followed by transformation of *Agrobacterium tumefaciens*. The recombinant clones were mixed with pCAMBIA 1302 (35S-GFP) in equimolar ratio and agro-infiltrated into leaves of *Nicotiana benthamiana* 16c line. GFP imaging through confocal microscope and stereo microscopic analyses were used to observe whether RNA silencing suppression occurred or not. Only the leaves infiltrated with 35s-GFP/ORF5 showed a GFP fluorescence signal similar to 35s-GFP/HC-Pro, a well studied positive RSS. Usually the induced host RNAi silencing is supposed to cleave the expressed GFP-RNA. However, it is suspected that ORF5 encoded protein was able to suppress the host silencing mechanism leading to retention of the GFP fluorescence signal. Later, quantitative reverse transcription PCR (qRT-PCR) assays showed a higher expression of GFP in ORF5 agro-infiltrated leaves. Together these results suggest that ORF5 encoded protein has the potential RSS function of SYMMV which successfully suppresses host RNAi silencing mechanism.

Seasonal Dynamics Of Antioxidant Enzymes And Phenolics Conferring Mymiv Resistance In Mungbean Cultivars

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Mungbean is a protein rich short-duration legume that ranks third after chickpea and pigeonpea and is widely cultivated in tropical and sub-tropical regions, making it vital for nutritional security. However, its productivity is severely affected by yellow mosaic disease caused by *Begomovirus vignaradiataindiaense* (mungbean yellow mosaic India virus/MYMIV) particularly under North-Indian conditions with yield losses upto 100% exceeding $300 million. The present study evaluated the differential activities of antioxidant enzymes in infected and non-infected plants of four mungbean cultivars, two resistant and two susceptible to MYMIV infection during *Summer* and *Kharif*/*Rainy* seasons of the year 2023. The results revealed that *Rainy* **season** showed highest disease incidence (DI), area under disease progress curve (AUDPC) and whitefly population (WFP) compared to *Summer*. Correlation analyses further showed that WFP and DI were significantly influenced by weather parameters like temperature, rainfall, sunshine hours and relative humidity. The presence of virus and copy number was confirmed through DAC-ELISA, PCR and qPCR. The qPCR results revealed higher accumulation of virus in susceptible cultivars than in resistant cultivars. The biochemical analysis showed that resistant cultivars exhibited higher levels of total phenol content, superoxide dismutase, peroxidase, ascorbate peroxidase, and phenylalanine ammonia lyase, lower catalase activity especially during *Rainy* season, indicating a strong defence mechanism mediated by phenylpropanoid pathway and antioxidants. Conversely, susceptible cultivars exhibited lower antioxidant enzyme activity, but higher catalase activity. All things considered, the research shows that MYMIV resistance in mungbean is a complex trait influenced by host antioxidant responses, vector biology, seasonal dynamics, and genotype of the plant. Thus, these antioxidants can be utilized as biochemical markers for screening MYMIV resistance in mungbean.

Prevalence And Diversity Of *Fusarium* Species Associated With Post-Harvest Spoilage Of Fruits From Delhi Region

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Fruits are vital for global nutrition and economic stability, yet significant post-harvest losses often caused by fungal diseases pose serious challenges to food security. Among the causal agents, *Fusarium* species are particularly concerning due to their broad host range and ability to produce mycotoxins, leading to severe quality deterioration and economic losses. This study aimed to characterize the *Fusarium* species associated with postharvest diseases of fruits collected from major wholesale markets (mandis) in Delhi, using both morphological and molecular approaches. A survey across five mandis revealed a high prevalence of *Fusarium*, which accounted for 43% of all fungal isolates obtained. Through detailed morphological analysis and multilocus phylogenetic inference using the *tef-1α* and *rpb2* genes, ten distinct *Fusarium* species were identified, belonging to five species complexes: *F. pernambucanum*, *F. irregulare*, *F. tanahbumbuense*, *F. brevicaudatum*, *F. chlamydosporum*, *F. oxysporum*, *F. sacchari*, *F. proliferatum*, *F. verticillioides*, and *F. solani*. Among these, *F. pernambucanum* was isolated most frequently and exhibited the broadest host range, underscoring its significance as a major post-harvest pathogen. Notably, this study reports *F. verticillioides* and *F. irregulare* for the first time in India as post-harvest pathogens of banana and mandarin, respectively. Pathogenicity tests on their respective fruit hosts confirmed the virulence of all identified species, with 23% of isolates classified as weakly pathogenic, 20% as mildly pathogenic, and 13% as highly pathogenic. Further, ISSR marker analysis revealed substantial genetic diversity among the *Fusarium* populations, clustering the isolates into four distinct genetic clades. These findings highlight the critical role of *Fusarium* species in post-harvest fruit decay and emphasize the urgent need for effective, targeted management strategies to mitigate losses and strengthen food security.

Keywords: Post-harvest diseases, survey, *Fusarium* spp., morpho-molecular characterization, genetic diversity

Synergistic Effects Of Endophytic *Bacillus Subtilis*, Probiotic *Lactobacillus Plantarum*, And Gras Chemical Against *Penicillium Digitatum* Causing Green Mould Rot In *Citrus* Spp.

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Citrus fruits are economically important horticultural crops, but their marketability is severely affected by post-harvest green mould rot caused by *Penicillium digitatum*. The present investigation aimed to develop an integrated, eco-compatible management strategy combining bacterial biocontrol agents with a Generally Recognized As Safe (GRAS) chemical under *In vitro* and *In vivo* conditions. Market surveys conducted across Tamil Nadu during 2024–2025 revealed variable disease incidence, with the highest Per cent Disease Index (PDI) of 37.54% recorded in Tiruvannamalai market. Fifteen isolates of *P. digitatum* were obtained, among which isolate Pd04 was identified as the most virulent based on cultural, morphological, and pathogenicity studies. ITS-PCR amplification confirmed its identity, and the sequence was deposited in GenBank (Accession No. PV202322). Among ten isolates each of endophytic *Bacillus* spp. and probiotic *Lactobacillus* spp., *Bacillus subtilis* (Bs02) and *Lactobacillus plantarum* (LAB07) exhibited maximum mycelial inhibition of 71.97% and 78.65%, respectively, under dual culture assay. GC-MS analysis of culture filtrates revealed antifungal metabolites such as oleic acid, n-hexadecanoic acid, benzenacetic acid derivatives, thymol, and bis (2-ethylhexyl) phthalate, which suppressed conidial germination and altered fungal morphology. In poison food technique, 40% culture filtrates completely inhibited fungal growth. Among GRAS chemicals evaluated, sodium bicarbonate (2000 ppm) recorded 78.17% inhibition and was selected for combination studies. *In vivo* fruit-dipping experiments demonstrated that the combined application of *B. subtilis*, *L. plantarum* and sodium bicarbonate significantly reduced disease incidence and preserved fruit quality, indicating a promising sustainable alternative for managing post-harvest green mould rot in citrus.

Keywords: Citrus, Green mould rot, Bio-control, GRAS, GC-MS analysis

Unraveling The Pathogen–Symptom Relationship In Rice Seed Discolouration Complex

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Rice (*Oryza sativa* L.) is a globally important staple crop, particularly in developing countries such as India, where it underpins food security and agricultural livelihoods. However, rice productivity and seed quality are increasingly threatened by biotic stresses, among which seed discolouration has emerged as a significant yet underexplored constraint. This study was undertaken to elucidate the relationship between fungal pathogens and symptom expression within the rice seed discolouration complex.

A systematic classification of discoloured rice seeds was performed based on visual symptomatology, including pigment intensity, colour variation, and distribution patterns on the seed surface. Twelve distinct discolouration types were identified. Subsequent mycological analyses led to the isolation and identification of ten fungal species associated with these discoloured seeds. Among them, *Bipolaris oryzae* was the most prevalent pathogen, detected in association with seven out of the twelve discolouration categories, highlighting its dominant role in the discolouration complex.

Quantitative assessment revealed that ash grey discolouration was the most frequent symptom type, representing 8.05% of the total seed samples, followed by ashy brown to blackish discolouration (7.35%). Notably, a consistent association was observed between specific fungal taxa and particular discolouration patterns, suggesting a strong pathogen–symptom specificity. This indicates that symptom expression in rice seeds is not random but is closely linked to the infecting fungal species and possibly their metabolic interactions with host tissues.

The findings highlight the multifactorial nature of rice seed discolouration, driven by complex interactions between seedborne fungi and environmental conditions during seed development, harvest and storage. This study provides critical insights into pathogen diversity and symptomatology, thereby contributing to improved diagnosis and management strategies. Understanding these associations is essential for the development of targeted seed treatment approaches and integrated disease management practices aimed at enhancing seed health and crop productivity.

Keywords: discolouration, mycoflora, seedborne fungi, *Bipolaris oryzae*

C8 – Applied Mycology: Innovations In Mushroom Cultivation & Nutraceuticals

Unraveling Macrofungal Diversity in the Northern Himalayas: Integrative Morphology, Multilocus Phylogeny and Functional Bioactive Profiling

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Macrofungi constitute an integral component of forest ecosystems, contributing to nutrient cycling, symbiotic networks, and ecosystem resilience, while providing significant nutritional and medicinal value. The northern Himalayan region of India, including Jammu & Kashmir, Uttarakhand and Himachal Pradesh represents a biodiversity-rich landscape spanning alpine meadows to temperate coniferous forests. Despite its ecological complexity, comprehensive studies integrating diversity assessment with functional bioactivity remain limited. This preliminary investigation aimed to document macrofungal diversity and elucidate their phylogenetic relationships alongside functional bioactive potential. Specimens were collected during 2024–2025 from diverse substrates including forest soils, grasslands, decaying organic matter and woody debris. Micromorphological characterization involved the assessment of basidiospore morphology and basidial features for accurate species identification. Species delimitation and phylogenetic reconstruction were achieved using multilocus sequence data from ITS, LSU and TEF1-α gene regions to ensure taxonomic robustness. Seventy distinct species were identified, predominantly representing genera such as *Ganoderma*, *Trametes*, *Schizophyllum*, *Pleurotus*, *Coprinellus*, *Coprinopsis*, *Russula* and *Gleophyllum*. Multilocus phylogeny corroborated morphological identification and resolved species-level relationships within major clades. Functional bioactive profiling of 70 representative taxa comprised antioxidant evaluation through DPPH radical scavenging and ferrous ion chelation assays, coupled with spectrophotometric determination of total phenolic content, condensed tannins, gallotannins and total flavonoids. Marked interspecific variability was observed, with several taxa exhibiting pronounced antioxidant activity positively correlated with phenolic and flavonoid content. Collectively, these findings establish a foundational framework for understanding macrofungal diversity and functional bioactive potential in the northern Himalayas, highlighting their ecological importance and prospective value in sustainable bioprospecting.

Keywords: Macrofungal diversity, Multilocus phylogeny, Bioactive profiling

Evaluation of different substrates for the cultivation of cordyceps

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The present study evaluated the suitability of different grain substrates for the growth and yield performance of *C. militaris*. Pooled data indicated that the minimum number of days required for complete colonization was observed in brown rice substrate (6.83 days), followed by sorghum grain (8.67 days), whereas the maximum colonization period was recorded in bajra grain (14.50 days). Pinhead formation occurred earliest in brown rice (25.17 days) followed by sorghum grain (26.34 days), while no pinhead formation was observed in rajgira grain, wheat grain, soybean grain powder, and cotton seed hull. The maximum number of stromata was obtained in brown rice (20.50), followed by sorghum grain (9.84), whereas the minimum was recorded in maize grain (3.50). Biochemical analysis revealed no major differences in protein, phenol, and total sugar content among treatments. The highest fresh weight yield (16.78 g/bottle) and biological efficiency (83.87%) were achieved with brown rice substrate, followed by sorghum grain substrate. Overall, the results indicate that **brown rice is the most suitable substrate for the cultivation of** *Cordyceps militaris* due to its superior colonization rate, stromata production, yield, and biological efficiency.

From Waste To Wealth: Enhancing Livelihoods Through Sustainable Pink Oyster Mushroom Production

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The accelerating impacts of climate change and persistent malnutrition call for resilient and nutrient rich food systems. The Pink Oyster mushroom, *Pleurotus djamor*, an edible basidiomycete widely cultivated in tropical and subtropical regions, offers significant promise in this context. Characterized by its distinctive rose pink fruiting bodies and tolerance to higher temperatures (25-35°C), it presents a clear advantage over temperate mushroom species under warming climatic conditions. This study highlights the dual role of *P. djamor* as a functional food and a livelihood support enterprise. Nutritionally, it is rich in high-quality protein (20-30% on a dry weight basis), essential amino acids, vitamins B-complex, and potent antioxidants, making it valuable in combating "Hidden Hunger" and micronutrient deficiencies. The research emphasizes the optimization of cultivation using locally available lignocellulosic substrates, such as soybean straw, wheat straw, date palm straw, and cluster bean straw. The mushroom efficiently degrades these agricultural residues through ligninolytic enzymes, converting low value biomass into protein rich food while contributing to sustainable waste management and reducing environmental risks such as stubble burning. From a socio-economic perspective, *P. djamor* represents a low investment, short duration enterprise, with a cropping cycle of 20-25 days from spawning to harvest. This rapid turnover makes it suitable for landless farmers, smallholders, and women's self help groups. Its integration into small scale farming systems enhances household nutritional security while generating steady income through the sale of fresh and value added products. Overall, cultivation of the Pink Oyster mushroom embodies a climate smart approach to agriculture, linking waste recycling, nutritional security, and rural economic resilience in a sustainable framework.

Keywords: *Pleurotus djamor*, climate resilience, nutritional security, livelihood diversification, substrate optimization

Endo-microbiomes of Milky Mushroom and its potential in Enhancement of Mushroom Growth Promotion

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Milky mushroom, tropical mushroom, white rot basidiomycetes fungi with scope for pharmaceutical and industrial importance. In current study, the research was investigated to explore the bacterial endophytes in the milky mushroom and their efficiency in the mushroom growth promotion. Ten isolates of bacterial endophytes have been isolated from matured milky mushroom. Among them, three isolates, Bacillus velezensis, B. pumilus and B. megaterium were morphologically and molecularly characterized due to its significant association with mushroom fungi. These endophytic bacteria have been biochemically validated and resulted in predominant production of Indole-3- acetic acid, Exopolysaccharides and nutrient mineralization. Based on the efficiency of three endophytes, B. megaterium found to induce high fruiting body within 13 days of cropping with improved spawning, button initiation and recorded the maximum biological yield. SEM analysis revealed the abundant presence of rod-shaped B. megaterium in treated mushroom bed. Further, molecular docking revealed a strongest interaction between bioactive compounds of B. megaterium and laccase protein of Calocybe indica. Result of GC-MS profile from B. megaterium treated mushroom revealed a diverse production of bioactive molecules viz., carboxylic acids, amino acids, fatty acids, terpenes, and secondary metabolites with antioxidant, and anti-diabetic properties. Notable compounds like L-Alanine, Agaritine, Lovastatin, β-glucans and Ergothioneine were expressed in treated mushroom. Thus, endophytic microbes from milky mushroom could have interesting role in promotion of mushroom growth for all types of edible mushroom to enhance the biological yield.

Keywords: Milky mushroom, endophytes, GCMS, biological efficiency

D. Policy, Trade & Entrepreneurship

D9 – GLOBAL BIOSECURITY: QUARANTINE, WTO & TRANSBOUNDARY PATHOGENS

Assessment Of Dna Extraction Protocols For Reliable Detection Of Tomato Leaf Curl Palampur Virus In Tomato Seeds

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Accurate detection of plant viruses in seeds is critical for maintaining seed health and preventing the dissemination of pathogens in crop production systems. The present investigation was conducted to evaluate and optimize suitable DNA extraction protocols for PCR-based detection of ***Tomato leaf curl Palampur virus*** **(ToLCPalV)** in tomato seeds. Several DNA isolation methods, including CTAB (without purification) by Abarshi *et al.,* 2010, modified CTAB by Dharajiya *et al.,* 2017, CTAB method of Murray and Thompson, 1980, SGS buffer protocol by Sudan *et al.,* 2017, and Doyle and Doyle method by Doyle and Doyle, 1990 were comparatively assessed for their efficiency in obtaining amplifiable DNA from tomato seeds subjected to different treatments. The extracted DNA was evaluated for quality, yield, and suitability for downstream molecular applications. Among the tested protocols, **modified CTAB and Doyle and Doyle methods** consistently yielded DNA of superior quality, enabling reliable amplification in conventional PCR as well as quantitative real-time PCR assays. Virus-specific primers amplified the expected target fragment from seed-derived DNA samples, and sequence analysis confirmed the presence of t**omato leaf curl Palampur virus**. Real-time PCR analysis further demonstrated sensitive detection across tested samples, indicating the presence of viral DNA in tomato seed lots. The optimized extraction methods were further validated across multiple tomato cultivars, where consistent amplification patterns confirmed the reliability and reproducibility of the protocols. The results highlight the importance of efficient nucleic acid extraction for accurate molecular detection of viral pathogens associated with seeds. The standardized protocols developed in this study provide a useful framework for **seed health diagnostics and early detection of viral pathogens**, which is essential for maintaining seed quality and minimizing the risk of pathogen spread in tomato cultivation systems.

Phylogenetic Relationship of *Ganoderma* species in Mezam Division, Northwest Region, Cameroon

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Ganoderma P. Karst is a pathogen that causes butt, root, and stem rot in trees, eventually leading to their death. However, this fungal species can be used to treat various human diseases. Due to morphological similarities among species, it is necessary to understand the phylogenetic relationships among *Ganoderma* species. This research aims to determine the Phylogenetic relationship of *Ganoderma* species in the Mezam Division, Northwest Region, Cameroon. Nine villages were sampled using opportunistic sampling. DNA was extracted from the ITS and TEF gene regions using the sorbitol-CTAB method. The ITS and TEF gene regions were amplified using ITS1, ITS4, EF595F, and EF1160R primers. Their identities were determined in GenBank using BLAST in NCBI, and a phylogenetic analysis was performed using MEGA version 11. The study identified 8 and 6 distinct Ganoderma species from the ITS and TEF gene regions, respectively. This includes *Ganoderma applanatum, G. brownii, G. cupreum, G. gibbosum, G. lucidum, G. multipileum, G. multiplicatum,* and *G. weberianum* from its ITS gene region, and *G. angustisporum, G. australe, G. eickeri, G. orbiforme, G. multiplicatum,* and *G. weberianum* from its TEF gene region. *G. multipileum, G. brownii,* and *G. gibbosum* are new records. Seven clades were obtained from the ITS gene regions, and six from the TEF gene, compared to GenBank. Isolates from Cameroon clustered with those collected from South Africa, China, Japan, the USA, and Brazil. The collected specimens significantly clustered together and formed a monophyletic group with other *Ganoderma* taxa, with solid support from ML values, implying that they have self-derived characters and that the Mezam division is diverse regarding *Ganoderma* species.

***Keywords**: Ganoderma* species, identification, molecular characters, phylogenetic relationship, Mezam Division

POSTER PRESENTATIONS

A. The Frontiers of Technology

A1 – DIGITAL PLANT PATHOLOGY: AI, ML & SMART SURVEILLANCE

When Aerobiology Meets Artificial Intelligence: A New Perspective on the Use of Machine Learning for the Early Detection and Forecasting of Plant Diseases

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Aerobiology, the science of airborne particles such as fungal spores, pollen or other biological entities are considered an essential discipline for the understanding of the spread of plant diseases. Many economically important plant pathogens are airborne, which makes the monitoring of airborne inoculum an essential tool for the forecasting of the spread of the disease. Artificial Intelligence(AI) and Machine Learning(ML), recent advances in these fields have opened new avenues for the use of aerobiology data in combination with environmental and epidemiological data for the development of more precise tools for the forecasting of the spread of plant diseases. The use of ML algorithms for the analysis of complex data sets that include airborne spores, environmental data and historical data on the spread of the disease can provide the tools for the forecasting of the spread of the disease. The use of predictive algorithms such as Random Forest, SVM or Neural Networks can provide the tools for the forecasting of the spread of the disease. This can be particularly useful for the development of early warning systems for the spread of the disease allowing for the optimization of the use of fungicides or the development of more precise disease forecasting tools. This review aims at highlighting the recent advances in the use of aerobiology for the monitoring of airborne pathogens, the use of ML for the forecasting of the spread of the disease and the future perspectives of the use of intelligent systems for the forecasting of the spread of the disease.

A2 – THE 'OMICS' REVOLUTION: GENOMICS, TRANSGENICS & GENE EDITING

Precision Genome Editing For Sustainable Disease Resistance: Crispr-Cas9 Targeting of Susceptibility Loci In Tomato-Fusarium Interaction

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Soil-borne fungal diseases remain a major constraint to sustainable crop production, causing substantial yield losses in vegetable crops worldwide. Among these diseases, vascular wilt caused by *Fusarium oxysporum* poses a serious threat to the cultivation of tomato. Conventional breeding strategies for disease resistance are often time-consuming and limited by complex genetic interactions between host plants and pathogens. Recent advances in Genomics and molecular biotechnology have created new opportunities for precise crop improvement through genome editing technologies. This study highlights the potential of CRISPR-Cas9-mediated precision genome editing to develop disease-resistant tomato plants by targeting host susceptibility loci involved in pathogen infection. Susceptibility genes that facilitate pathogen colonization were identified through genomic and transcriptomic analyses and selected as potential targets for CRISPR-based editing. Targeted modification of these loci was designed to disrupt host-pathogen interaction pathways that are exploited by *F. oxysporum* during infection. Edited tomato lines were evaluated under controlled conditions to assess disease incidence, symptom severity and plant growth performance following pathogen inoculation. The edited plants exhibited reduced vascular discoloration, lower disease severity and improved plant vigour compared with non-edited control plants. Molecular analyses confirmed successful editing of the targeted loci, demonstrating the effectiveness of genome editing in altering plant susceptibility mechanisms and enhancing host resistance. Overall, the results emphasize that precision genome editing offers a promising and sustainable strategy for improving disease resistance in crops. Integrating CRISPR-based genome engineering with modern genomic tools can accelerate the development of resilient crop varieties, reduce dependence on chemical fungicides and contribute to environmentally sustainable agricultural systems and global food security.

Keywords : CRISPR-Cas9, Genome editing, Tomato wilt, *Fusarium oxysporum*, Susceptibility genes, Sustainable disease management

Evaluation of Fungicides, Organic Formulations and Bio-Agents for the Sustainable Management of Cumin Blight Caused by *Alternaria Burnsii*

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Cumin is an important spice crop, is mainly grown in the states of Rajasthan and Gujarat. Alternaria blight, caused by *Alternaria burnsii*, leads to substantial crop losses, hindering efforts to meet demand and achieve profitability. *Alternaria burnsii* pathogen is major constraint resulting in significant economic loss in cumin production. At present the disease is prevalent in all the cumin growing regions of India. The effectiveness of different new generation fungicides, bio-agents and neem formulations were tested using the poisoned food and dual culture techniques. All the fungicides significantly inhibited the mycelial growth of *Alternaria burnsii*. Under field conditions, plots were sprayed with combi-fungicides, Tebuconazole 50% + Trifloxystrobin 25% WG @0.10% showed lowest disease incidence (16.42% PDI) and highest percentage of disease control (78.59% PEDC), followed by plots sprayed with combi-fungicide Azoxystrobin 18.2% + Difenoconazole 11.4% SC @0.20%, which showed 18.25% PDI and 76.23% of PEDC, along with the highest seed yield of 0.749 kg/plot and 0.729 kg/plot and significant increase in per cent yield (109.92% and 104.29%) respectively.

Keywords- *Alternaria burnsii*, combi fungicides, bio-agents, neem formulations.

Survey, Molecular Characterization and Integrated Disease Management of Black Scurf of Potato in Meerut District

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Black scurf of potato caused by the soil-borne fungus *Rhizoctonia solani* Kühn is an economically important disease affecting potato production in many potato-growing regions. The disease is characterized by the formation of black, irregular sclerotia on the surface of tubers, which reduces their market quality and overall yield potential. The present study was conducted to assess the occurrence of black scurf in the Meerut district, characterize the associated pathogen at the molecular level and explore effective strategies for disease management. Diseased tubers exhibiting typical symptoms were collected from potato fields during the survey and the pathogen was isolated under laboratory conditions. Molecular identification of the isolates was carried out using polymerase chain reaction (PCR) amplification with fungal-specific and fungal universal primers, followed by sequence analysis for accurate pathogen confirmation. Understanding the molecular characteristics of the pathogen is essential for reliable identification and for studying variability among isolates. Such information plays a significant role in developing effective disease management strategies and improving disease monitoring programs. In addition, integrated approaches focusing on reducing soil-borne inoculum and minimizing disease incidence were evaluated under controlled conditions for the effective management of black scurf. The findings of this study contribute to a better understanding of the pathogen associated with black scurf of potato and emphasize the importance of integrated disease management strategies for reducing disease severity and improving potato productivity in the region.

Keywords: Black scurf, *Rhizoctonia solani*, Molecular characterization, PCR analysis,
Integrated disease management.

Transcriptomics insights into sorghum defence mechanisms against anthracnose disease

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Sorghum, *Sorghum bicolor* L. Moench, represents an important cereal crop grown in tropical and semi-arid climates, acting as a primary source of food, animal feed, and industrial products. However, sorghum yield has been substantially impacted by various diseases, and anthracnose, caused by the fungal pathogen *Colletotrichum sublineolum*, has been reported to be one of the most damaging diseases affecting sorghum. Elucidation of the molecular basis of sorghum-pathogen interactions has been of prime importance for the development of disease resistance and increasing crop productivity. Recent advancements in transcriptomics have been instrumental in providing important insights into host defense responses, and various studies have been conducted to assess global mRNA and miRNA expression in response to *C. sublineolum* infection in resistant and susceptible sorghum genotypes. The results of these studies have demonstrated significant transcriptional reprogramming in response to pathogen infection, and thousands of genes have been reported to be differentially expressed in resistant and susceptible genotypes. In the resistant genotypes, defense responses have been reported to be activated early in the infection process, indicating an effective immune response in sorghum. The functions of the genes differentially expressed in response to *C. sublineolum* infection have been reported to be associated with various biological processes, including photosynthesis, carbohydrate metabolism, secondary metabolism, immune signaling, and chitin binding. The important gene families, including receptor-like kinase, mitogen-activated protein kinase signaling, pentatricopeptide repeat, and WRKY transcription factor, have been reported to be important in the defense mechanisms of sorghum. The small RNA transcriptome has been reported to be important in understanding the role of various miRNAs, and their differential expression in response to *C. sublineolum* infection has been reported to be associated with various defense responses in sorghum. The results of the transcriptome and small RNA studies have provided important insights into the molecular mechanisms of sorghum-pathogen interactions and have been important in understanding the potential molecular targets for the development of disease-resistant cultivars using modern breeding approaches.

Comparative Assessment of Alternaria Blight Resistance in Different Mustard Varieties

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Rapeseed-Mustard are known as "Oilseed brassica" popularly and globally. Oilseed brassica is a major *Rabi* oilseed crop in India, contributing 11.3% of global edible oil supply. It is grown all over India including tropical and subtropical regions. Alternaria blight (*Alternaria* spp.) of Indian mustard is one of the most important diseases which reduce quantity and quality of seed yield. The present investigation was conducted to identify stable sources of host resistance under inoculated field conditions during Rabi 2024 and 2025 at Rajasthan College of Agriculture, MPUAT, Udaipur. Twenty cultivars were screened in a Randomized Block Design with three replications and disease severity was assessed using a standard 0–5 scale to compute Percent Disease Index (PDI). Considerable variation in disease response was observed among the varieties. Variety DRMR 1165-40 exhibited a resistant (1-10% leaf area infected) reaction. DRMRIJ-31 and NRCDR 601 were categorized as moderate resistant (11-25% leaf area infected), whereas DRMR 2017-15, NRCHB-101, Rohini and Parwati showed moderately susceptible (26-50% leaf area infected) reactions. NRCDR 2, Vaibhav, Benoy, PM- 26, Pusabold and DRMR 150-35 were recorded as susceptible (51-75% leaf area infected) , whereas RH 406, DRMR 16-38, RH-819, Pusa- Mustard 25, Varuna, Vardhan and Kranti showed highly susceptible (>75% leaf area infected) reactions under inoculated field conditions. The identified resistant varieties serve as valuable genetic resources and potential donor for breeding aimed at developing durable Alternaria blight resistant Mustard varieties.

Keywords: Mustard, Alternaria Blight, Varieties, Screening, Oilseed brassica.

Comparative Evaluation Of High-Fidelity Dna Polymerases For Long-Range Amplification Of Subtelomeric Genomic Regions In *Phaseolus Vulgaris*

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Plant chromosome subtelomeric regions are structurally dynamic genomic domains with a high concentration of segmental duplications, resistance gene clusters and repetitive DNA. Due to the complexity of the sequences and the potential instability of the polymerase, these biologically significant regions are challenging to amplify using long-range PCR. In *Phaseolus vulgaris*, comprehensive assessments of high-fidelity polymerases for the amplification of extensive subtelomeric fragments are still scarce. We examined the ability of four commercially available long-range DNA polymerases to amplify three overlapping genomic targets from a subtelomeric region of chromosome 10 (4.2 kb, 7.9 kb, and 12.1 kb). Specificity, reproducibility and recovery of full-length products were used to evaluate the effectiveness of amplification. All enzymes effectively amplified the 4.2 kb fragment; however, the amplification's strength decreased as the fragment length increased. Only PrimeSTAR GXL consistently produced full-length amplicons at 12.1 kb, while Phusion, Q5, and LongAmp Taq showed non-specific amplification or premature termination in the same conditions. Using primers with a common 5′ tag in a suppression PCR strategy did not make it much easier to amplify larger targets. Bioinformatic characterization showed that the GC content was similar across fragments, but it also showed that there were repeat-enriched clusters in the 12.1 kb region. This means that repeat clustering combined with longer template length makes elongation more difficult. It is important to note that the maximum fragment capacities reported by the manufacturer did not always match the actual amplification results. These results show that the efficiency of long-range PCR depends on the choice of polymerase for subtelomeric plant genomic regions with lot of repeats and not on the size of fragments.

Keywords: Long-range PCR, Subtelomeric regions, *Phaseolus vulgaris,* Repeat-rich DNA, High-fidelity polymerase, Resistance gene clusters, Sequence complexity

Chickpea-*Ascochyta rabiei* interaction: Insights into structural resistance mechanisms

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Chickpea cultivation is severely constrained by Ascochyta blight caused by *Ascochyta rabiei* (Pass.) Labr, a destructive disease capable of causing yield losses of up to 100%. The present study aimed to evaluate the differential infection process of *A. rabiei* and to investigate the role of pre-existing structural barriers in resistant (GL 17020) and susceptible (JG-62) chickpea genotypes. Plants of both genotypes were grown under controlled conditions and artificially inoculated with a local isolate of the pathogen. Disease development and histopathological changes were monitored at different intervals after inoculation. Initial disease symptoms appeared on the leaves of the susceptible genotype as yellowish necrotic spots at 4 days after inoculation (DAI), whereas the resistant genotype exhibited only localized necrotic lesions at 5 DAI. Similarly, stems of the susceptible genotype developed elongated dark brown lesions by 6 DAI, while only a few restricted lesions were observed in the resistant genotype at 7 DAI. Histological observations revealed severe distortion of parenchymatous tissues and collapse of vascular bundles in the leaves of the susceptible genotype by 6 DAI, whereas tissues in the resistant genotype remained largely intact. A similar trend was observed in stem tissues, where the resistant genotype maintained intact cortical and vascular structures with limited fungal colonization (5 hyphae mm^{-2}), in contrast to the pronounced tissue distortion observed in the susceptible genotype at 7 DAI. Microscopic examination further demonstrated that pathogen penetrates host tissues through both the cuticle and stomata, mediated by the formation of appressoria and infection pegs. Anatomical analyses indicated that resistant genotype possessed significantly higher trichome density in leaves and stems (27.94 and 24.72 mm^{-2}, respectively) and greater cuticle thickness (5.45 and 2.83 µm, respectively) compared with the susceptible genotype (11.33 and 9.36 mm^{-2} trichome density and 2.52 and 1.58 µm cuticle thickness, respectively). In contrast, the stomatal index was significantly higher in the susceptible genotype (24.33% in leaves and 14.00% in stems) than in the resistant genotype (15.14% and 7.88%, respectively), potentially facilitating pathogen entry and disease development. These findings highlight the importance of structural and anatomical traits in conferring resistance to Ascochyta blight in chickpea. The identified features, including increased trichome density, thicker cuticle and reduced stomatal index, may serve as valuable indicators for large scale screening of chickpea germplasm and could be effectively exploited in breeding programs aimed at developing cultivars with enhanced resistance to *A. rabiei*.

Field Screening and Molecular Characterization of Mungbean (*Vigna radiata* L.) Genotypes for Resistance to Web Blight Caused by *Rhizoctonia solani.*

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Mungbean [*Vigna radiata* (L.) Wilczek] is an important pulse crop widely cultivated in India and other Southeast Asian countries owing to its high nutritional value and easily digestible protein content. Among the various diseases affecting mungbean, web blight caused by *Rhizoctonia solani* is emerging as a serious constraint to crop productivity, particularly under warm and humid conditions. This disease can cause significant yield losses by damaging the leaves, stems and pods. The identification of resistant genotypes is considered one of the most effective and environmentally safe strategies for web blight management. Therefore, this study aimed to identify mungbean genotypes resistant to web blight and characterize them using molecular markers. In the present investigation, 95 mungbean genotypes were evaluated for resistance to web blight under natural field conditions using an augmented experimental design. The genotypes were planted in two rows per entry and were periodically observed for disease development at different growth stages. Disease severity was recorded at regular intervals and these observations were used to calculate disease progression parameters, including the Area Under the Disease Progress Curve (AUDPC), relative AUDPC (rAUDPC) and mean r-value. Based on disease reaction, selected genotypes exhibiting resistant to susceptible responses were further subjected to molecular characterization using RAPD markers to assess the genetic diversity associated with web blight resistance. In this study, we observed considerable variation in disease severity among the evaluated genotypes. Many genotypes exhibited low disease severity and AUDPC values, indicating a higher level of resistance to web blight, whereas others showed moderate-to-high susceptibility. Molecular analysis using RAPD markers successfully differentiated resistant and susceptible genotypes and revealed genetic diversity among the tested ones. Resistant genotypes tended to cluster separately from susceptible ones, suggesting the presence of distinct genetic backgrounds associated with web blight resistance in this population. The identified resistant genotypes can serve as valuable genetic resources for breeding programs aimed at developing web blight-resistant mung bean varieties.

Keywords: Web blight, *Rhizoctonia solani*, Mungbean, AUDPC, RAPD markers.

Role Of RNAi In Plant Disease Management

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Global food security is increasingly threatened by rapid population growth and escalating biotic stresses intensified by climate change. Plant pathogens like fungi, viruses, bacteria, and nematodes account for substantial crop losses worldwide. Conventional disease management strategies rely heavily on chemical pesticides, which contribute to environmental contamination, human health concerns, and the emergence of resistant pathogen populations. RNA interference (RNAi) has emerged as a precise, sequence-specific, and environmentally sustainable alternative for plant disease management.

RNAi is a conserved post-transcriptional gene silencing mechanism triggered by double-stranded RNA (dsRNA), which is processed by Dicer-like enzymes into small interfering RNAs (siRNAs) or microRNAs (miRNAs). These small RNAs are incorporated into the RNA-induced silencing complex (RISC), guiding sequence-specific degradation or translational repression of target mRNAs. In plants, diversified RNAi pathways underpin development, genome stability, and defense responses. Technological advances have enabled multiple delivery strategies, including Virus-Induced Gene Silencing (VIGS), Host-Induced Gene Silencing (HIGS), and Spray-Induced Gene Silencing (SIGS).

Recent studies demonstrate successful application of RNAi against various fungal pathogens such as *Fusarium graminearum*, *Verticillium dahliae*, *Botrytis cinerea*, and *Phytophthora infestans*; bacterial pathogens including *Agrobacterium tumefaciens*, *Erwinia amylovora*, and *Xanthomonas citri*; and viral pathogens such as Citrus Tristeza Virus. Both transgenic (HIGS) and non-transgenic (SIGS) approaches have significantly reduced pathogen biomass, disease index, and yield losses under greenhouse and field conditions.

Despite challenges such as dsRNA instability, delivery barriers, regulatory constraints, and potential off-target effects, emerging solutions including nanocarrier-based delivery systems, optimized sequence design, microbial dsRNA production platforms, and multiplexed constructs are enhancing efficacy and feasibility.

Overall, RNAi represents a next-generation, sustainable strategy for crop protection, offering targeted pathogen control while reducing reliance on chemical pesticides. Continued refinement of delivery systems, biosafety assessment, and large-scale validation will be critical to translating RNAi technologies into durable agricultural solutions.

Assessment of maize lines for resistance against mycotoxins producing fungi (*Fusarium* and *Aspergillus*)

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The present investigation was carried out to assess the resistance of maize varieties against mycotoxin-producing fungi under inoculated field conditions during *Kharif* 2024 and 2025 at the Rajasthan College of Agriculture, MPUAT, Udaipur. The objective of the study was to identify stable sources of host resistance that could be utilized in breeding programmes for developing disease-resistant maize cultivars. Fourteen maize cultivars were evaluated in a Randomized Block Design (RBD) with two replications. Artificial inoculation was performed to ensure uniform disease pressure in the field. Disease severity was recorded using a standard 1–7 rating scale and converted into Percent Disease Index (PDI) to classify varietal response.

The results revealed considerable variability in disease reaction among the tested cultivars across both seasons. The PDI values ranged from 4.59 per cent to 34.74 per cent, indicating responses from highly resistant to susceptible categories. Some cultivars consistently recorded low disease intensity, demonstrating stable resistance under inoculated conditions, whereas others exhibited moderate to higher susceptibility. The observed variation among the genotypes suggests the presence of useful genetic resistance against mycotoxin-producing fungi in maize. These resistant cultivars can serve as potential sources in breeding programmes and may contribute to reducing disease incidence and mycotoxin contamination in maize production system.

Keywords: Maize, mycotoxin-producing fungi, host resistance, field screening, Percent Disease Index (PDI), artificial inoculation, varietal evaluation

Computational Investigation of Environmental Neurotoxins and Their Interaction with GAPDH in Dementia

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Dementia a progressive neurodegenerative disorder causing memory loss, cognitive decline, and behavioural changes. There are several evidence present surrounding environments that exposure to environmental chemicals including pesticides, herbicides, fungicides, and heavy metals, may contribute to the development of neurodegenerative diseases. The present study showed to identify key genes associated with dementia disorder and to investigate the interaction of different neurotoxic chemicals with a selected target protein. Gene data related to dementia were collected from various databases, including MalaCards, GeneCards, and OMIM. Bioinformatic approach was applied to construct a gene interaction network using Cytoscape tool. Based on network topology analysis, eight hub genes were identified, among which GAPDH was selected for further investigation. GAPDH enzyme plays a crucial role in cellular metabolism, energy production and its emerging involvement in neurodegeneration. A list of environmental chemicals with known or suspected neurotoxic effects including pesticides, herbicides, fungicides, carbamates, organochlorines, and heavy metals were selected for analysis. We have use molecular docking analysis to evaluate the interaction between these compounds and the GAPDH protein. The results show six compounds out of 16 chosen to be highly influentials in causing the disease showing the binding affinity ranging from-7.2 to -7.9 leading to formation of stable interaction hence downregulating the enzyme activity among these Azoxystrobin turned out to be most interactive chemical compound with the target GAPDH with a binding energy of -7.9. Thus, the result Showcases valuable insights into the potential molecular mechanisms to understand how environmental toxins may influence dementia progression through protein interaction pathways. This study focusses on the significance of integrating bioinformatics and molecular docking approaches to understand the impact of environmental factors on neurodegenerative diseases and may contribute to the identification of potential therapeutic targets.

Keywords: Dementia, GAPDH, Molecular Docking, Neurotoxic Chemicals, Systems Biology, Azoxystrobin

B. INTEGRATED DISEASE MANAGEMENT & ECOLOGY

B4 – BIO-INTENSIVE IDM/IPM: BIOCONTROL, ENDOPHYTES & GREEN CHEMISTRY

Deciphering The Role Of Phyllosphere And Carposphere Endophytic Microbiome In Postharvest Diseases Management Of Banana Fruits

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Phyllosphere and carposphere endophytic microbiome are critical to plants, they interact in multiple ways (though poorly characterized) to regulate physiological and metabolic pathways in turn have growth promoting effects, elevated stress tolerance, and expanding the plant's metabolic repertoire with novel defense pathways and can be effectively utilized in management of postharvest diseases. Banana (*Musa* spp.)—an important plant for study of microbiome-based disease protection we initiated our present investigation with tripartite system of fruit (banana)–pathogen (*Fusarium verticillioides*, *Colletotrichum musae*, *Colletotrichum gloeosporioides* and *Lasiodiplodia theobromae* causing crown rot, anthracnose and fruit rot at the post-harvest stages)–endophyte interaction. 1Isolation from phyllosphere and carposphere the endophytic microbiome constituted of *Chaetomium* spp., *Penicillium* sp., *Aspergillus* spp., *Fusarium* spp., *Trichoderma* sp., *Colletotrichum* spp., *Coprinopsis* sp., *Curvularia* sp. and *Alternaria* sp. These associated mycoflora expressed strong antagonism against derived fruit associated phytopathogenic fungi suggesting an eco-friendly alternative to chemical fungicides. Endophytes have reported multiple mechanisms that are used to inhibit pathogenic growth and increase fruit health. We identified *T. asperellum* as a potential endophyte effective against all the banana fruit associated mycoflora. Use of endophytic microbiome has the potential to reduce the harmful dependence on chemical pesticides and fungicides in postharvest disease management.

Keywords: Post-Harvest Diseases, Banana, Endophytes, Tripartite Interaction, Trichoderma

Integrated Use of Fungicides, Nano-formulations and Biocontrol Agents for Yield Enhancement of Post-Flowering Stalk Rot of Maize

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A field study was conducted to evaluate the effect of seed treatment with fungicides, *Trichoderma viride* and chitosan-based nano formulation on growth, yield attributes and management of post-flowering stalk rot (PFSR) of maize caused by *Fusarium verticillioides*. The results revealed that all treatments significantly improved plant growth, yield components and reduced disease incidence compared to the untreated control. Among the treatments, the moderately resistant variety Pratap Makka-3 treated with Bavistin + *T. viride* recorded the maximum plant height (225.18 cm), number of internodes (13.38), cobs per plant (1.17), cob length (24.89 cm), cob diameter (14.55 cm), grains per cob (308.55) and 1000-grain weight (266.91 g). In the susceptible variety Surya, the highest yield-attributing parameters were observed with Saaf + *T. viride*, recording plant height of 216.20 cm, 12.98 internodes, 1.16 cobs per plant, cob length of 24.50 cm and 1000-grain weight of 252.86 g. The application of chitosan-based nano formulation along with *T. viride* further enhanced root length, shoot growth, dry matter accumulation and grain weight, while significantly reducing the percent disease index of PFSR. The compatibility of *T. viride* with fungicides such as Saaf and the nano-based formulation suggests an integrated approach for effective management of *F. verticillioides*. Thus, seed treatment combining bio-agents, fungicides and nano-formulation can improve maize productivity and disease management.

Keywords: Post flowering stalk rot, Fungicide, Nano-formulation, Bio control agent, Yield enhancement.

Exploration Of The Synergistic Interaction Between Biochar And Trichoderma Spp. For The Suppression Of Plant Pathogen

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Biochar is a carbon-rich material produced through pyrolysis of organic biomass under limited oxygen conditions. It improves soil physicochemical properties, enhances microbial activity, and contributes to the suppression of soil-borne plant pathogens. In plant pathology, biochar acts as a soil amendment that modifies the rhizosphere environment and supports beneficial microorganisms. Its synergistic interaction with *Trichoderma* spp. can enhance biocontrol efficiency against pathogenic fungi. The present study evaluated biochars derived from rice husk, corn husk, sugarcane bagasse, wheat straw, and acacia biomass incorporated into potato dextrose agar (PDA). Growth of *Trichoderma* spp. on biochar-amended media was compared with normal PDA. Dual culture assays with *Fusarium* sp. revealed enhanced antagonistic activity in amended media. 5% biochar showed maximum inhibition of pathogen growth. Results indicate that optimized biochar application significantly enhances the antagonistic potential of *Trichoderma*, offering a sustainable approach for managing soil-borne plant pathogens.

Keywords: Biochar, Synergistic Interaction, Antagonistic Activity, Soil-Borne Plant Pathogens, Trichoderma

Role of Ecological Factors Influencing the Efficacy of Bio-Control Agents in Plant Disease Management

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In the context of environmentally friendly practices, biological control agents (BCAs) have come into focus as an alternative for chemical pesticides for the control of plant diseases. However, the field performance of BCA is often inconsistent due to the influence of multiple ecological factors. Ecological factors, which often influence the field performance of biological control agents can be broadly classified into abiotic and biotic factors. Abiotic factors, such as temperature, humidity, soil moisture, pH, soil type, etc., often influence the antagonistic activity of biological control agents. Similarly, biotic factors, such as host cultivar, pathogen variation, native microflora, etc., also influence the field performance of biological control agents. Some of the biological control agents, such as *Trichoderma, Pseudomonas, Bacillus,* etc., often inhibit the growth of plant pathogens by virtue of their antagonistic ability. In addition to ecological factors, the field performance of biological control agents can also be affected by other factors, such as formulation, mode of application, dosage, etc. Some of the research findings suggest that prophylactic application of biological control agents can significantly influence their field performance. Therefore, it is essential for us to gain detailed insights into the complex interactions between environmental parameters, host, pathogen, and biological control agents for the improvement of biological control of plant diseases. Future research should be directed towards improving the ecological compatibility of biological control agents, so that their field performance can be stabilized for the control of plant diseases.

In Vitro Evaluation Of Fungicides And Botanicals For Suppressing Mycelium Growth Of *Colletotrichum Capsici* [(Syd.) Butler And Bisby] Causes Anthracnose (Leaf Spot) Of Betelvine

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Betelvine (*Piper betle L.*) commonly known as paan, is a vine belonging to the family *piperaceae*. It is an important cash crop of India mainly cultivated for its leaves which is used for mastication along with arecanut due to its stimulatory aromatic taste. The productivity of betelvine is affected by different fungal and bacterial diseases, among them anthracnose is one of the important fungal disease caused by *Colletotrichum capsici*[(Syd.) Butler and Bisby]. Anthracnose and leaf spot caused by *Colletotrichum* sp. is important disease as reduces market value of betel leaves. The present research work was conducted at Department of Plant Pathology, JNKVV, Jabalpur, M. P. during 2022-2023. The fungicidal and botanical management studies were taken up to know the best fungicide and botanical required for retard the growth of the fungus. In this study fungicides single and combo products were evaluated under condition using the Poisoned food technique against C.*capsici* at 100, 200,500and1000ppm concentrations. Propiconazole25%EC at all four concentrations was found to be performed superior than rest other fungicides with a maximum inhibition (100%) of mycelial growth. Copper oxychloride 50%WP, Tebuconazole50%+ Trifloxystrobin 25%WG and Carbendazim12%+Mancozeb63%WP exhibited 100% inhibition at 500 and 1000 ppm concentration while Mancozeb75% WP exhibited the poorest result on 1000 ppm with 85.61% inhibition. Among the botanicals tested Datura was found best against under condition.In the current investigation, best result for percent inhibition of mycelial growth was exhibited 15.70, 30.09 and 37.17% by datura at all three-concentration tested followed by 6.63, 15.04 and 30.75 % in bryophyllum and 7.07, 13.71 and 22.57% in garlic.

Keyword :- Betelvine, Colletotrichum, fungicide, botanical, inhibition *etc.*

Field Evaluation of New Generation Fungicides, Bioagents and Nano Formulation for the Management of Zonate Leaf Spot in Sorghum

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Zonate leaf spot of sorghum caused by *Gloeocercospora sorghi* is an emerging disease responsible for significant yield losses. The present investigation was undertaken to evaluate the efficacy of new generation fungicides, bioagents and a bio-nano formulation against the pathogen under *in vitro* and field conditions. *In vitro* studies were conducted using the poison food technique for fungicides and dual culture technique for bioagents. Among all treatments, Tebuconazole 50% + Trifloxystrobin 25% WG proved most effective, recording complete inhibition (100%) of mycelial growth at 0.10 and 0.15% concentrations. Tebuconazole 25% EC and Azoxystrobin 11% + Tebuconazole 18.3% SC were the next best treatments. Among bioagents, *Trichoderma harzianum* showed higher antagonistic activity (63.67% inhibition) compared to *Pseudomonas fluorescens* (49.34%). The bio-nano formulation exhibited moderate inhibition under laboratory conditions. Field evaluation revealed that two foliar sprays of Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.10% recorded the lowest disease severity (11.93% PDI) and highest disease control efficiency (68.92%). The same treatment also resulted in maximum green fodder yield (32.89 kg/plot) and grain yield (1.80 kg/plot), representing 98.93% and 95.68% yield increase over control, respectively. The study concludes that Tebuconazole 50% + Trifloxystrobin 25% WG is highly effective and economically viable for managing zonate leaf spot of sorghum, while bioagents may serve as supportive components in integrated disease management strategies.

Keywords:- Sorghum, Zonate leaf spot, fungicide, Bio-agent.

Bio-Intensive Disease Management through Biocontrol Agents in Natural Farming Systems for Climate-Resilient Agriculture

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Climate change, coupled with excessive dependence on chemical pesticides, has intensified plant disease outbreaks and adversely affected soil health and ecosystem stability. Natural farming systems emphasize ecological balance, biodiversity conservation and minimal chemical intervention, providing a sustainable pathway for long-term crop protection. In this context, biocontrol agents offer an eco-friendly and climate-smart alternative for disease management. The present investigation evaluated the efficacy of selected microbial biocontrol agents, including *Trichoderma* spp., *Pseudomonas fluorescens* and native endophytic fungi, in suppressing major soil-borne pathogens under natural farming conditions. Field and controlled experiments were conducted to assess disease incidence, plant growth attributes, yield performance and soil biological properties. Treatments involved seed treatment, soil application and foliar sprays using microbial formulations integrated with natural inputs such as *Jeevamrit* and botanical extracts. Results revealed a significant reduction in disease severity and enhanced plant vigor in treated plots compared to untreated controls. Improved root development, higher biomass accumulation and increased yield were recorded under integrated biocontrol applications. Soil analysis indicated enhanced microbial diversity and elevated enzymatic activities, suggesting improved soil health and functional resilience. The combined application of microbial consortia demonstrated synergistic effects in pathogen suppression compared to individual strains. The study highlights the potential of bio-intensive integrated disease management as a sustainable approach for strengthening plant immunity and ensuring climate-resilient agriculture. Adoption of biologically driven strategies can reduce chemical dependency, restore ecological balance and contribute significantly to long-term food security in vulnerable agroecosystems.

Keywords: Bio-intensive disease management, Biocontrol agents, Natural farming, Soil health, Climate-resilient agriculture, Sustainable crop protection

Effect Of Botanicals And Carbendazim 50% Wp On Anthracnose (*Colletotrichum Lindemuthianum*) Of Black Gram (*Vigna Mungo* L.)

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The present study was conducted to evaluate the efficacy of selected botanicals and carbendazim in managing anthracnose disease of black gram caused by *Colletotrichum lindemuthianum* under field conditions. The experiment was laid out in a RBD with three replications at the CRF, Department of Plant Pathology, SHUATS, Prayagraj during the kharif season of 2023. Seeds were treated with Carbendazim 50% WP @2g/kg prior to sowing. Foliar sprays included five botanicals and one fungicide viz. T_1- Neem oil (2ml/L), T_2- Eucalyptus oil (2ml/L), T_3- Tea tree oil (2ml/L), T_4- Lavender oil (2ml/L), T_5- Thyme oil (2ml/L), T_6- Carbendazim (1g/L), and T_0- Control. All treatments significantly reduced disease intensity and improved yield compared to control. The most effective treatment was T_6- Carbendazim seed treatment (2g/kg) + foliar spray (1g/L), recording minimum disease intensity (22.33%), highest yield (7.86 t/ha), and maximum cost-benefit ratio (1:2.43). This was followed by T_1- Carbendazim seed treatment (2g/kg) + Neem oil spray (2ml/L), which showed 23.14% disease intensity, 6.76 t/ha yield, and 1:2.07 cost-benefit ratio. The control recorded highest disease intensity (43.48%), lowest yield (3.15 t/ha), and minimum cost-benefit ratio (1:1.03). The findings indicate that integrated use of carbendazim as seed treatment and foliar spray is most effective for managing anthracnose in black gram under field conditions.

Keywords: Anthracnose, Black Gram, Botanicals, Carbendazim, Colletotrichum lindemuthianum, Per cent Disease Intensity, Yield.

Evaluation of Bioagents, Inorganic Compounds and Fungicides against Alternaria Leaf Spot of Potato under North Gujarat Conditions

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Alternaria leaf spot of potato, caused by *Alternaria solani*, is a major foliar disease responsible for significant yield losses. A field experiment was conducted during *Rabi* seasons of 2024–25 and 2025–26 at Banaskantha, North Gujarat agro-climatic zone (GJ-4) to evaluate the efficacy of bioagents, inorganic compounds and fungicides against the disease in potato cv. Kufri Pukhraj. Eight treatments comprising bioagents (*Trichoderma harzianum*, *Pseudomonas fluorescens*), inorganic compounds (calcium chloride, copper sulphate), fungicides (chlorothalonil, trifloxystrobin, tebuconazole + trifloxystrobin) and untreated control were evaluated in a randomized block design. Disease severity was recorded as Percent Disease Index (PDI) and yield was measured at harvest. Pooled analysis revealed significant differences among treatments. The lowest disease severity was recorded in tebuconazole + trifloxystrobin (23.90% PDI) with highest percent disease control (52.11%), followed by trifloxystrobin (29.87% PDI). The highest disease severity was observed in untreated control (49.92% PDI). Correspondingly, maximum tuber yield (27.67 t/ha) and highest yield increase over control (78.49%) were recorded in tebuconazole + trifloxystrobin, followed by trifloxystrobin (26.13 t/ha). Bioagents and inorganic compounds showed moderate efficacy in disease reduction and yield improvement. The study suggests that combination fungicide (tebuconazole + trifloxystrobin) is highly effective for managing Alternaria leaf spot of potato under North Gujarat conditions.

Module For Rapeseed-Mustard Disease Management In North Gujarat

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Indian mustard, *Brassica juncea* (L.) Czern & Coss is one of the most important oilseed crops in India grown next to groundnut. It is cultivated mainly in Rajasthan, Uttar Pradesh, Punjab, Haryana, Gujarat, Madhya Pradesh and Assam. In Gujarat, area under mustard cultivation is maximum in North Gujarat. White rust and powdery mildew are major diseases in North Gujarat. An IDM module consisting soil application (1 kg *T. harzianum* /50 kg FYM); Basal application of zinc sulphate (15 kg/ha) + sulphur (40 kg/ha) + borex (10 kg/ha); seed treatment with *T. harzianum* formulation @10 g/kg seed; line sowing (45×20cm) and no irrigation during 25th Dec. to 15th Jan was tested during *Rabi*, 20219-20 in North Gujarat agro-climatic zone-IV and compared with farmer's practices (control) consisting line sowing (45×15cm) against powdery mildew and white rust diseases. Mustard variety, DRMRIJ 31 was sown for experimentation and other recommended agronomic practices were common in both modules. Significantly lower white rust disease index (36.1%) was observed with IDM module as compared to farmer's practices (43.6%). However, powdery mildew disease severity (%) and seed yield (kg/ha) observed in IDM module were statistically similar to farmer's practice. Comparatively lower powdery mildew and higher seed yield (1952.0 kg/ha) was recorded with IDM Module as compared to farmer's practices (1830.0 kg/ha).

Biocontrol potential of native *Trichoderma* against *Sclerotium rolfsii*

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Potential native isolates of *Trichoderma* were isolated from different fields of the Agricultural Research Station, Ummedganj, Kota from rhizospheric soil samples using standard isolation and purification techniques. The obtained isolates were further studied for their cultural and morphological characteristics. Cultural characterization on potato dextrose agar revealed rapid colony growth with noticeable variation in colony colour, texture and growth pattern, ranging from light to dark green shades with either fluffy or appressed growth and smooth colony margins. Microscopic observations showed septate, hyaline mycelium with branched conidiophores bearing phialides producing characteristic green conidia, confirming their identity as *Trichoderma* spp. Several isolates also showed strong antagonistic activity against the pathogen *Sclerotium rolfsii* among which ARS K 21 displayed highest antagonism which was at par with ARS K 11.

Keywords: *Trichoderma*, Rhizosphere, Isolates, Antagonism, *Sclerotium rolfsii*.

Bioprotective role of Trichoderma harzianum in promoting plant growth and managing against sheath blight and sheath rot disease of Rice, Oryza sativa L.

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Rice, Oryza sativa L. is the most important cereal crop and staple food for half of the world's population. In rice growing area major fungal diseases like sheath blight and sheath rot disease affects the rice cultivation. The use of biological control agents offers ecofriendly and sustainable alternative to chemical management. The present study evaluated that the antagonistic effect of Trichoderma harzianum on the pathogen Rhizoctonia solani and Sarocladium oryzae under in vitro and field conditions. In vitro study revealed, T. harzianum can inhibit the growth of R. solani and S. oryzae up to by 73.05% and 66.67% respectively under dual culture through secretion of volatile and non-volatile substances. Biopriming of rice seeds (var. CAUR1) with T. harzianum based bioformulation viz., UmTricho showed significant influence on seed germination rate (97.99%) and vegetative growth of seedlings (shoot length -18.73 cm, root length -8.46 cm, fresh weight -234.66 mg, dry weight -99.33

mg and seeding vigour index -2665.04) as compared to untreated seeds. The bio-efficacy of UmTricho a nd microbial consortium CAU-Bioenhance (a liquid biofertilizer) was evaluated complying different treatments viz., seed, seedling dip and foliar spray either singly or in combination. Combined treatment of seed treatment with UmTricho + seedling root dip with UmTricho + seedling root dip with CAU-Bioenhancer + foliar spray with UmTricho at 15 days interval up to panicle initiation stage gave best result in significant reduction of disease incidence of sheath blight and sheath rot. The findings suggested that UmTricho in combination with CAU-Bioenhancer has the ability to produce antimicrobial, plant growth promoting and suppression of soil borne pathogen viz., R. solani and S. oryzae in rice.

Keywords: Trichoderma harzianum, Antagonistic, Rhizoctonia solani, Sarocladium oryzae, UmTricho, CAU-Bioenhancer.

Screening and Molecular Identification of Mango Endophytes as Biological Control Agents Against Anthracnose Pathogen *Colletotrichum gloeosporiodes*

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Mango (Mangifera indica L.) is one of the most important tropical fruit crops, widely cultivated for its economic and nutritional value. However, its productivity is severely constrained by anthracnose disease caused by *Colletotrichum gloeosporioides*, which leads to significant pre- and post-harvest losses. The present study aimed to isolate, evaluate, and molecularly characterize endophytic microorganisms from healthy mango tissues and to assess their antagonistic potential against *C. gloeosporioides* under in vitro conditions.

A total of ten endophytes were isolated from leaves, twigs, and roots of mango plants collected from the Horticulture Farm, Anand Agricultural University, Anand. Preliminary screening using the dual culture technique identified five efficient antagonists: *Trichoderma* sp., *Lasiodiplodia* sp., *Chaetomium* sp., and two *Bacillus* spp. Among them, *Trichoderma* sp. exhibited the highest growth inhibition (75.29%) of the pathogen, followed by *Lasiodiplodia* sp. (64.07%), *Chaetomium* sp. (62.10%), and *Bacillus* spp. (62.93% and 55.66%).

Morphological and molecular characterization using ITS (fungi) and 16S rRNA (bacteria) sequencing confirmed the identities as *Trichoderma asperellum*, *Lasiodiplodia theobromae*, *Chaetomium globosum*, *Bacillus pumilus*, and *Bacillus subtilis*, with 95–99% similarity in BLAST analysis. The findings highlight the potential of mango-associated endophytes as promising biological control agents against anthracnose disease and support their integration into sustainable disease management strategies.

Mechanistic Evaluation Of Chemical Fungicides Against *Fusarium Oxysporum* Via Conidial Inhibition And Enzymatic Profiling

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Fusarium oxysporum, the etiological agent of vascular wilt in chilli (*Capsicum annuum* L.), remains a primary constraint to global agricultural productivity, necessitating the development of robust chemical intervention strategies. The present investigation was conducted to elucidate the inhibitory mechanisms of diverse fungicides through integrated *in-vitro* assays. Efficacy was evaluated using two wet-lab studies *viz*., conidial germination inhibition tests and qualitative enzymatic profiling to determine metabolic disruption. Our results demonstrate that Tebuconazole 50% + trifloxystrobin 25% WG, Carbendazim 12% + mancozeb 63% WP, Thiophanate-methyl 70% WG and Propiconazole 25% EC significantly suppressed conidial germination. Furthermore, qualitative assays indicated a marked deactivation of essential fungal metabolic enzymes, specifically protease, dehydrogenase and catalase, suggesting a synergistic disruption of both structural integrity and oxidative stress management within the pathogen. These findings provide critical insights into the biochemical pathways targeted by these fungicides, offering a scientific localized framework for designing precision based Integrated Disease Management (IDM) protocols for the sustainable mitigation of *Fusarium* wilt.

Keywords: *Fusarium oxysporum*, Vascular wilt, Conidial germination inhibition tests, Qualitative enzymatic profiling, Protease, Dehydrogenase, Catalase and IDM

Management Of Gummy Blight In Muskmelon Under Semi-Arid Condition Of Rajasthan

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Muskmelon (*Cucumis melo* L.) is being cultivated in 350-hectare area of Jaipur district and prone to attack by various diseases and pests that hamper production of this crop. Gummy stem blight is serious disease of muskmelon that generally infest muskmelon plants at vegetative growth stage. Characteristic symptoms of this disease are cracking of stem accompanied with gummy ooze. Severe infestation leads to death of plants before fruiting that cause severe yield losses. Proper diagnosis is prerequisite to manage any disease. Majority of farmers misdiagnose gummy stem blight incidence as infestation of fruit fly and use insecticide to manage the same. Only few farmers are spraying (T-1) Carbendazim 12%+ mancozeb 63% @ 2gm/lit after incidence of disease. Above fungicide required multiple applications that increased cost of cultivation. To keep in mind above circumstance, KVK Jaipur-1, conducted an OFT to manage gummy stem blight and demonstrated (T-2) topical application of Tebuconazole 50%+ Tryfloxystrobin 25% @1gm/lit (Ist at last week of February and 2nd at 10 days of first spray). Results of assessed practice (T-2) revealed that only 2.15% disease incidence was recorded as compare to 18.5% incidence in farmers' practice (T-1). Yield of assessed technology was 290 q/ha, 20.83% increase in yield with Rs. 4,45,500/ha with net return and 3.31 B: C ratio, whereas yield of farmer practice was 240 q/ha with Rs. 3,42,000/ha with net return and 2.85 B:C ratio.

Keywords-Gummy blight, muskmelon, management

Eco-friendly Management of Chickpea Collar Rot through Integrated Use of *Trichoderma asperellum* and Enriched Vermicompost

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Collar rot of chickpea caused by *Sclerotium rolfsii* is a destructive soil-borne disease responsible for considerable yield losses in chickpea-growing regions. The present study was conducted to evaluate the effectiveness of different application methods of *Trichoderma asperellum* for the management of collar rot under controlled conditions. The results revealed that significant variation occurred among treatments in reducing disease incidence and promoting plant growth. At 40 days after sowing, the least per cent disease incidence was recorded in the integrated treatment consisting of seed treatment with *Trichoderma asperellum* @ 10 g kg^{-1} seed combined with soil application of enriched vermicompost @ 10 g kg^{-1} soil before sowing. This treatment was found to be most effective in suppressing the disease. The next best treatments were soil application of enriched vermicompost @ 10 g kg^{-1} soil before sowing, followed by soil application of *Trichoderma asperellum* @ 5 g kg^{-1} soil before sowing, seed treatment @ 10 g kg^{-1} seed, and drenching @ 5 g L^{-1} after seedling emergence. In contrast, the untreated control (without *Trichoderma asperellum* and without pathogen inoculation) recorded the highest disease incidence, with approximately 70 per cent disease observed at the time of assessment. The integrated treatment also resulted in maximum per cent disease control and significantly increased seedling height compared with other treatments. The findings of the present study demonstrate that the combined application of Trichoderma through seed treatment and soil application of enriched vermicompost is highly effective in reducing collar rot incidence and enhancing early seedling growth in chickpea. Such integrated use of biocontrol agents and organic amendments offers a promising, eco-friendly approach for sustainable management of soil-borne diseases in chickpea cultivation.

Keywords: Chickpea, *Sclerotium rolfsii*, *Trichoderma asperellum*

Evaluation of Biocontrol Agents for the Management of Root Rot of Mungbean Caused by Rhizoctonia bataticola

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Mungbean (*Vigna radiata* L), an important short-duration pulse crop widely cultivated in India, plays a vital role in ensuring nutritional security due to its high protein content and adaptability to diverse agro-climatic conditions. However, its productivity is significantly constrained by root rot disease caused by Rhizoctonia bataticola, which leads to severe plant mortality and yield losses under favorable environmental conditions.

The *in vitro* studies were conducted to assess the antagonistic potential of four biocontrol agents, namely *Trichoderma harzianum*, *Trichoderma viride*, *Pseudomonas fluorescens* and *Bacillus subtilis*, against *R. bataticola*. The results revealed that all tested biocontrol agents significantly inhibited the mycelial growth of the pathogen. Among them, *T. harzianum* exhibited the highest per cent inhibition of mycelial growth (87.52%), followed by *T. viride* (83.25%). In comparison, moderate inhibition was recorded with *P. fluorescens* (46.94%), while *B. subtilis* showed the lowest inhibitory effect (37.51%). Field evaluation through seed treatment at the rate of 6 g kg^{-1} seed further confirmed the effectiveness of fungal biocontrol agents in reducing disease incidence. At 45 days after sowing, the lowest per cent disease incidence (20.35%) was recorded in plots treated with *T. harzianum*, followed by *T. viride* (26.50%), as compared to untreated control (47.99%). Correspondingly, maximum disease control was achieved with *T. harzianum* (57.60%), followed by *T. viride* (44.78%), whereas *P. fluorescens* (34.15%) and *B. subtilis* (28.61%) were comparatively less effective. Overall, the findings of the present study clearly demonstrate the superior performance of T. harzianum in suppressing *R. bataticola* both under in vitro and field conditions. The use of effective biocontrol agents as seed treatment offers a promising, eco-friendly and sustainable approach for integrated management of mungbean root rot.

Keywords: Mungbean, Trichoderma, Root rot

Field efficacy of *Trichoderma viride* against collar rot of chickpea incited by *Sclerotium rolfsii*

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Chickpea (*Cicer arietinum* L.) is an important pulse crop in India. Collar rot caused by *Sclerotium rolfsii* is a devastating disease resulting 55-95 per cent seedling mortality in chickpea. An on-farm testing carried out to assess the efficacy of *Trichoderma* as soil and seed treatment for management of collar rot in chickpea during three consecutive years 2021-22, 2022-23 and 2023-24. In assessed practice seed treatment with *Trichoderma viride at* 10 g/kg seed plus application of T. viride at 5 kg/ha multiplied on decomposed with 100 kg FYM at the time of sowing found lowest mean per cent disease incidence (4.79) as compared to farmers practices (20.16). The average yield of T2 was 22.41 q /ha which was increased by 18.19 per cent over farmers practices (18.96 q/ha) during three consecutive years 2021-22, 2022-23 and 2023-24. The average net returns Rs.86748 was recorded under assessed practice which was 26.17 per cent higher over farmers practices (Rs. 68750).

***Keywords**:* Chickpea*,* Collar Rot, *Trichoderma viride*

Field efficacy of *Beauveria bassiana* against leaf eating caterpillars in soybean

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Soybean is a major kharif crop which have 1.82 lakh ha area in the Kota district, however, the incidence of leaf eating caterpillars causing considerable yield losses in soybean. To avoid losses caused by these defoliator pests' microbial insecticide was used under this on farm testing (OFT) during 2023 and 2024. The microbial insecticides play an important role in insect pests management. They are biodegradable in nature and making the soybean cultivation more profitable rather than chemical insecticides. In assessed practice spray of Beauveria bassiana ($1x10^8$ cfu) @ 1 liter/ ha after initial incidence of leaf eating caterpillars and 2nd Spray after 15 days interval found effective and 2.41 average larval population per meter row length (mrl) was recorded as compared to farmers practices (3.50) during 2023 and 2024. The average yield of T2 was 15.08 q /ha which was increased by 8.41 per cent over farmers practices (13.91 q/ha).

Keywords: Soybean, defoliators, Management

Evaluation of Fungicides, Organic Formulations and Bio-Agents for the Sustainable Management of Cumin Blight Caused by *Alternaria Burnsii*

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Cumin is an important spice crop, is mainly grown in the states of Rajasthan and Gujarat. Alternaria blight, caused by *Alternaria burnsii*, leads to substantial crop losses, hindering efforts to meet demand and achieve profitability. *Alternaria burnsii* pathogen is major constraint resulting in significant economic loss in cumin production. At present the disease is prevalent in all the cumin growing regions of India. The effectiveness of different new generation fungicides, bio-agents and neem formulations were tested using the poisoned food and dual culture techniques. All the fungicides significantly inhibited the mycelial growth of *Alternaria burnsii*. Under field conditions, plots were sprayed with combi-fungicides, Tebuconazole 50% + Trifloxystrobin 25% WG @0.10% showed lowest disease incidence (16.42% PDI) and highest percentage of disease control (78.59% PEDC), followed by plots sprayed with combi-fungicide Azoxystrobin 18.2% + Difenoconazole 11.4% SC @0.20%, which showed 18.25% PDI and 76.23% of PEDC, along with the highest seed yield of 0.749 kg/plot and 0.729 kg/plot and significant increase in per cent yield (109.92% and 104.29%) respectively.

Keywords- *Alternaria burnsii*, combi fungicides, bio-agents, neem formulations.

Evaluation of Yield Reduction in Pearl Millet (*Pennisetum glaucum*) Due to Ergot Disease

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Pearl millet (*Pennisetum glaucum*) is a climate-resilient cereal crop widely cultivated in arid and semi-arid regions of the world, particularly in parts of Africa and South Asia such as India and Nigeria. The crop is well adapted to harsh environmental conditions, including high temperatures, low rainfall, poor soil fertility and salinity. Pearl millet is an annual C_4 crop belonging to the family *Poaceae* and produces compact ear heads containing nutrient-rich grains. It is valued for both human consumption and livestock fodder. Nutritionally, pearl millet is rich in protein, dietary fiber, iron and essential micronutrients, contributing significantly to food and nutritional security. Pearl millet is highly susceptible to several biotic stresses, leading to reduced yields and economic losses. Major diseases include **ergot** (*Claviceps fusiformis*), **downy mildew** (*Sclerospora graminicola*), **smut** (*Moesziomyces penicillariae*), **leaf blast** (*Pyricularia grisea*) and **rust** (*Puccinia substriata* var. *indica*). Ergot, caused by the fungus *Claviceps fusiformis*, is a highly destructive floral disease of pearl millet that adversely affects both grain yield and quality. The disease manifests as the replacement of healthy grains with dark, hardened sclerotia, rendering affected panicles unfit for consumption. Its impact is particularly severe under epidemic conditions, with susceptible cultivars experiencing yield losses ranging from 58 to 70 per cent. The disease not only reduces the total harvestable grain but also compromises marketability and nutritional value, emphasizing the urgent need for effective management strategies, including the use of resistant varieties and cultural practices, to mitigate its impact on pearl millet production.

Keywords: *Claviceps fusiformis* Ergot, Pearl millet, Yield

Impact Of Climate Change On The Emergence, Epidemiology And Management Of Plant Diseases In Major Crops

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Climate change is emerging as a critical factor influencing the occurrence, spread, and management of plant diseases in major agricultural crops. Rising global temperatures, changing rainfall patterns, elevated atmospheric CO_2 levels, and frequent extreme weather events are significantly altering the interactions among host plants, pathogens, and the environment. These climatic changes can accelerate pathogen growth and reproduction, extend the geographic range of many plant pathogens and vectors, and increase the frequency and intensity of disease outbreaks in important crops such as wheat, rice, maize, and soybean. In addition, fluctuations in temperature and humidity can affect plant physiology and weaken plant defense systems, making crops more susceptible to infections. Climate variability also favors the emergence of new pathogens and the re-emergence of previously minor diseases, posing serious threats to crop productivity and global food security. From an epidemiological perspective, shifting climatic conditions complicate disease prediction and monitoring, reducing the reliability of traditional forecasting models. Therefore, adaptive and integrated disease management strategies are required to address these challenges. Approaches such as the development of climate-resilient crop varieties, improved disease surveillance, advanced predictive modeling, and sustainable agricultural practices are essential to reduce disease risks. Strengthening research and policy support will be vital for ensuring effective plant disease management and sustainable crop production under changing climatic conditions.

Keywords*:* Climate change, plant diseases, epidemiology, crop protection, disease emergence, climate-resilient crops, sustainable agriculture.

Survey Of Black Leg And Soft Rot Of Potato Caused By *Pectobacterium Carotovora*

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An intensive roving survey was conducted to assess the severity of Black leg and Soft rot of potato during Rabi 2023 and 2024 in major potato growing areas of Rajasthan *viz*., Dholpur, Bharatpur, Kota, Jhalawar and Udaipur districts.

Three village from each district and three fields from each village were randomly selected. A total of one fifty potato farmer's fields were randomly surveyed to data on disease intensity/index and production data collected from as per farmer suggested the per cent yield loss estimation was done based on the data collected on production from the farmers of surveyed locations thereafter the productivity of each field calculated and the field having maximum productivity (kg ha) was assumed as protected field from Black leg and soft rot of potato. Percentage yield loss over protected field was calculated due to Black leg and Soft rot of potato in Rajasthan. The disease severity was recorded individually using 0-5 rating scale based on leaf area, stem and fruit covered by blight symptoms following the rating scale described by Pandey *et al*., (2003)

Keywords- Survey, disease intensity, black leg, soft rot, disease severity

Exploring Native Fungal Endophytes for The Biocontrol of Fusarium Wilt in Gladiolus

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Fusarium wilt of gladiolus, caused by *Fusarium oxysporum* f. sp. *gladioli*, results in 60–70% plant mortality, leading to substantial economic losses for growers. The community of endophytic fungi naturally associated with gladiolus shares the plant's ecological niche and forms an integral part of its mycobiome. As a rich reservoir of microbial diversity, endophytes hold considerable promise for sustainable disease management. Despite their potential for sustainable disease management, these native endophytes remain entirely unexplored as biocontrol agents against gladiolus pathogens. In this study, a total of 28 native endophytic fungal isolates were obtained and subjected to preliminary identification based on morphological characteristics, followed by molecular characterization based on ITS sequencing. Phylogenetic analysis confirmed the presence of diverse genera, including *Trichoderma, Cladosporium, Penicillium, Aspergillus, Talaromyces, Alternaria*, and *Clonostachys*. Bioactivity evaluation of the isolated endophytes was performed using dual-culture, volatile metabolite, and non-volatile metabolite assays to assess their antagonistic potential against *F. oxysporum* f. sp. *gladioli*. Several isolates demonstrated strong antagonistic activity in dual-culture tests, achieving inhibition percentages between 22.85% and 75.71%. Volatile metabolite assays confirmed that the isolates generated antifungal volatiles, achieving 16.66 to 52.22% suppression of pathogen growth. Similarly, evaluation of non-volatile metabolites showed that diffusible compounds produced by the endophytes suppressed Fusarium growth, with inhibition ranging from 15% to 81.25%. *Trichoderma harzianum, Penicillium chrysogenum,* and *Aspergillus tubingensis* were found to be highly effective as compared to other isolates exhibiting the greatest broad-spectrum antagonism through both volatile and diffusible metabolites. Further, these selected endophytes demonstrated a marked reduction in *Fusarium* wilt incidence and suppressed the wilt, compared to the untreated control under glasshouse conditions. The results underscore the significant, untapped potential of these native endophytes as promising, eco-friendly biocontrol agents for the sustainable management of *Fusarium* wilt in gladiolus cultivation.

Keywords: Gladiolus, Fusarium wilt, biological management, native endophytes

Survey and Morphological Chacterization of Stem Gall Diseases of Coriander Caused by *Protomyces macrosporus*

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A roving survey was carried out to find out the incidence and intensity of stem gall disease of coriander from different coriander growing districts of Humid South-Eastern Plain Zone V of Rajasthan *viz*. Kota, Baran and Jhalawar districts were conducted for *Rabi* 2021-2022 from December to March at various stages of the crop growth fifteen locations surveyed of Humid South-Eastern Plain Zone V of Rajasthan *viz*. Kota, Baran and Jhalawar and districts during present investigations. The maximum stem gall disease incidence (70%) was recorded in Ramganj Mandi of Kota district followed by 60% incidence in Kalya khedi of Kota and 60% incidence in Shahbad of Baran districts, whereas minimum stem gall disease of coriander incidence (25%) observed in Kanwas of Kota district followed by incidence (35%) in Gopalpura village of Baran district.

The maximum PDI (47.5%) of stem gall disease was observed in Ramganj Mandi of Kota district followed by stem gall disease PDI (37.5%) in Shahbad and PDI (32.5%) in Anta of Baran district. The minimum PDI (10%) was recorded in Kanwas of Kota district followed by PDI (12.5%) in Nadi khod village and PDI (15%) in Jarga village of Jhalawar district and PDI (15%) in Gopalpura of Baran. The morphological characters *viz*., shape, size and germination of chlamydospores of as *Protomyces macrosporus* under microscope.

Keywords: Survey, Stem gall, Coriander, Disease incidence, Disease intensity, Morphological

Survey Of Curvularia Leaf Spot Disease Of Maize Caused By *Curvularia Lunata*

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The surveyed were carried out during *Kharif*, 2023 and 2024, the Curvularia leaf spot disease incidence was observed in most of the surveyed field. In *Kharif,* 2023, per cent disease incidence (PDI) in surveyed areas ranged from 11.65% (Kapurthala districts of Punjab) to 48.07% (Chittorgarh districts of Rajasthan) at the district level, 10.26% (Sultanpur tehsil of Kapurthala districts of Punjab) to 50.07% (Chittorgarh tehsil Chittorgarh districts of Rajasthan) at the tehsil level and 9.20% (Akalpur village of Sultanpur tehsil of Kapurthala districts) to 54.50% (Aakola Khuurd village of Chittorgarh tehsil Chittorgarh districts) at the village level. Similarly, dusring In *Kharif,* 2024 the PDI in surveyed areas ranged from 11.88% (Kapurthala districts of Punjab) to 48.08% (Chittorgarh districts of Rajasthan) at the district level, 10.90% (Sultanpur tehsil of Kapurthala districts of Punjab) to 49.63% (Chittorgarh tehsil Chittorgarh districts of Rajasthan) at the tehsil level and 9.80% (Akalpur village of Sultanpur tehsil of Kapurthala districts) to 53.10% (Aakola Khuurd village of Chittorgarh tehsil Chittorgarh districts) at the village level. These data indicate that occurrence and distribution of disease was widespread in Rajasthan and other states.

Keywords- Curvularia, survey, disease incidence, occurrence of disease, distribution

Integrated Management of Root Rot of chickpea Incited by Rhizoctonia bataticola

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Chickpea (*Cicer arietinum* L.) is an important pulse crop that belongs to the *Leguminaceae* family and is grown in tropical, subtropical and temperate regions of the world and occupies the third position among important grain legumes after common bean and pea. However, its productivity is significantly affected by various diseases, among which root rot caused by *Rhizoctonia bataticola* is one of the most destructive. To manage this disease effectively, an experiment was conducted under *in vivo* conditions during the *Rabi* seasons of 2023–24 and 2024–25 to evaluate the efficacy of *Trichoderma harzianum* and nano zinc oxide (ZnO) in different combinations.

The results revealed significant variation among treatments in reducing disease incidence and enhancing yield. Among all treatments, the combined application of seed soaking with nano ZnO, soil application, seed treatment with *T. harzianum*, and foliar spray of nano ZnO (T11) recorded the lowest pooled disease incidence (12.17%) and the highest disease reduction over control (78.34%). This treatment also resulted in the highest pooled yield (16.47 q/ha) with an increase of 81.36% over control.

Other combination treatments such as T8 (T3+T1+T2) and T10 (T3+T1+T4) also showed promising results, with disease incidence reduced to 17.00% and 16.83%, respectively, along with substantial yield improvements. In contrast, the control treatment recorded the highest disease incidence (56.17%) and the lowest yield (9.08 q/ha).

Overall, integrated use of nano ZnO and *T. harzianum* proved highly effective in managing root rot and improving yield in chickpea. The study suggests that combined application strategies can be a sustainable and eco-friendly approach for disease management in chickpea cultivation.

Keywords: Pea, *Trichoderma harzianum,* Nano ZnO

Screening Of Chilli Germplasm And Comparative *In-Vitro* And *In-Vivo* Evaluation Of Fungicides, Bio-Control Agents, And Botanical Extracts Against Anthracnose Disease Caused By *Colletotrichum Capsici*

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Chilli (*Capsicum annuum* L.) is a widely grown and economically important vegetable crop around the world. It is primarily used as a spice, flavoring agent, and coloring in cooking etc.Chilli is susceptible to a wide range of diseases caused by fungi, bacteria, viruses, nematodes, and abiotic stressors. One of the key biotic factors limiting chilli crop yield and productivity is anthracnose disease. In a screening of 21 chilli germplasms for susceptibility to anthracnose, six were moderately susceptible, ten were susceptible, and five were highly susceptible. Testing botanicals against *Colletotrichum capsici in-vitro* showed that Onion extract had the highest percent inhibition of radial growth at 40.22% (10% concentration), followed by Madar, Lantana, and Crow foot grass. Among bioagents and fungicides, *Pseudomonas fluorescens* had the minimum radial growth (17.49 mm) and highest per cent inhibition (68.72%), followed by *Trichoderma asperellum* (24.96 mm and 64.52%). Hexaconazole resulted in zero radial growth and 100% inhibition, outperforming other treatments. *In-vivo* studies recorded the highest disease control in plots treated with Hexaconazole achieved the highest disease control (56.80%), followed by *Trichoderma asperellum* (41%), *Pseudomonas fluorescens* (37.3%), Onion (24.20%), Madar (17.90%), Lantana (11.6%), and Crow foot grass (5.76%). These results highlight the potential of integrated disease management strategies for controlling anthracnose in chili crops.

Keywords: *Colletotrichum capsici*, Disease control, Antifungal activity, Botanicals, Bio-agents

Integrated Field and *In Vitro* Screening for Identification of Wilt Resistant Sources in Pigeonpea

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Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important food legume cultivated in semi-arid tropical and subtropical regions under diverse agro-ecological conditions. It serves as a rich source of high-quality dietary protein for humans and also contributes to livestock feed and fuelwood. Although India is the largest producer of pigeonpea, the country continues to import significant quantities annually, indicating a gap between production and demand. Among the various constraints, biotic stresses, particularly diseases, are major limiting factors affecting productivity and sustainability. Under field conditions, pigeonpea is severely affected by diseases such as wilt, sterility mosaic, Phytophthora blight, dry root rot, and Alternaria leaf spot. Identification of stable and resistant genotypes is essential for developing disease-resistant cultivars. In the present study, 169 pigeonpea genotypes were evaluated under field conditions in a wilt sick plot during *Kharif* 2025 at the Pulses Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The experimental layout consisted of single rows (4 m length) of each genotype, with every ten entries alternated by two rows of susceptible checks (ICP 2376 and GJP 1) to ensure uniform disease pressure.Out of the evaluated genotypes, 153 were found susceptible, 2 genotypes (PLP 25 and BSMR 736) exhibited moderate resistance, and 14 genotypes (ICPL 20096, ICPL 11227, ICPL 94062, ICPL 20125, ICPL 11226, WRGE 93, WRP 1, GRG 811, IPAC 79, BDH 716, KPL 44, BRG 5, MAL 13, and WRP 1) were identified as resistant. Additionally, important agronomic parameters such as plant height, chlorophyll content, and flowering percentage were recorded to assess overall plant performance. Further, the resistance of these genotypes was confirmed through *in vitro* hydroponic based screening system. The identified resistant genotypes can serve as valuable donors in pigeonpea breeding programs aimed at developing wilt-resistant varieties, thereby contributing to enhanced productivity and self-sufficiency in pigeonpea production.

Role of *Ampelomyces quisqualis* as hyperparasitism for powdery mildew management

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Powdery mildew, caused by biotrophic fungi such as *Erysiphe*, *Podosphaera*, *Oidium* etc, is a major constraint to crop productivity globally due to its rapid dispersion and dependency on living host tissues. The extensive use of chemical fungicides for its management has resulted in resistance development, environmental pollution, and food safety concerns, necessitating the development of sustainable alternatives. In this context, a mycoparasitic fungus *Ampelomyces quisqualis* has gained attention as a highly specific biological control agent of powdery mildew pathogens. Hyperparasitism by *A. quisqualis* involves a series of coordinated interactions beginning with targeted recognition of powdery mildew colonies, likely mediated by chemical signals and surface cues. Then, the hyperparasite attaches to host hyphae and initiates penetration through the secretion of cell wall degrading enzymes such as chitinases and β-1,3-glucanases, which facilitate the breakdown of fungal cell walls. Subsequent internal colonization leads to consumption of cytoplasmic contents and disruption of pathogen metabolism, ultimately resulting in structural collapse of hyphae. Formation of pycnidia of *A. quisqualis* within the hyphae, conidiophores, and cleistothecia of powdery mildew fungi, enabling *in situ* reproduction and effective spread within pathogen populations. This process significantly reduces sporulation and inoculum potential of the pathogen, thereby limiting further disease progression. Besides, competition for nutrients and potential production of secondary metabolites may further contribute to disease suppression. However, its efficacy is influenced by environmental factors such as humidity and is most effective during early stages of pathogen development. Its high host specificity, ecological safety, and compatibility with integrated disease management strategies make it a promising tool for sustainable agriculture. Importantly, it poses no risk to crop or consumer since it only targets the pathogenic fungus which makes it especially appealing for high value crops and for organic farming where synthetic fungicides are prohibited. It will contribute to development of better eco-friendly approaches for management of powdery mildew disease.

B5 – SOIL HEALTH, NEMATOLOGY & ROOT MICROBIOME

Auspicious Temperature and pH for the Development of S*clerotium rolfsii* of Lentil *(Lens culinaris L.)*

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Lentil (*Lens culinaris* L.), an edible pulse from the legume family, is a bushy annual plant rich in essential amino acids (including methionine and cysteine in sprouted forms), dietary fiber, folate, vitamin B1, and minerals. Red (pink) lentils have lower fiber content (11%) than green lentils (31%). However, lentil productivity and seed marketability suffer from various diseases affecting leaves, stems, roots, and pods, with collar rot or root rot caused by the soil-borne pathogen *Sclerotium rolfsii* Sacc. being the most destructive, causing up to 50% yield losses. This fungus prevails in tropical, subtropical, and warm temperate regions. Field studies revealed characteristic symptoms, including white mycelial strands (hyphae) around the collar region and surrounding soil. Laboratory experiments tested mycelial growth and sclerotia production at 15, 20, 25, 30, and 35 °C, showing optimal performance at 25 °C (comparable to 30 °C) after 4 days of incubation. In pH trials (6.5–7.5), maximum mycelial growth occurred at pH 6.5, 7.0, and 7.5 after 7 days.

Keywords: Incubation, Lentil, Mycelial, *Sclerotium rolfsii*, Temperature, pH

Screening of Pigeon Pea Genotypes for Resistance against Alternaria Leaf Spot

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Alternaria leaf spot, caused by *Alternaria* spp., is an emerging leaf disease of pigeon pea that can cause significant reduction in photosynthetic leaf surface, pod setting, and ultimately grain yield. The use of resistant varieties is an effective and environmentally safe approach for the control of this disease. The aim of this study was to evaluate the resistance of pigeon pea genotypes to Alternaria leaf spot. A total of 46 pigeon pea genotypes, including one susceptible check (GT-101), were evaluated for resistance to Alternaria leaf spot under natural epiphytotic conditions. The disease severity was recorded at 60, 90, 120, and 150 days after sowing (DAS) using the standard disease rating scale. The Area Under Disease Progress Curve (AUDPC) was calculated for all the entries. In addition, the infection percentage of the pods was recorded at maturity. Significant variation for disease response was noticed among the entries. The disease severity increased progressively with the age of the crop on all the entries. The entry IC614652 showed the least disease severity (1.27–5.00%), the least AUDPC (289.0), and no pod infection. These findings suggest that the entry IC614652 is highly resistant. Other promising entries, such as IC611215, IC611216, IC611247, and IC612565, also showed low disease severity. In contrast, the highest disease severity (13.50–54.00%), the highest AUDPC (3199.50), and 45% pod infection were noticed on the entry GT-101, the susceptible check. The findings of this study reveal that significant variation exists for resistance to Alternaria leaf spot in pigeon pea. These findings on the resistance of the entries to Alternaria leaf spot can be of immense use for the development of varieties with resistance to this disease.

Exploring the Potential of Plant Microbiome in Promoting Plant Health and Suppressing Soil-Borne Pathogens in Agricultural Systems.

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The plant microbiome, which includes diverse communities of microorganisms associated with plant roots, leaves, and surrounding soil, plays a vital role in maintaining plant health and productivity. In agricultural systems, soil-borne pathogens such as *Fusarium, Rhizoctonia, Pythium, and Sclerotium* cause significant yield losses in many crops. Traditional disease management strategies mainly rely on chemical pesticides, which may lead to environmental concerns and pathogen resistance. Therefore, sustainable and eco-friendly alternatives are increasingly needed.Beneficial microorganisms present in the plant microbiome, particularly in the rhizosphere, contribute significantly to plant growth promotion and disease suppression. Microbial groups such as plant growth-promoting rhizobacteria (PGPR), mycorrhizal fungi, and other beneficial microbes can inhibit pathogens through mechanisms like competition for nutrients and space, production of antimicrobial compounds, and induction of systemic resistance in plants. These interactions help enhance plant vigor and reduce disease incidence.Recent advances in molecular biology and sequencing technologies have improved the understanding of microbial diversity and their functional roles in crop ecosystems. Harnessing the plant microbiome offers a promising approach for sustainable disease management. Integrating microbiome-based strategies with existing crop protection practices can enhance plant health, improve crop productivity, and support environmentally sustainable agriculture.

Keywords*:* Plant microbiome, rhizosphere, soil-borne pathogens, biological control, plant health, sustainable agriculture.

Evaluation of Organic Amendments for the Management of *Sclerotium rolfsii* Causing Soil-Borne Disease

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Stem rot of cluster bean caused by *Sclerotium rolfsii* is a destructive soil-borne disease responsible for considerable yield losses in cluster bean-growing regions. The present investigation was carried out to evaluate the antifungal potential of various organic amendments against *Sclerotium rolfsii*, a major soil-borne pathogen causing significant yield losses in many crops. The experiment was conducted under *in vitro* conditions using seven treatments, namely castor cake, cotton cake, mustard cake, neem cake, groundnut cake, linseed cake, and an untreated control. Each amendment was tested at 5% and 10% concentrations to assess its effect on mycelial growth inhibition. The results indicated significant variation among treatments in suppressing the growth of the pathogen. Among all the organic amendments, neem cake proved to be the most effective, recording 53.33% and 73.33% inhibition of mycelial growth at 5% and 10% concentrations, respectively. Linseed cake was found to be the next best treatment, with 45.56% and 56.67% inhibition at the respective concentrations. Other amendments exhibited moderate to lower levels of inhibition, whereas the untreated control showed maximum fungal growth. The enhanced inhibitory effect of neem cake may be attributed to the presence of biologically active compounds such as azadirachtin and other secondary metabolites known for their antifungal properties. The present findings are in closeagreement with earlier studies, which have also reported the superior efficacy of neem-based amendments against *S. rolfsii*. Overall, the study highlights the potential of organic amendments, particularly neem cake, as an eco-friendly and sustainable approach for managing soil-borne pathogens. Incorporation of such amendments can reduce dependency on chemical fungicides and support environmentally safe disease management strategies. Further field-level validation is suggested to confirm their effectiveness under natural conditions.

Keywords: *Sclerotium rolfsii*, neem cake, organic amendments, mycelial growth inhibition.

Identification Of Tolerant Potato Genotypes Against Fusarium Dry Rot For Reducing Storage Losses

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Potato (*Solanum* tuberosum L.) dry rot, induced by *Fusarium sambucinum*, represents a significant post-harvest challenge that impacts tuber quality and storability, especially in warm storage environments. This study assessed twenty potato genotypes regarding their response to dry rot through controlled artificial wound inoculation. A virulent isolate of *F. sambucinum* was confirmed at the molecular level via rRNA gene sequencing (GenBank accession no. PX447085.1) and utilised for uniform inoculation. Notable differences ($P \leq 0.05$) were identified among genotypes regarding days to symptom appearance, disease incidence, lesion diameter, lesion depth, rottage percentage, and dry matter content. The incidence of disease at 28 days post-inoculation ranged from 4.88% to 42.30%, whereas rottage fluctuated between 5.77% and 46.50%. The diameter and depth of lesions varied from 0.7 to 4.6 cm and from 3.9 to 16.8 mm, respectively. Genotypes including Kufri Sangam, Kufri Badshah, and Kufri Chipsona-1 demonstrated delayed symptom expression, diminished lesion development, and reduced rottage, suggesting a degree of tolerance. Kufri Pukhraj, Kufri Neelkanth, and Kufri Mohan exhibited early symptom development and significant tissue colonisation, indicating high susceptibility. Pearson's correlation analysis indicated strong positive associations between disease incidence, lesion diameter, lesion depth, and rottage percentage, while dry matter content exhibited a significant negative correlation with disease severity parameters. The tuber slice assay supported quantitative observations by showing variations in mycelial growth intensity and tissue discolouration across genotypes. The research reveals significant genotypic variability in response to *F. sambucinum* and identifies cultivars that exhibit relative tolerance, which may enhance storage management and decrease post-harvest losses.

B6 – ECO-PATHOLOGY: NATURAL FARMING, AGRO-SCAPING & CLIMATE RESILIENCE

Population Fluctuation Of Various Insect Pests Of Summer Sorghum In North Gujarat

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A study was conducted to investigate the seasonal incidence of major insect pests of summer sorghum and their relationship with weather parameters under North Gujarat conditions. The highest shoot fly dead heart incidence (40.00%) was observed during the 4^{th} week after sowing corresponding to the 15^{th} Standard Meteorological Week (SMW), whereas the lowest incidence (6.67%) was recorded during the 9^{th} week after sowing (20^{th} SMW). Correlation analysis revealed a significant negative relationship between shoot fly infestation and wind speed ($r = –0.625^*$), suggesting that higher wind velocity may suppress pest activity. Stem borer infestation reached its peak (40.00% dead hearts) during the 19^{th} SMW, while the minimum incidence (3.33%) occurred during the 23^{rd} SMW. A significant positive correlation was observed between stem borer incidence and bright sunshine hours ($r = 0.611^*$), indicating favourable conditions for pest development. The shoot fly complex comprising *Oscinella* spp. and *Etecephala* spp. recorded peak maggot populations of 2.93 and 4.63 maggots per quadrate, respectively, during the 17^{th} SMW, with no significant influence of abiotic factors on their abundance. Similarly, ash weevil population peaked at 0.73 individuals per plant during the 18^{th} SMW without any major correlation with weather parameters. Leaf hopper population reached its maximum density (0.56 individuals per plant) during the 21^{st} SMW and exhibited a highly significant positive correlation with bright sunshine hours ($r = 0.717^{**}$) and significant positive correlations with maximum temperature ($r = 0.677^*$) and minimum temperature ($r = 0.573^*$). Natural enemies such as spiders were present throughout the crop period, with the highest population (0.23 individuals per plant) during the 18^{th} SMW and a significant positive correlation with maximum relative humidity ($r = 0.571^*$). Overall, shoot fly incidence predominated during early crop stages, while stem borers and foliage feeders appeared from mid-vegetative to reproductive stages.

Keywords: Abiotic factors, correlation, dead hearts, shoot fly, wind velocity

Disease Cycle, Symptomatology, and Yield Losses Caused by Alternaria Blight in Mustard

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Alternaria blight, caused primarily by *Alternaria brassicae* and *A. brassicicola*, is a major foliar disease affecting mustard (*Brassica juncea*) and can cause significant yield reduction under conducive environmental conditions. The pathogen survives on crop debris, infected seeds, and volunteer plants, serving as a primary inoculum source. Dissemination occurs via wind-borne conidia and splashing rain, leading to rapid secondary infections under high humidity and moderate temperatures, completing a polycyclic disease cycle during the crop season. Typical symptoms begin as small, dark brown circular spots on older leaves, which expand into concentric lesions with yellow halos, leading to leaf blight and premature defoliation. Stem and branch infections produce elongated dark lesions, weakening plant structure, while siliqua infection results in sunken, necrotic spots that reduce seed size and quality. Severe infections can lead to up to 40–60% yield loss, depending on cultivar susceptibility and environmental conditions. Understanding the disease cycle and symptomology is crucial for timely detection, effective monitoring, and the development of integrated disease management strategies to minimize yield losses and sustain mustard production

Typical symptoms begin as small, dark brown circular spots on older leaves, which expand into concentric lesions with yellow halos, leading to leaf blight and premature defoliation. Stem and branch infections produce elongated dark lesions, weakening plant structure, while siliqua infection results in sunken, necrotic spots that reduce seed size and quality. Severe infections can lead to up to 40–60% yield loss, depending on cultivar susceptibility and environmental conditions. Understanding the disease cycle and symptomology is crucial for timely detection, effective monitoring, and the development of integrated disease management strategies to minimize yield losses and sustain mustard production.

Keywords: Mustard, *Alternaria brassicae*, blight, symptomology, yield loss, disease cycle

Beyond Disease Severity: Using AUDPC and R To Decode Stem Gall Disease In Coriander

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Stem gall disease, caused by *Protomyces macrosporus* Unger, is a major constraint in coriander production, leading to significant yield losses. To evaluate varietal resistance, thirty coriander genotypes were screened under sick plot conditions. Disease progression was quantified using two epidemiological parameters: the Area Under Disease Progress Curve (AUDPC), which reflects cumulative disease pressure over the time, and the rate of infection (r), which indicates the speed of epidemic development over a period of time. Disease severity (%) was recorded at regular intervals, and AUDPC was calculated using the trapezoidal method, while disease rate of infection (r) was estimated through logistic regression of disease progress data.

Results revealed considerable variation among genotypes, with AUDPC values ranging from 1168.5 to 2488, and r values from 0.016 to 0.067. ACr1 exhibited low AUDPC coupled with reduced r, indicating strong resistance and slower epidemic progression. On the other hand, susceptible varieties showed high AUDPC values and rapid disease rates.

This dual-parameter approach provided a comprehensive understanding of stem gall resistance among the different genotypes, highlighting with both reduced disease burden and slower epidemic spread. The findings emphasize the importance of integrating AUDPC and r in varietal screening to identify promising coriander lines for resistance breeding and sustainable disease management.

Efficacy of fungal endophytes of tea ecosystem for the management of Blister blight

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Tea is likely the most widely used non-alcoholic beverages around the world, contributing major role in strengthening the economy of country and making India the 2nd largest tea producing country in the world. ***Exobasidium vexans*** an obligate parasite causing Blister Blight disease in tea has serious implications on quality of tea production. As Poor literature are available till date for the management of pathogen through biological approach, chemical is the limited option for the management. To address this issue bio-efficacy of fungal endophytes will be studied under modified media. Isolation of endophytes as well as pathogen will be done followed by both cultural and morphological characterization. On the basis of *in-vitro* efficacy best fungal endophytes will be selected, mode of action will be studied and further studies will be done. Field records showing positive results in management of Blister Blight will come forward as a milestone in Tea ecosystem management.

Keywords: Endophytes, *Exobasidium vexans*, fungi, management and tea

Genetic Variability for Resistance to Alternaria Leaf Spot in Pistillate Lines of Castor (*Ricinus communis* L.) Under Natural Epiphytotic Conditions

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Alternaria leaf spot, caused by *Alternaria ricini*, is a significant leaf spot disease affecting castor (*Ricinus communis* L.), leading to substantial reductions in photosynthetic area and yield. This study aimed to evaluate the genetic variability for resistance in thirty pistillate lines of castor under natural epiphytotic conditions. A randomised block design was utilised for the study. The experiments were carried out in the *kharif* season of 2025 in Oilseed Research station, Sardarkrushinagar. Disease severity was evaluated using a scale from 0 to 5, and the percent disease index was computed. Considerable variation was observed among the evaluated genotypes. The percent disease index varied significantly, with values between 10.42 and 81.06. Among the evaluated genotypes, the disease response indicated that the SKP 129 genotype exhibited resistance to Alternaria leaf spot. Twelve genotypes exhibited moderate resistance, fourteen genotypes demonstrated moderate susceptibility, and three genotypes were susceptible to the disease. Considerable variation was observed among the genotypes tested. This suggests the existence of genetic diversity concerning resistance to Alternaria leaf spot. The resistant and moderately resistant genotypes identified in this study can be utilised for the development of disease-resistant castor hybrids.

Comparative efficacy and LT_{50} analysis of biopesticides and botanicals against *Helicoverpa armigera* (Hubner) on chickpea under laboratory conditions

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Chickpea (*Cicer arietinum* L.) is a significant *Rabi* crop in India, suffering productivity losses due to the gram pod borer, *Helicoverpa armigera*, a harmful pest. The reliance on chemical insecticides has led to resistance, environmental issues, and harm to non-target species, highlighting the necessity for eco-friendly insecticides. This study evaluates the effectiveness of biopesticides and botanical insecticides against the gram pod borer in laboratory conditions during the *Rabi* season of 2025-2026, utilizing a Completely Randomized Design with nine treatments and three replications featuring the Gujarat Gram-3 variety. The treatments were evaluated by leaf dip method at the specified concentrations of each insecticide, and larval mortality was assessed after 24, 48, and 72 hours post-treatment. The results revealed a significant increase in larval mortality of *Helicoverpa armigera* in all the treatments after 72 hours of treatment, and among all the treatments, Neem Seed Kernel Extract 5% (NSKE 5%) @ 3ml/L (T3) recorded the maximum larval mortality of 100% and was significantly superior to all other treatments, followed by azadirachtin 10,000 ppm (T2) @ 3ml/L, Datura leaf extract (T8) @ 3ml/L, *Beauveria bassiana* 1.15 WP (T1) @ 3ml/L, and karanj leaf extract (T7) @ 3ml/L, whereas lantana (T5) @ 3ml/L and ipomoea (T6) @ 3ml/L recorded moderate to low efficacy, whereas the untreated control did not show any mortality, and the results of the study revealed that the time required for 50% mortality (LT_{50}) of *Helicoverpa armigera* was lowest in NSKE 5% @ 3ml/L, followed by azadirachtin 10,000 ppm @ 3ml/L and Datura leaf extract @ 3ml/L, whereas *Beauveria bassiana* 1.15 WP @ 3ml/L required a comparatively longer time. The study concludes that neem-based botanicals, especially NSKE, are effective and rapid in their action against *Helicoverpa armigera*, a significant and polyphagous pest of pulses, and can be successfully integrated into eco-friendly practices.

Evaluation of New-Generation Fungicides for the Management of Yellow Rust of Wheat (Puccinia striiformis f. sp. tritici)

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Fungicides may be an important means to manage when severe epidemics of rust occur, however, their usage results in increased production costs for farmers. On evaluation of the bio-efficacy of different new generation fungicides against P. striiformis f. sp. tritici in-vitro for its management, all new generation fungicides were significantly inhibited urediospores germination at different concentrations (0.1- 0.2%). Among them, Azoxystrobin 14% + Epoxiconazole 9% SC was most effective at all three concentrations (i.e., 0.10, 0.15 and 0.20 per cent) and inhibited maximum spore germination (99.20%) followed by Propiconazole 13.9% + Difenoconazole 13.9% EC inhibited (99.01); Azoxystrobin 4.8% + Chlorothalonil 40% w/w SC inhibited (98.61%); Azoxystrobin 11% + Tebuconazole 18.3% SC inhibited (97.81%); Tebuconazole 50% + Trifloxystrobin 25% WG inhibited (97.21%); Propiconazole 25% EC inhibited (96.82%); Tebuconazole 25.9% EC inhibited (95.82%); Azoxystrobin 23% SC inhibited (94.83%) and Difenoconazole 25% EC inhibited (93.85%) urediospore germination at all three concentrations. Fungicides evaluated under field condition revealed that minimum disease severity (10.37%) was observed on spray application of Azoxystrobin 14% +Epoxiconazole 9% SC @ 0.15% with 72.50% disease control followed by Propiconazole 13.9% + Difenoconazole 13.9% EC (12.21%) with 67.66% disease control. Maximum disease intensity (37.76%) was recorded on plants grown in control plots. Similarly, 15 days after second spray Azoxystrobin 14% + Epoxiconazole 9% SC @ 0.15% showed minimum per cent disease severity (13.32%) with maximum disease control (70.94%) followed by Propiconazole 13.9% + Difenoconazole 13.9% EC @ 0.1% (15.54%) with 66.14% disease control. Among different treatments all nine treatments were found significantly effective in reduction of disease and increased yield. The highest grain yield (7kg/plot) were observed in treatment of Azoxystrobin 14% + Epoxiconazole 9% SC @ 0.15 per cent and 59.09% increase in yield over control with 1:2.56 cost: benefit ratio. Minimum yield of grain (5.6kg/plot) was recorded in spray application of Difenoconazole 25% EC and 27.27% increase in yield over control with 1:1.73 cost: benefit ratio. Kanwar et al., (2018) conducted field experiment to evaluate the efficacy of different chemical fungicides against stripe rust of barley caused by Puccinia striiformis f. sp. hordei by spraying of Tebuconazole 50%+Trifloxystrobin 25% WG (0.05%, 0.1%) and Tebuconazole 25.9 EC (0.05%, 0.1%) and they reported that Trifloxystrobin 50% + Tebuconazole 25% @ 0.1% was found best with minimum disease (8.08 PDS) along with highest yield (56.50q/ha). It was followed by Tebuconazole @ 0.1% (9.43 PDS), Trifloxystrobin + Tebuconazole @ 0.05 %, (10.35 PDS) and Tebuconazole @ 0.05% (11.68 PDS). The yield performance of Tebuconazole @ 0.1% (42.33 PDS) and Trifloxystrobin + Tebuconazole @ 0.05 % (54.90 q/ha) were at par with Trifloxystrobin 25% +Tebuconazole 50% WG @ 0.1 (56.59 q/ha).

Keywords: New generation fungicides, Yellow rust of wheat, Puccinia striiformis f. sp. tritici

CRISPR- Cas9 mediated editing of plants susceptibility genes providing durable resistance against rapidly evolving fungal and bacterial pathogens

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Among the major biotic constraints in rice (*Oryza sativa*) production, the brown planthopper (*Nilaparvata lugens*), rice blast caused by *Magnaporthe oryzae*, and bacterial blight caused by *Xanthomonas oryzae* pv. *oryzae* have been identified as major constraints. Developing resistant cultivars to these stresses remains the most sustainable and environmentally safe option to combat these stresses. Advances in multiplex CRISPR/Cas9 gene editing technology have made it possible to knock out multiple S genes at once. Such technology can be used to efficiently knock out multiple S genes to develop rice cultivars with broad-spectrum resistance to multiple stresses. Empirical studies have shown that key S genes responsible for insect and pathogen susceptibility can be efficiently targeted by the CRISPR/Cas9 system. For instance, genes responsible for brown planthopper sensitivity, i.e., ACS2; BSR-D1, ERF922, and Pi21 responsible for rice blast sensitivity; and Xa5 responsible for bacterial blight sensitivity have been efficiently targeted by the CRISCR/Cas9 system. The expression cassettes for the guides have been assembled in a multiplex binary vector. The binary vector has been used to transform rice plants via the Agrobacterium-mediated system. The Cas9-induced DSBs have been repaired by NHEJ to create indel mutations in the S genes. Triple mutant rice lines have been generated for the S genes. Such rice lines have shown enhanced resistance to brown planthopper, rice blast, and bacterial blight compared to the wild-type rice lines. In addition, the rice lines have retained major agronomic traits. Compared to conventional breeding for developing rice cultivars with multiple resistance to multiple stresses, the efficiency of the system in developing rice cultivars with broad-spectrum resistance to multiple stresses makes it an efficient system for developing rice cultivars with enhanced resistance to multiple stresses.

Epidemiological Dynamics of Cercospora Leaf Spot of Mungbean in Relation to Weather Parameters Caused by Cercospora canescens

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Cercospora leaf spot (CLS) caused by *Cercospora canescens*, is a major foliar disease of mungbean (*Vigna radiata* L.) that adversely affects crop growth and yield under favourable environmental conditions. An understanding of the epidemiology of this disease is crucial for effective prediction and management. The present investigation was undertaken to study the epidemiological aspects of Cercospora leaf spot in relation to prevailing weather conditions during *Kharif* 2023 and *Kharif* 2024. Disease severity was recorded periodically throughout the crop growth period, and its relationship with meteorological factors such as temperature, relative humidity, rainfall was analysed. The results revealed that the disease appeared during the early vegetative stage and progressively increased with crop age, reaching maximum severity during flowering and pod formation stages. Correlation studies indicated that both maximum and minimum temperatures (°C) had a positive influence on disease development. Relative humidity (%) and rainfall (mm) also showed a significant positive association with disease severity, suggesting that warm and humid conditions favoured rapid disease progression. Extended periods of leaf wetness resulting from frequent rainfall and high humidity created favourable conditions for pathogen infection and spread. In contrast, maximum temperature exhibited a negative correlation, whereas minimum temperature showed a positive correlation during both cropping seasons. Overall, the study demonstrates that weather parameters play a decisive role in the epidemiology of CLS of mungbean. These findings provide valuable insights for predicting disease outbreaks and emphasize the importance of weather-based disease forecasting. The information generated can be effectively utilized for timely implementation of integrated disease management strategies to minimize yield losses and improve mungbean productivity.

Keywords: Cercospora Leaf Spot (CLS), Disease severity, Disease forecasting, Epidemiology, Weather parameters.

Natural Farming For Sustainable Disease Suppression Under Climate Stress

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Natural farming is a sustainable and eco-friendly approach for managing plant diseases, particularly under increasing climate stress conditions such as drought temperature fluctuations, and irregular rainfall. This research explores the role of natural farming practices in enhancing plant health and reducing disease incidence through ecological and biological mechanisms. In this systems, practices such as mulching, crop diversification, mixed cropping and the application of indigenous organic formulations like *Jeevamrut* and *Beejamrut* enhance soil fertility and microbial diversity. These beneficial microorganisms suppress plant pathogens through mechanisms including competition antibiosis, and induced systemic resistance. Climate stress often weakens plant defense systems and favors pathogen development natural farming helps mitigate these effects by improving soil structure and increasing water-holding capacity, thereby maintaining a stable root environment. Crop diversification further disrupts pathogen life cycles and reduces host continuity, thereby minimizing disease spread. Natural farming promotes above-ground biodiversity by supporting beneficial insects and natural enemies that regulate pest populations and disease vectors. Natural farming is cost-effective and suitable for smallholder farmers as it utilizes locally available resources and reduces input costs. It enhances long-term soil productivity and environmental sustainability while ensuring crop resilience under changing climatic conditions.

Keywords: Natural farming, Climate stress, Sustainable agriculture, Pathogen suppression, Soil fertility

C. FOOD SECURITY & VALUE ADDITION

C7 – POST-HARVEST PATHOLOGY, MYCOTOXINS & FOOD SAFETY

Physical Treatment For Control Of Post-Harvest Diseases Of Fruit And Vegetables

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Post-harvest diseases significantly contribute to global food losses, causing about 30-40 % reduction in fruits and vegetables after harvest. Due to their high moisture content and soft texture, fresh produce is highly susceptible to fungal pathogens such as *Colletotrichum*, *Penicillium*, *Botrytis*, *Aspergillus*, *Fusarium* and *Sclerotinia* which also cause health risks through mycotoxin production. Growing concerns over the health and environmental impacts of synthetic fungicides have increased interest in safer, non-chemical alternatives. Physical treatments are eco-friendly methods to control post-harvest diseases while maintaining produce quality. Techniques such as heat treatment, cold storage, modified atmosphere packaging and UV-C irradiation effectively reduce microbial growth and extend shelf life without chemical residues. A one study showed that hot water treatment at 53 °C for 20 minutes is optimal for 'Carabao' mango. It reduced anthracnose (48.71-52.63 %) and stem-end rot (48-60.86 %). HWT was fungistatic (not fungicidal) and did not affect fruit quality.

Keywords: Physical treatments, post-harvest diseases, residue- free technology, shelf-life extension, food safety

Post-Harvest Survey, Molecular Identification and *In Vitro* Management of *Streptomyces scabies* Associated with Common Scab of Potato in Meerut District

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Potato is the fourth most extensively cultivated crop worldwide and holds significant economic importance. Among bacterial diseases affecting potato, brown rot, common scab and soft rot are the most destructive. A postharvest survey was conducted during 2024 in potato fields across six blocks of Meerut District to assess the incidence of common scab disease. The highest disease incidence was recorded in Daurala block (3%), followed by Janikhurd (2.6%), Sardhana (2.5%), and Meerut Sadar (2.2%), whereas the lowest incidence was observed in Mawana block (1%). A total of six Streptomyces isolates were recovered from infected potato tubers. Among these, four isolates exhibited cultural characteristics typical of *Streptomyces scabies*, including profuse aerial mycelial growth and creamy white to grey colonies. These isolates were further characterized on different culture media. On Starch Casein Agar, Potato Dextrose Agar, and Yeast-Malt Extract Agar, colonies appeared brown in colour, while white colonies were observed on Nutrient Agar. Molecular identification was performed through PCR amplification of the 16S rDNA gene, in which two isolates produced an amplicon of approximately 1500 bp, confirming their identity as *S. scabies*. Antibiotic sensitivity was evaluated using the disc diffusion method. All isolates exhibited complete resistance to Aztreonam and showed minimal sensitivity to Imipenem. The maximum inhibition zone was recorded with Amikacin (26 mm), followed by Carbenicillin (15 mm) and Piperacillin (9.5 mm). Furthermore, four biological control agents were assessed for their antagonistic activity against *S. scabies* using the disc diffusion assay. Among them, *Trichoderma harzianum* showed the highest inhibitory effect (35 mm), followed by *Trichoderma viride* (29.5 mm) and *Bacillus subtilis* (23 mm). The least inhibition was observed with *Pseudomonas fluorescens* (10.5 mm), indicating its comparatively lower antagonistic potential against the pathogen.

Keyword: *Streptomyces scabies,* Common Scab of Potato, Molecular identification, DNA

Biological Control Of Penicillium Fruit Rot Disease Using Antagonistic Microorganisms

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Post harvest fruit losses caused by *Penicillium* species represent a major economic and food safety concern worldwide. Species such as *Penicillium expansum*, *Penicillium digitatum* and *Penicillium italicum* are responsible for blue mold and green mold diseases in apples, pears, citrus and other fruits, leading to substantial quantitative and qualitative losses during storage and marketing. In addition, *P. expansum* produces the mycotoxin patulin, posing serious health risks. Although synthetic fungicides have been widely applied for disease management, the emergence of resistant strains, environmental contamination and increasing regulatory restrictions have accelerated the search for sustainable alternatives. Biological control using antagonistic microorganisms-particularly yeasts and bacteria has emerged as a promising eco-friendly approach. Yeast antagonists suppress pathogens mainly through nutrient and space competition, biofilm formation, secretion of lytic enzymes, production of volatile organic compounds and induction of host resistance. Bacterial antagonists act *via* antibiosis, siderophore-mediated iron competition, hydrolytic enzyme production, quorum sensing interference and activation of induced systemic resistance.

Keywords: Post harvest diseases; *penicillium expansum*; *penicillium digitatum*; *penicillium italicum*; biological control; antagonistic microorganisms; yeast antagonists; bacterial antagonists; patulin; antifungal mechanisms; induced systemic resistance; sustainable disease management.

Mitigation of Aflatoxin Contamination in Stored Groundnut Using Essential Oil-Based Bio-Fumigants

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Aflatoxins, which are mainly produced by *Aspergillus flavus*, are harmful and carcinogenic substances that significantly affect the production and storage of groundnuts. Such as inadequate storage conditions worsen post-harvest losses, making a large portion of agricultural products unfit for consumption. This research examined the inhibitory effects of plant-derived essential oils (EOs) namely clove, cardamom and garlic as natural and safe alternatives for managing mold growth and aflatoxin contamination in stored groundnuts. The EOs were obtained through hydro distillation and analyzed using GC-MS, which identified eugenol (39.88%) as the primary compound in clove oil and alpha-terpineol acetate (36.50%) in cardamom oil. The antifungal efficacy was assessed using the well diffusion method against *A. flavus* isolates. The results indicated that clove and cardamom oils completely inhibited mycelial growth at concentrations of 250 ppm or higher. In simulations involving stored groundnuts, clove oil achieved a 92% inhibition rate of growth, while cardamom oil resulted in an 88% reduction. Notably, garlic oil did not show any antifungal activity against the strains tested and combinations of the oils did not provide any additional benefits. These results highlight the promise of clove and cardamom EOs as potent bio-fumigants to improve food security and reduce the health hazards linked to aflatoxins. This eco-friendly strategy diminishes the dependence on synthetic chemical preservatives while maintaining the safety and quality of stored groundnuts.

Keywords: Aflatoxins, Essential oils, Food security, Groundnuts

Assessment Of Antifungal Efficacy Of *Mentha Arvensis* L. Essential Oil Against Fungi Contaminating Stored *Piper Longum* L

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The present study deals with the postharvest fungal diversity associated with *Piper longum* L. during storage as well as assessment of *Mentha arvensis* L. essential oil (MAEO) as natural fungitoxicant against *Aspergillus flavus*. The average pH and moisture content of collected stored *Piper* ranged from (6.10±0.01-6.52±0.02) and (9.53±0.13-13.8±0.28) respectively. Mycoflora analysis of collected stored Pippali samples using serial dilution technique exhibited significant amount of storage fungal colonies. A total of 214 fungal species were recovered excluding Mucorales members. Among these, sample 3 showed the highest occurrence frequency (35.04%) while sample 2 showed the lowest (31.30%). Cumulatively, *Aspergillus flavus* showed highest relative density (15.88%) followed by *Aspergillus niger* (13.55%) and *Penicillium* spp. (13.55 %) while lowest relative density was found in *Aspergillus terreus* (1.40%) followed by *Curvularia* sp. (2.33%). Some common members of order Mucorales viz. *Mucor* sp., *Rhizopus* sp. and *Absidia* sp. were also reported. MAEO completely inhibited the growth of *A. flavus* at 3 mg ml^{-1} and also exhibited broad spectrum fungitoxicity against 10 recovered storage fungi at MIC against *A. flavus* i.e. 3 mg ml^{-1}. The chemotype of MAEO was determined by GC-MS analysis which showed 21 constituents. Menthol was found to be the major component (67.66%) followed by Isomenthone (9.16%) and menthone (6.57%). The findings showed MAEO was efficient in checking fungal growth of storage fungi and can be used as a natural and eco-friendly preservatives against postharvest fungal contamination of *Piper longum* during storage.

Keywords: *Piper longum*; Mycoflora; *Aspergillus*; *Mentha arvensis*; Essential oil; GC-MS

Assessment Of *Ocimum Tenuiflorum* L. Essential Oil as Green Preservatives Against Fungal Contamination of *Sorghum Bicolor* (L.) Moench During Storage

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The present study deals with the postharvest fungal diversity associated with *Sorghum* millet during storage as well as assessment of *Ocimum tenuiflorum* L. essential oil (OTEO) as natural fungitoxicant against *Aspergillus flavus.* The average pH and percent moisture content of collected stored *Sorghum* millet ranged (6.48±0.01-6.70±0.04) and (10.27±0.03-12.97±0.19) respectively. Mycological analysis of collected stored *Sorghum* millet samples using serial dilution technique exhibited significant amount of storage fungal colonies. A total of 208 fungal isolates were recovered excluding Mucorales members. The sample 1, 2 and 3 exhibited a total number of 12, 7 and 9 identified species respectively. Cumulatively, *Aspergillus niger* was dominated and exhibited highest relative density (18.26%) followed by *A. flavus* (17.78%), *A. fumigatus* (12.98%) and *Penicillium* spp. (11.53%) whereas, both *A. candidus* and *Curvularia* sp. showed the lowest (0.48%) relative density followed *by A. terreus* (0.96%). Some common members of order Mucorales viz. *Absidia* sp., *Mucor* sp. and *Rhizopus* sp. were also reported. OTEO completely inhibited the growth of *A. flavus* at 1.0 mg ml^{-1} and also exhibited broad spectrum fungitoxicity against 10 recovered storage fungi at MIC against *A. flavus* i.e. 1.0 mg ml^{-1}. The GC-MS analysis showed Methyleugenol as major component (70.90%) followed by Caryophyllene (14.31%) and beta-cubebene (4.14%). The findings showed OTEO was efficient in checking fungal growth of storage fungi and can be used as potent green preservatives against postharvest fungal contamination of *Sorghum* millet during storage.

Keywords*:* Mycoflora, *Aspergillus*, *Ocimum tenuiflorum*, Essential oil, *Sorghum* millet, GC-MS

Exploration Of Pigmented Yeasts From Natural Habitats For The Management Of Post-Harvest Pathogens

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Post-harvest fungal diseases significantly affect the quality and shelf life of fruits and vegetables, causing substantial losses during storage and marketing. The extensive use of synthetic fungicides has led to pathogen resistance, chemical residues, and environmental and health concerns. Therefore, developing sustainable alternatives for post-harvest disease management is essential. In this study, naturally pigmented yeasts were investigated as potential biological control agents against major post-harvest fungal pathogens. Yeast isolates were obtained from diverse natural niches such as leaves, fruits, bark, and other plant-associated habitats rich in microbial diversity. Preliminary characterization was performed based on colony morphology and pigment production. Molecular confirmation was performed through amplification of the D1/D2 domain of the LSU rDNA and genera *Rhodotorula*, *Aureobasidium*, *Sporobolomyces*, *Pseudozyma* were identified. Further the antagonistic potential of the yeast isolates was evaluated against important post-harvest fungal genera belongs to *Alternaria*, *Penicillium*, and *Aspergillus* species using dual culture assays among which A. pollulans (Gaa) exhibited highest mycelial growth inhibition of 50% against *A. alternata*, 66% against *P. expansum* and 48% against *A. flavus*. In addition, volatile organic compound (VOC) assays and non-volatile metabolite assays were conducted to assess the inhibitory effects mediated through gaseous and diffusible metabolites produced by the yeasts. Among all the tested isolates, A. *melanogenum* (L2) exhibited the highest antagonistic activity, with 73.3% against *A. alternata*, 81.7% against *P. expansum*, 68.3% against *A.flavus*. Considering its highest inhibitory activity against the tested pathogens, isolate L2 was identified as the most promising candidate and selected for further investigation. Overall, the study reveals that pigmented yeasts constitute a promising yet relatively underexplored group of microorganisms with considerable potential for sustainable post-harvest disease management.

Keywords: Pigmented yeast, natural habitat, antagonistic activity, post-harvest pathogen

Artificial Production of *Cordyceps bassiana* a teleomorph of *Beauveria bassiana*

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An attempt was made to produce *Cordyceps bassiana* from its anamorph *Beauveria bassiana* in artificial condition. Sixteen specimen isolates of *B. bassiana* were collected from four states of North East India *viz*., Assam, Arunachal, Nagaland and Mizoram. Compatibility between the different isolates of *B. bassiana* were made in half strength Sabouraud's dextrose agar yeast extract (SDAY) agar plates in different combinations. The four compatible isolates were inoculated in different combinations in brown rice media. After regular observation until 60-90 days of incubation, the four combinations produced perithecial stromata.

Keywords: *Cordyceps bassiana, Beauveria bassiana,* perithecia, stromata

C8 – APPLIED MYCOLOGY: INNOVATIONS IN MUSHROOM CULTIVATION & NUTRACEUTICALS

Antimicrobial Potential Of Natural Bioactives Agents Against Oral Pathogens

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Dental caries and periodontal diseases are primarily driven by biofilm-forming oral pathogens such as Streptococcus mutans, Lactobacillus spp., and Candida albicans. Conventional antibiotics remain effective but their overuse has accelerated resistance, highlighting the need for safer, plant-derived alternatives. Natural bioactives from Psidium guajava (guava) and Musa paradisiaca (banana) have demonstrated antimicrobial properties, motivating evaluation against clinically relevant oral isolates. This study aimed to assess the antimicrobial activity of guava and banana leaf extracts against oral pathogens. Oral swabs were cultured on selective media, and isolates were identified via Gram staining and biochemical assays. Aqueous extracts of guava and banana leaves were prepared and tested using agar well diffusion and broth optical density analysis, with amoxicillin serving as the reference control. The isolates were confirmed as S. mutans, Lactobacillus spp., and C. albicans. Both plant extracts produced measurable inhibition zones, with banana extract consistently yielding larger zones than guava. Broth assays revealed dose-dependent suppression of microbial growth, with banana extract showing greater optical density reduction compared to guava at equivalent concentrations. Amoxicillin exhibited superior inhibition, yet the plant extracts demonstrated significant activity against all tested pathogens. These findings confirm that guava and banana leaf extracts possess antimicrobial potential against cariogenic bacteria and C. albicans. While less potent than conventional antibiotics, their efficacy supports further exploration of phytochemicals as adjunctive or alternative agents for oral health management.

Keywords: Oral microbiota; Natural antimicrobials; Plant extracts; Guava; Banana; Antibacterial.

Oyster Mushroom Cultivation: Exploring the Efficiency of Different Substrates

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Oyster mushroom (*Pleurotus sp.*) is one of the most widely cultivated edible mushrooms due to its high nutritive value, prompt growth, and ability to utilize a wide range of lignocellulosic wastes. The present study evaluates the performance of oyster mushroom cultivation on different agricultural substrates to identify the most suitable and economically substrate for its cultivation. Commonly available substrates such as wheat straw, mustard straw, ground shell, pearl millet straw and sunhemp stalk etc. were selected for comparison under controlled environmental conditions.The substrates were pasteurized and inoculated with mushroom spawn, and observations were recorded on parameters such as mycelial colonization period, time required for pinhead formation, number of fruiting bodies, yield, and biological efficiency. Significant variations were observed among the substrates. Wheat straw demonstrated faster mycelial growth and earlier fruiting. Among all substrates, wheat straw recorded the highest yield and biological efficiency, followed closely by mustard straw, indicating their suitability for large-scale cultivation. The differences in productivity can be attributed to variations in substrate composition, aeration, moisture retention, and nutrient availability. The study highlights that the selection of an appropriate substrate plays a crucial role in optimizing oyster mushroom production. Utilizing locally available agricultural wastes not only reduces cultivation costs but also contributes to sustainable waste management and environmental conservation. Therefore, wheat straw is recommended as the most effective substrates for oyster mushroom cultivation, especially in regions with abundant availability of this material.

***Keywords*:** Agricultural substrates, Biological efficiency, Cultivation, Oyster mushroom, Wheat straw

D. POLICY, TRADE & ENTREPRENEURSHIP

D9 – GLOBAL BIOSECURITY: QUARANTINE, WTO & TRANSBOUNDARY PATHOGENS

Safeguarding Plant Health: Biosecurity And Biosafety Challenges In Modern Crop Protection

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Biosecurity and biosafety are essential pillars of sustainable crop protection, aimed at preventing the introduction, establishment and spread of harmful biological agents that threaten plant health, food security and biodiversity. With expanding global trade, climate variability and increased movement of planting materials, the risk of transboundary plant pests and invasive alien species has significantly intensified. In India, the Directorate of Plant Protection, Quarantine & Storage (DPPQS) regulates import and export of agricultural commodities under the Plant Quarantine Order (2003) to prevent the entry of exotic pests, while international coordination through the International Plant Protection Convention ensures harmonized phytosanitary standards worldwide. Incidents such as the invasion of *Spodoptera frugiperda* and the global spread of *Tomato brown rugose fruit virus* (ToBRFV) demonstrate the serious consequences of inadequate surveillance and delayed detection. Major challenges include contaminated germplasm exchange, transboundary pest migration, invasive alien species and limitations in conventional phytosanitary screening methods. Effective biosecurity requires systematic risk assessment, quarantine enforcement, early detection techniques and coordinated regulatory mechanisms to safeguard agricultural productivity and ecological stability.

Keywords: plant biosecurity, biosafety, plant quarantine, molecular diagnostics, crop protection

WTO Sanitary and Phytosanitary (SPS) Measures: Impact on Smallholder Market Access.

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Sanitary and Phytosanitary (SPS) measures of the World Trade Organization (WTO) aim to protect human, animal and plant health in agricultural trade. These measures help ensure food safety and prevent the spread of pests and diseases. However, for smallholder farmers, especially in developing countries, meeting SPS requirements is often difficult and limits their access to profitable agricultural markets. Smallholder farmers face many challenges such as lack of awareness about SPS standards, high costs of testing and certification, poor infrastructure and limited technical support. Because of these constraints, farmers struggle to comply with food safety rules, plant quarantine regulations and quality standards required in domestic and export markets. As a result, their agricultural products are often rejected or sold at lower prices, reducing farm income and market opportunities. This paper discusses how SPS measures affect smallholder farmers' participation in agricultural markets. While SPS rules are necessary for safe trade, they can act as barriers when farmers do not receive adequate training, extension services, and institutional support. At the same time, the study shows that proper implementation of SPS measures can improve farm practices, crop quality and plant health management. The paper emphasizes the importance of capacity building, farmer training, better extension services, and investment in testing and certification facilities. Strengthening cooperation between governments, agricultural institutions, and farmer organizations can help smallholders meet SPS standards. Inclusive and farmer-friendly SPS implementation is essential to improve smallholder market access and promote sustainable agricultural development.

Keywords: WTO-SPS measures, Smallholder farmers, Agricultural market access, Food safety standards, Phytosanitary regulations, Sustainable agriculture

False Smut Of Rice As A Transboundary Plant Pathogen: Emerging Risks To Global Food Security

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False smut of rice, caused by the fungal pathogen *Ustilaginoidea virens*, has emerged as an increasingly important disease in major rice-growing regions worldwide. The disease manifests as characteristic smut balls that replace rice grains, leading to yield reduction, grain quality deterioration and contamination with toxic compounds such as ustiloxins, which pose risks to food and feed safety. The spread of the pathogen is facilitated by the movement of infected seeds, conducive environmental conditions and intensified rice cultivation practices. Climatic factors, particularly high humidity and temperature during the flowering stage, significantly enhance disease development and dissemination across production regions. Beyond direct crop losses, false smut also threatens market value and international trade due to strict phytosanitary standards. Addressing this emerging threat requires strengthened surveillance, use of disease-free seed, development of resistant cultivars and coordinated phytosanitary management.

Keywords: False smut of rice; *Ustilaginoidea virens*; transboundary plant pathogen; rice pathology; phytosanitary management; food safety

D10 – Lab To Land: Agri-Business, Start-Ups, Policy & IPR

Policy and Regulatory Framework for Plant Protection in India

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Innovation-driven entrepreneurship in plant protection, including bio-pesticides, microbial plant-health agents, digital pest-management platforms and precision agriculture technologies, is increasingly recognized as a key driver of sustainable agricultural development. However, the growth of such ventures depends greatly on supportive and efficient policy and regulatory frameworks. In India, plant protection is primarily governed by the Destructive Insects and Pests Act, 1914, the Plant Quarantine (Regulation of Import into India) Order, 2003 and the Insecticides Act, 1968. These regulations provide guidelines for quarantine procedures, product registration and the regulation of crop protection products and agricultural trade. Many of these policies were designed decades ago and often struggle to accommodate modern bio-based technologies. In particular, microbial plant protection products such as bio-pesticides and beneficial microorganisms face complex and fragmented regulatory procedures. Startups frequently encounter challenges such as lengthy approval timelines, high compliance costs and limited infrastructure for field trials and large-scale production, which can delay commercialization and market entry. Additional laws, including the Protection of Plant Varieties and Farmers' Rights Act, 2001 and the Biological Diversity Act, 2002, establish a unique intellectual property framework that seeks to balance the interests of plant breeders, farmers and biodiversity conservation. While these laws promote innovation and protect biological resources, their interaction with traditional knowledge systems and commercialization processes often creates regulatory complexities for entrepreneurs and emerging agri-biotechnology startups.

Keywords: Plant Protection Policy, Bio-pesticides, Agri-biotechnology Startups, Regulatory Framework, Intellectual Property Rights (IPR)

Prospects Of Medicinal Mushroom Marketing In India After Pandemic Era

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The post-pandemic era has significantly enhanced the scope of medicinal mushroom marketing in India, driven by increased awareness of immunity, preventive healthcare, and inherent demand for diverse plant-based protein sources. The COVID-19 pandemic accelerated the demand for nutraceuticals and ideal functional foods, bringing medicinal mushrooms such as Reishi, Cordyceps, Lion's Mane, Shiitake and Oyster into the spotlight due to their bioactive compounds including beta-glucans providing immune modulation benefits and antioxidant properties. India's mushroom industry is growing rapidly due to increasing health awareness and changing healthy food habits. The market, valued at around USD 1.58 billion in 2025, is expected to reach USD 5.29 billion by 2035, with a compound annual growth rate (CAGR) of about 12.84%. Traditionally, the industry has been dominated by button mushrooms, which still account for nearly 60–70% of total production. However, there is a clear shift toward high-value medicinal and exotic mushrooms, which offer better growth opportunities and higher profits. Medicinal mushrooms such as Cordyceps and Reishi have strong economic potential. Cordyceps can sell for ₹1.5–3.5 lakh/kg, while Reishi is priced at around ₹4,000/kg, indicating lucrative opportunities in the nutraceutical and pharmaceutical markets. The rise of digital marketing, e-commerce platforms, and direct-to-consumer models has further boosted accessibility and demand for value-added products such as powders, capsules, and extracts. In addition, India's mushroom exports are increasing, with around 25% growth, showing strong demand in international markets for medicinal varieties. Despite this growth, some challenges remain, including low consumer awareness, short shelf life of fresh mushrooms, lack of organized markets, and unclear regulations. However, government support, research activities, and the rise of startups are helping to overcome these issues. Hence, medicinal mushroom marketing in post-pandemic India is a fast-growing agri-business and profitable sector with strong potential to improve farmers' income, support entrepreneurship, and contribute to both economic growth and public health.

Keywords: Agri- business, Medicinal mushroom, Marketing, Post pandemic, Profitable sector

Metabolomic Profiling and Biochemical Responses of *Monacrosporium eudermatum* Against Root-Knot Nematode

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Nematophagous fungi represent a viable and sustainable methodology for the management of plant-parasitic nematodes via mechanical entrapment and biochemical interactions. The present investigation assesses the biocontrol capabilities of *Monacrosporium eudermatum* against *Meloidogyne incognita*, with particular emphasis on its trapping efficiency, the biochemical responses it elicits, and the metabolomic reprogramming it induces. Morphological analysis disclosed the presence of hyaline, septate hyphae and a well-developed three-dimensional adhesive network of traps that proficiently ensnared and immobilized second-stage juveniles (J2), subsequent to their penetration and digestion. Greenhouse bioassays demonstrated a statistically significant decrease in root galling alongside enhanced plant growth, thereby substantiating its biocontrol efficacy. Biochemical assessments revealed augmented plant defense mechanisms, characterized by an increased total phenolic content along with heightened activities of peroxidase (PO) and phenylalanine ammonia lyase (PAL), indicating the potential for induced systemic resistance. Utilizing LC-MS/MS for metabolomic profiling, in tandem with multivariate methods like PLS-DA, OPLS-DA, and VIP scoring, highlighted crucial metabolic changes in response to stress from nematodes. Noteworthy upregulated metabolites, such as 3-hexadecyloxy propylamine, 1-(isopropylamino)-2-hexadecanol, and tridemorph, are likely implicated in the immobilization of nematodes and the disruption of their membranes, whereas metabolites like methyl-1,3,4,5-tetrahydro-2H-1,5-benzodiazepine exhibited downregulation. Pathway analyses underscored the activation of purine, pyrimidine, and vitamin B6 metabolic pathways. Collectively, *M. eudermatum* exemplifies an integrated approach comprising trapping, defense induction, and metabolite-mediated suppression, thereby reinforcing its potential as an environmentally sustainable biocontrol agent.

Keywords: *Monacrosporium eudermatum*, *Meloidogyne incognita*, Biocontrol, Metabolomics, LC–MS/MS.

Mycoeconomy Advancement through Mushroom Value Addition Smart Foods and Mycelium Derived Sustainable Materials

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The mycoeconomy is an idea that is developing to leverage mushrooms and their mycelium in the food and material industries. Nevertheless, mushrooms are very sensitive to perishable goods, which means that they cause a lot of losses after harvesting and limits their marketability. My proposed research discusses the current challenge by creating value-added mushroom-based food products and investigating mycelium-based sustainable materials in the context of a circle.

Dehydrated mushroom powder was utilized to produce value added foodstuffs like mushroom Ladoo, mushroom Bhujia and extruded snacks (mushroom Murkure) made of mushroom. These products were tested on nutritional and sensorial acceptability. The outcome was that the nutritional quality was significantly better than the conventional products, and protein content rose by 15-25% and dietary Fiber by 10-18%. The sensory assessment based on a 9-point hedonic scale showed that consumers were highly accepting, and mushroom Murkure (≈8.5), Bhujia (≈8.2) was mostly preferred because of the crispy texture and a well-known taste. Mushroom Ladoo (=7.8) was also acceptable and found to be a nutrient-enriched functional food.

Besides food uses, mycelium has also been used to make biodegradable materials as films and leather like products using agro wastes like wheat straw and sawdust. These materials demonstrated the following desirable qualities: flexibility, biodegradability, and low environmental impact and were a good substitute against plastic and synthetic leather.

Mushroom-based foods combined with mycelium-based materials are a viable solution to minimise waste, improve resource utilisation and diversify value chains. This strategy helps to secure nutritional security, encourages rural entrepreneurship, and helps in sustainable development.

Overall, it can be emphasized that mushroom value addition and mycelium innovation can greatly empower the mycoeconomy and help to make the future more sustainable.

Keyword: Mycoeconomy, Mushroom Value Addition, Functional Foods, Mycelium-Based Biomaterials, Nutritional Security, Circular Bioeconomy.

Study of Microbiome Diversity and Its Role in Soil Health and Plant-Parasitic Nematode Control

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The diversity of the soil microbiome is crucial in maintaining soil health and regulating plant-soil interactions, especially the suppression of PPNs. This study investigates soil microbial community composition, diversity, and functions, as well as their roles in enhancing soil quality and nematode control. Soil microbes which include bacteria, fungi and actinomycetes; the beneficials that aid nutrient cycling, decompose organic matter and improve soil structure. A balanced microbiome affords enhanced growth of plant systems while increasing nutrient uptake and gaining systemic resistance against pathogens. The research also illustrates the antagonistic interactions of beneficial microorganisms with PPNs by parasitism, competition, and the manufacture and excretion of nematocidal compounds. Plant growth-promoting microbes and mycorrhizal fungi lessen damage and improve the health of plants against nematodes through direct and indirect suppression of nematodes. The composition and activity of the microbiome are greatly affected through soil's physicochemical properties, agricultural practices and the environment. Furthermore, organic amendments, crop rotation, and fewer chemical inputs are important to developing beneficial microbial communities. Soil fertility gets enhanced further and biological control of nematodes is strengthened coupled with using such approaches. In-depth understanding of soil microbiome–nematode interactions is critical for sustainable agriculture. In summary, enhancing the diversity of soil microbiome could be an effective strategy for the improvement of soil health and management of plant-parasitic nematodes.

Keywords: Microbiome of soil; Diversity of microbes; Health of soil; Nematodes a plant parasite; Control biological; Rhizosphere.

Physico-Chemical Changes Associated with Post-Harvest Deterioration in Mango (*Mangifera indica* L.) cv. Dashehari Under Different Agro-Climatic Conditions of Uttar Pradesh

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Department of Agriculture, Integral University, Lucknow, Uttar Pradesh, India

Post-harvest losses in mango during different stages of handling, storage and transportation represent a major problem for the quality and shelf life of the fruit and its marketability as a result of the physiological deterioration and susceptibility to microbial spoilage of the fruit, which proceeds rapidly. The present investigation was undertaken to assess physico-chemical changes which are associated with post-harvest deterioration in mango (Mangifera indica L.) cv. Dashehari under different agro-climatic conditions of Uttar Pradesh. Fruits were harvested at physiological maturity from four locations, namely, Lucknow, Barabanki, Hardoi and Sitapur and analysed under ambient storage conditions (27-35C). A total of fourteen physical and nine chemical parameters were evaluated to measure the fruit quality and storage behavior. Large variation between locations was found. Fruits from Lucknow showed better quality characteristics such as higher fruit weight (272.86 g), pulp weight (189.40 g), total soluble solids (16.52 ^{o}Brix), and ascorbic acid content (37.56 mg/100 g) and lower physiological loss in weight (4.01%). In contrast, fruits from Sitapur had low quality characteristics relatively to Sitapur fruits and a decreased shelf life. During storage TSS increased and reached peak levels on 6th day, whereas acidity and firmness decreased progressively, indicating ripening associated biochemical changes. These changes cause softening of tissues and provide favourable conditions for microbial invasion and therefore accelerate post-harvest deterioration. Storage up to 6-7 days at ambient conditions, was accompanied by rapid quality loss, indicating the highly perishable nature of the cultivar. The study shows that agro-climatic conditions play an important role in the post-harvest behaviour and susceptibility to deterioration. The results give scientific basis for location-specific production, effective management of storage and ways to reduce post-harvest losses in mango.

Keywords: Mango, post-harvest deterioration, shelf life, physico-chemical changes, agro climatic variation

Resistance Screening of Urd bean Varieties to Anthracnose Incited by *Colletotrichum lindemuthianum* (Sacc. & Magn.) Briosi and Cavara.

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Black gram (*Vigna mungo* (L.) Hepper) is an important pulse crop cultivated widely across India, contributing significantly to dietary protein and sustainable cropping systems. Anthracnose caused by *Colletotrichum lindemuthianum* is a destructive foliar disease leading to substantial yield loss particularly under humid monsoon conditions. The present investigation was undertaken to identify stable sources of host resistance under inoculated field conditions. Fourteen cultivars (thirteen urd bean and one green gram) were evaluated during *Kharif* 2024 and 2025 at RCA, MPUAT, Udaipur, using a Randomized Block Design with three replications. Disease severity was recorded at 70 DAS using the 0–9 scale of Mayee and Datar (1986) with slight modification to compute Percent Disease Index (PDI). None of the variety showed immune reaction; however, significant variation in disease response was observed. Variety Black Gold exhibited a highly resistant reaction with the lowest Percent Disease Index (4.59%). Four varieties Alankar **(7.47%), Vijay (8.45%), Nirali (7.43%)** and **Phule Vasu (7.63%)** were categorized as resistant. Six varieties showed moderate resistance, while PU-01 RSSC (24.93%) and Mukandara Urad-2 (23.56%) were moderately susceptible. Kopargaon variety showed highest disease severity (34.74%) which recorded as susceptible. The identified resistant varieties constitute valuable genetic resources for developing durable anthracnose-resistant varieties of black gram.

Keywords: Black gram, *Colletotrichum* spp. Anthracnose, Varieties, Screening

In Vitro and *In Vivo* Evaluation of Phytoextracts and wrapping Materials for the Management of Post-harvest Fruit Rot of Papaya

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Papaya (*Carica papaya* L.) is economically important and a popular fruit crop. It is consumed as fresh fruit, vegetable as well as processed product. The samples are collected from different markets/mandi of Udaipur, Chittorgarh, Bhilwara, Rajsamand and Sirohi district. The three major fungal pathogens *Colletotrichum truncatum*, *Fusarium pallidoroseum* and *Aspergillus niger* were isolated in Department of Plant Pathology, Rajasthan College of Agriculture, MPUAT, Udaipur and identified by ITCC, New Delhi under accession numbers 11.843.23, 11.844.23 and 11.845.23, respectively. In management studies, ten phyto-extracts were tested *in vitro* conditions for their efficacy by following the poison food technique. During the evaluation of the relative efficacy of phyto-extracts, mustard oil consistently showed the highest mean per cent growth inhibition for *C. truncatum*, *F. pallidoroseum* and *A. niger* with 70.74, 88.52 and 87.90 per cent respectively. Also under *in vivo* conditions, mustard oil resulted with highest mean efficacy of disease control (83.26, 86.46 and 85.35%) against *C. truncatum*, *F. pallidoroseum* and *A. niger*, respectively. The study further assessed the impact of seven different wrapping materials on disease incidence and fruit quality during storage of papaya. Wrapping fruits with newspaper consistently exhibited the least disease incidence for all three pathogens and also led to the improvement in shelf life with the longest shelf life of up to 13 days for both *C. truncatum* and *A. niger* and 12 days for *F. pallidoroseuma* long with reduced physiological weight loss. An evaluation of IDM practices revealed that combining mustard oil with newspaper showed the most effective control against infestation of all three fruit rot pathogens, with significant reductions in disease incidence (21.67%, 20.00% and 25.00% for *C. truncatum*, *F. pallidoroseum* and *A. niger* respectively and increased shelf life 9 to 15 days.

Keywords: Fruit rot, *Colletotrichum truncatum*, *Fusarium pallidoroseum*, *Aspergillus niger*

योगी आदित्यनाथ

मा. मुख्यमंत्री, उत्तर प्रदेश सरकार

विकसित उत्तर प्रदेश वर्ष 2047 हेतु 22 संकल्प

सूर्य प्रताप शाही

मा. मंत्री
कृषि, कृषि शिक्षा एवं
कृषि अनुसंधान विभाग

बलदेव सिंह औलख

मा. राज्य मंत्री
कृषि, कृषि शिक्षा एवं
कृषि अनुसंधान विभाग

1. 1.0 (एक) ट्रिलियन यू0एस0 डॉलर कृषि क्षेत्र के योगदान का लक्ष्य, प्रदेश की संभावित 06 ट्रिलियन डॉलर की अर्थव्यवस्था में रखा गया है
2. फसल सघनता में वृद्धि
3. फसलों की उत्पादकता एवं उत्पादन
4. मृदा स्वास्थ्य सुदृढ़ीकरण
5. भूमि उपचार
6. लगभग 75 प्रतिशत तक मशीनीकृत आधारित कृषि
7. गन्ना में सहफसली खेती को बढ़ावा
8. बीज पार्क की स्थापना
9. कृषि वानिकी
10. किसानों की आय तीन गुना करना
11. स्मार्ट फसल विविधीकरण
12. सतत कृषि उत्पादन
13. एग्री-टेक का विस्तार
14. पेस्ट मॉनिटरिंग एवं सर्विलांस
15. माइक्रो इरीगेशन का प्रयोग
16. कृषि में नवीकरणीय ऊर्जा
17. जलवायु अनुकूल कृषि
18. उच्च मूल्य वाली फसल का विस्तार
19. कृषि इनोवेशन केंद्र स्थापित करना
20. निर्यात और प्रसंस्करण क्लस्टर विकसित करना
21. फसल बीमा
22. सघन प्रशिक्षण एवं क्षमता विकास

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कृषि उन्नति के 150 वर्ष

दलहनी की नवीनतम उन्नतशील प्रजातियां

सूर्य प्रताप शाही

मा. मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

बलदेव सिंह औलख

मा. राज्य मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

कंचन (IPCK 2009–145)

अधिसूचित वर्षः– 2023

पकने की अवधिः– 120–130 दिन, उत्पादकताः– 20–22 कु./हे.

विशिष्ट गुणः– काबुली चना, बाजार मूल्य अधिक, प्रोटीन की मात्रा 20–22%

पंत मटर 484

अधिसूचित वर्षः– 2024

पकने की अवधिः– 120 दिन, उत्पादकताः– 23–24 कु./हे.

विशिष्ट गुणः– प्रोटीन 26%, समय से बुवाई हेतु, रस्ट, पाउडरी मिल्डयु, एफिड एवं पॉड बोरर से अवरोधी

प्रसार शिक्षा एवं प्रशिक्षण ब्यूरो, कृषि विभाग, लखनऊ

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कृषि उन्नति के 150 वर्ष

कृषक उत्पादक संगठन (एफपीओ)

- प्रदेश में कृषक उत्पादक संगठन की अवधारणा को गति प्रदान करने, संगठन के व्यवसायिक गतिविधियों के प्रोत्साहन, पूर्व से गठित समूहों को सहयोग प्रदान कर बेहतर बनाना
- 29 सितम्बर, 2020 को उत्तर प्रदेश कृषक उत्पादक संगठन नीति, 2020 लागू
- एफ०पी०ओ० शक्ति पोर्टल देश का कृषक उत्पादक संगठन के पंजीकरण हेतु प्रथम पोर्टल विकसित
- स्थानीय इंफ्रास्ट्रक्चर यथा कोल्ड स्टोरेज, वेयर हाउस, प्रोसेसिंग यूनिट आदि को प्रोत्साहन।
- अबतक 3962 एफ०पी०ओ० गठित, जिनमें -
  - 563 से अधिक फार्म मशीनरी बैंक/432 कस्टम हायरिंग सेन्टर स्थापित
  - 100 बीज प्रसंस्करण इकाइयां स्थापित
  - 602 भण्डारण/शीतगृह इकाई क्रियाशील
  - आत्मनिर्भर कृषक समन्वित विकास योजना अंतर्गत गठित कृषक उत्पादक संगठन को शेयर पूंजी अंशदान

प्रसार शिक्षा एवं प्रशिक्षण ब्यूरो, कृषि विभाग, लखनऊ

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मा. मुख्यमंत्री, उत्तर प्रदेश सरकार

कृषि उन्नति के 150 वर्ष

मक्का की नवीनतम उन्नतशील प्रजातियां

सूर्य प्रताप शाही

मा. मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

बलदेव सिंह औलख

मा. राज्य मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

पकने की अवधिः– 110–115 दिन, उत्पादकताः– 80–85 कु./हे.

विशिष्ट गुणः– सिंचित,

मायडिस लीफ ब्लाईट एवं चारकोल राट मध्यम अवरोधी,

फाल आर्मी वार्म मध्यम अवरोधी,

पकने की अवधिः– 110–115 दिन, उत्पादकताः– 70–72 कु./हे.

विशिष्ट गुणः– सिंचित,

बायो–फोर्टीफाईड–उच्च प्रोविटामिन

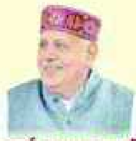
(6.77 माइक्रोग्राम/ग्राम)

योगी आदित्यनाथ

मा. मुख्यमंत्री, उत्तर प्रदेश सरकार

कृषि उन्नति के 150 वर्ष

सरसों की नवीनतम उन्नतशील प्रजातियां



सूर्य प्रताप शाही

मा. मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

बलदेव सिंह औलख

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कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

आजाद महक

अधिसूचित वर्षः- 2021

पकने की अवधिः- 120-125 दिन, **उत्पादकताः-** 24-25 कु./हे.

विशिष्ट गुणः- समय से बुवाई हेतु उपयुक्त, सिंचित

इरुसिक एसिड की मात्रा बहुत कम

पूसा सरसों-32

अधिसूचित वर्षः- 2021

पकने की अवधिः- 125-120 दिन, **उत्पादकताः-** 20-22 कु./हे.

विशिष्ट गुणः- समय से बुवाई हेतु उपयुक्त

ऊसर भूमि हेतु उपयुक्त

अल्टरनेरिया ब्लाइट अवरोधी

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कृषि उन्नति के 150 वर्ष

गेहूँ की नवीनतम उन्नतशील प्रजातियां

योगी आदित्यनाथ
मा. मुख्यमंत्री, उत्तर प्रदेश सरकार

सूर्य प्रताप शाही

बलदेव सिंह औलख

पकने की अवधिः- 155 दिन, उत्पादकताः- 79-40 कु./हे.
विशिष्ट गुणः- सिंचित दशा मे पीला रस्ट अवरोधी
सूखा एवं ताप सहिष्णु
बायो-फोर्टीफाईड जिंक 40-60 पी.पी.एम.

पकने की अवधिः- 150 दिन, उत्पादकताः- 70-80 कु./हे.
विशिष्ट गुणः- सिंचित दशा में
पीला एवं भूरा रस्ट अवरोधी
बायो-फोर्टीफाईड-प्रोटीन 12-10 प्रतिशत

प्रसार शिक्षा एवं प्रशिक्षण ब्यूरो, कृषि विभाग, लखनऊ

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मा. मुख्यमंत्री, उत्तर प्रदेश सरकार

देश में उत्तर प्रदेश की मुख्य फसलों का स्थान

सूर्य प्रताप शाही

मा. मंत्री

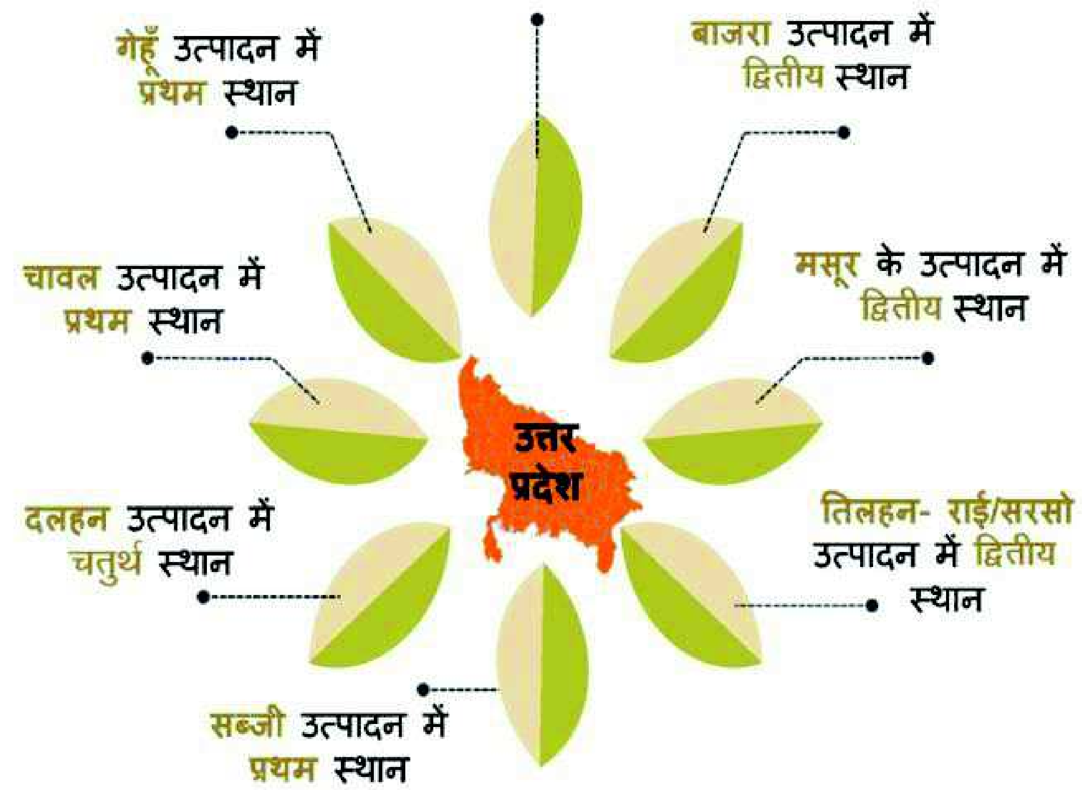
कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

बलदेव सिंह औलख

मा. राज्य मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

उ0प्र0 का देश के कृषि क्षेत्र में 11% के साथ खाद्यान्न उत्पादन में 20% योगदान



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कृषि उन्नति के 150 वर्ष

उत्तर प्रदेश एक दृष्टि में

सूर्य प्रताप शाही

मा. मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

बलदेव सिंह औलख

मा. राज्य मंत्री

कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

(वर्ष 2024-25 मे भूमि उपयोगिता के आकड़े)

क्र.सं.			
1.	भूमि उपयोगिता के लिए प्रतिवेदित क्षेत्रफल	लाख हेक्टेयर	240.93
2.	वास्तविक बोया गया क्षेत्रफल	लाख हेक्टेयर	163.65
3.	कुल बोया गया क्षेत्रफल	लाख हेक्टेयर	297.83
4.	खरीफ	लाख हेक्टेयर	137.43
5.	रबी	लाख हेक्टेयर	147.32
6.	ज़ायद	लाख हेक्टेयर	13.08
7.	वास्तविक सिंचित क्षेत्रफल	लाख हेक्टेयर	141.72
8.	फसल सघनता		182%

कृषि जलवायु अंचल 2024-25

न्यून- 86-7%(>0.5%) मध्यम-11.80%(0.5-0.75%), उच्च-1.45% (>0.75%)

क्र.सं.	कृषि जलवायु अंचल	मिट्टी के प्रकार	जीवांश कारबन (न्यून <0.5%)
1.	तराई क्षेत्र	दोमट मिट्टी	86.68%
2.	पश्चिमी मैदानी क्षेत्र	दोमट,बलुई,दोमट मिट्टी	82.21%
3.	मध्य पश्चिमी मैदानी क्षेत्र	दोमट मिट्टी	89.08%
4.	दक्षिणी पश्चिमी अर्द्धशुष्क मैदानी क्षेत्र	दोमट मिट्टी	89.23%
5.	मध्य मैदानी क्षेत्र	बलुई,दोमट मिट्टी	89.83%
6.	बुन्देलखण्ड क्षेत्र	काबर, राकर, पड़वा, काली मिट्टी	76.50%
7.	उत्तर-पूर्वी मैदानी क्षेत्र	बलुई, दोमट मिट्टी	75.26%
8.	पूर्वी मैदानी क्षेत्र	बलुई सिल्ट दोमट मिट्टी	94.07%
9.	विंध्य क्षेत्र	बलुई दोमट लाल मिट्टी	83.45%

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योगी आदित्यनाथ
मा. मुख्यमंत्री, उत्तर प्रदेश सरकार

उत्तर प्रदेश की कृषि उत्पादन एवं उत्पादकता में देश स्तर पर स्थिति

सूर्य प्रताप शाही
मा. मंत्री
कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

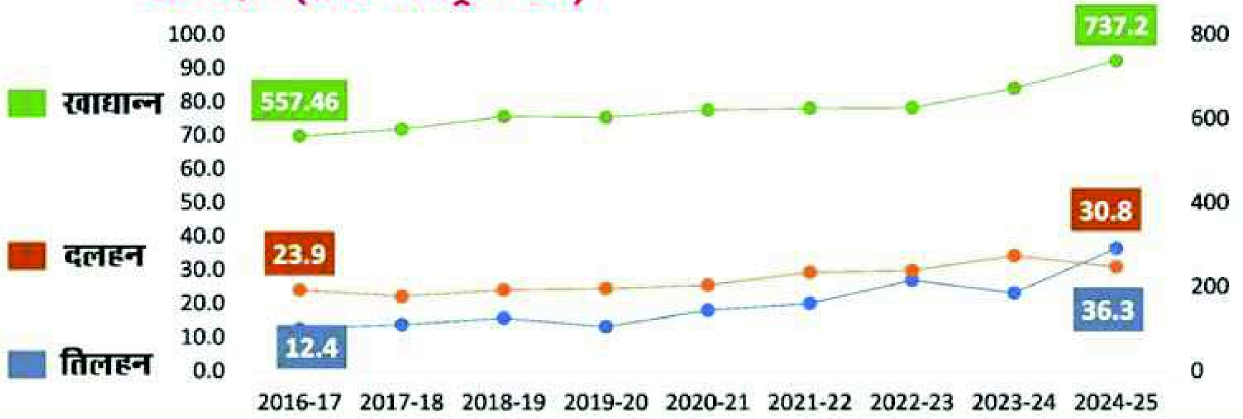
बलदेव सिंह औलख
मा. राज्य मंत्री
कृषि, कृषि शिक्षा एवं कृषि अनुसंधान विभाग

- उत्तर प्रदेश ने कृषि के क्षेत्र में अहम एवं उल्लेखनीय प्रगति की है।
- भारत की कृषि योग्य भूमि में उत्तर प्रदेश की हिस्सेदारी 11 प्रतिशत है।
- देश के कुल खाद्यान्न उत्पादन में उत्तर प्रदेश का योगदान 20 प्रतिशत है।
- उत्तर प्रदेश का देश में गेहू, चावल, गन्ना, एवं आलू के उत्पादन में प्रथम स्थान है, बाजरा, मसूर एवं राई सरसों में द्वितीय तथा दलहन में तृतीय स्थान है। ।

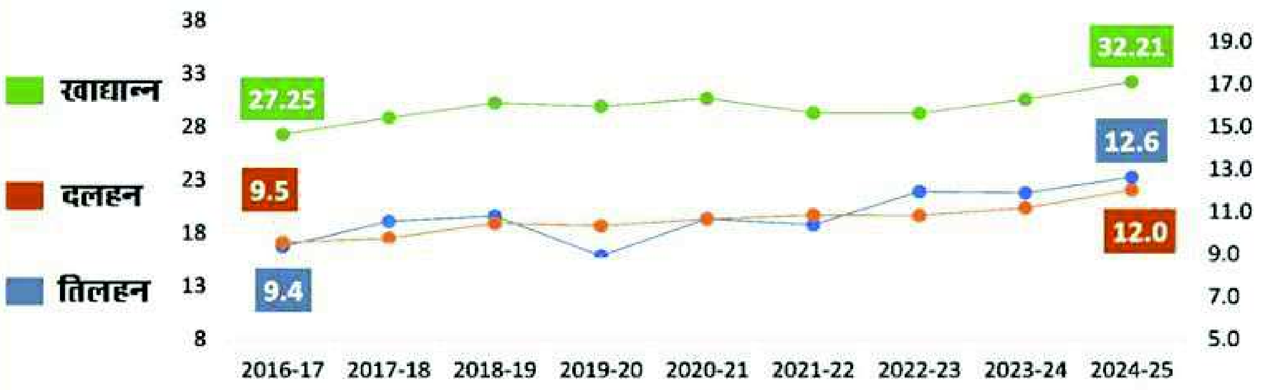
विकसित भारत अभियान
1947 TO 2047

उत्तर प्रदेश का दलहन तिलहन एवं खाद्यान्न के उत्पादन एवं उत्पादकता में हुई वृद्धि

उत्पादन (लाख मीट्रिक टन)



उत्पादकता (क्विंटल प्रति हेक्टेयर)



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DCM Shriram Sugar : A part of DCM Shriram Ltd., DCM Shriram Sugar is one of India's leading integrated sugar producers, driving the transition towards a sustainable, circular, and energy-efficient sugar ecosystem.

With a diversified presence across Agri-Rural, Chemicals & Vinyl, and Value-Added businesses, its Sugar & Distillery operations are at the forefront of green fuel, renewable power, and responsible manufacturing.

Scale of Impact : 4 integrated sugar plants in Uttar Pradesh, 42,400 TCD crushing capacity, 180 million litres ethanol production, 166 MW green power generation, 12 TPD Compressed Biogas plant , 2,50,000+ farmers engaged.

Integrated Business Model :

Sugar | Efficiency at Scale : Operations across Ajbapur, Rupapur, Hariawan, and Loni combine high manufacturing efficiency with deep farmer partnerships. From sowing to harvest, engagement with 2.5 lakh+ growers enhances productivity, soil health, and quality—making it a trusted partner to leading FMCG brands.

Ethanol | Enabling Green Fuel Transition : With 180 million litres annual production, ethanol operations convert sugar by-products into clean fuel, supporting India's blending program and reducing fossil fuel dependence.

Power | Waste to Renewable Energy : 166 MW co-generation capacity, powered by bagasse, converts agricultural residue into green power—strengthening the grid while lowering carbon footprint.

Compressed Biogas | Advancing Circular Energy : Our 12 TPD Compressed Biogas plant converts organic residues into clean gaseous fuel, contributing to sustainable mobility and waste-to-energy solutions while further strengthening the circular economy

Circular by Design

Sugarcane → Sugar | Ethanol | Power | Soil Nutrients

This integrated model ensures: Zero waste operations, Maximum resource efficiency, Multiple value streams, Enhanced farmer incomes

By converting a single crop into food, fuel, and energy, the system delivers both economic resilience and environmental sustainability.

AMITY UNIVERSITY: PIONEERING EXCELLENCE IN AGRI-FOOD INNOVATION

Amity University has established itself as a leader in cutting-edge agri-food research, innovation, and entrepreneurship. Through the Amity Food & Agriculture Foundation (AFAF), the university drives interdisciplinary research aimed at strengthening food security, sustainable agriculture, and value-added processing. The department integrates modern biotechnological tools, agri-tech interventions, and nutraceutical innovations to bridge the gap between farm productivity and global food markets.

AFAF's vision is to transform India's agri-food ecosystem by supporting farmers, empowering entrepreneurs, and enabling sustainable food value chains. With its focus on farm-to-fork approaches, the department actively works on projects spanning crop improvement, food safety, functional foods, and biotic/abiotic stress management.

Key Focus Areas of AFAF

- **Agri-tech & Smart Farming:** Harnessing AI, IoT, drones, and precision agriculture for improved productivity.
- **Food Processing & Value Addition:** Innovating processing technologies to enhance shelf life, nutrition, and marketability of farm produce.
- **Nutraceuticals & Functional Foods:** Developing food solutions for health and wellness.
- **Sustainability & Climate Resilience:** Research on eco-friendly practices, waste utilization, and climate-smart farming.
- **Entrepreneurship & Start-ups:** Supporting student- and faculty-led ventures aligned with ODOP, Start-up India, and MSME policies.

Contributions of Dr. Shalini Singh Visen

Dr. Shalini Singh Visen, a key researcher and Director at AFAF, has been actively contributing to applied agricultural biotechnology and food innovation. Her work bridges traditional knowledge with modern science, creating sustainable solutions for current agricultural challenges.

Major Research Projects

- Dissemination of safe and cost effective evolved IPM technologies for combacting pest and soil borne diseases of solanaceous crops in Bahraich district of Uttar Pradesh funded by UP Council of Science and Technology. (Registered and Trained 200 Framers) (Completed)
- Dissemination of safe and cost effective evolved IPM technologies for combacting Panama welt of Banana spreading in Barabanki, Bahraich and Sitapur District of U.P. Funded by NABARD. (Trained 120 Framers) (Completed)
- Restoration of threatened/endangered wild brassica species in their natural habitat and development of genetic and genomic resources resilient for their abiotic and biotic stresses. Approved for funding by Biodiversity Board UP. Department of Forest. (Ongoing)
- Dissemination of Mushroom Production Technology and Promoting Mushroom Production on Peri-Urban Areas of Eastern Uttar Pradesh Funded by RKVY, Horticulture, Lucknow. (Ongoing)
- From Peel to Plate: Transforming Fruit Waste into Nutrient Rich 3D Printed Foods Funded by UP Council of Science and Research (Ongoing)
- Unveiling potential futuristic use of fly ash promoting sustainable agriculture practices.

Copyrights & Intellectual Property

- Received Copy right on Banana pseudo stem enhancing microbial growth.
- Received Copy right for BHOOMITRA app Our machine-learning model predicts optimal crop and fertilizer recommendations based on soil nutrient levels.
- Received Copy right for BANANA VASCULAR SAP ELIXIR PROMISING REVITALIZING PROPERTIES
- Received Copy right on Modulations in photoperiod enhances metabolite production in Brassica species.

Sericin modulates the Biofilm of Bacillus cereus by enhancing the cell motility

Development of Nanopotassium Fertilizer from Banana Peel Waste: A Sustainable Approach

- Recived Copy right for formulation concept STRESTOL-A PLANT BASED ANTI-STRESS BIOPROTECTANT
- Recived copy right of Tissue culture G9 pseudostem enhancing the microbial (E.coli)growth

- Recived copy right on Sericin acts as a potent inhibitor of trans plasma membrane electron transport in saccharomyces cerevisie

Impact & Vision

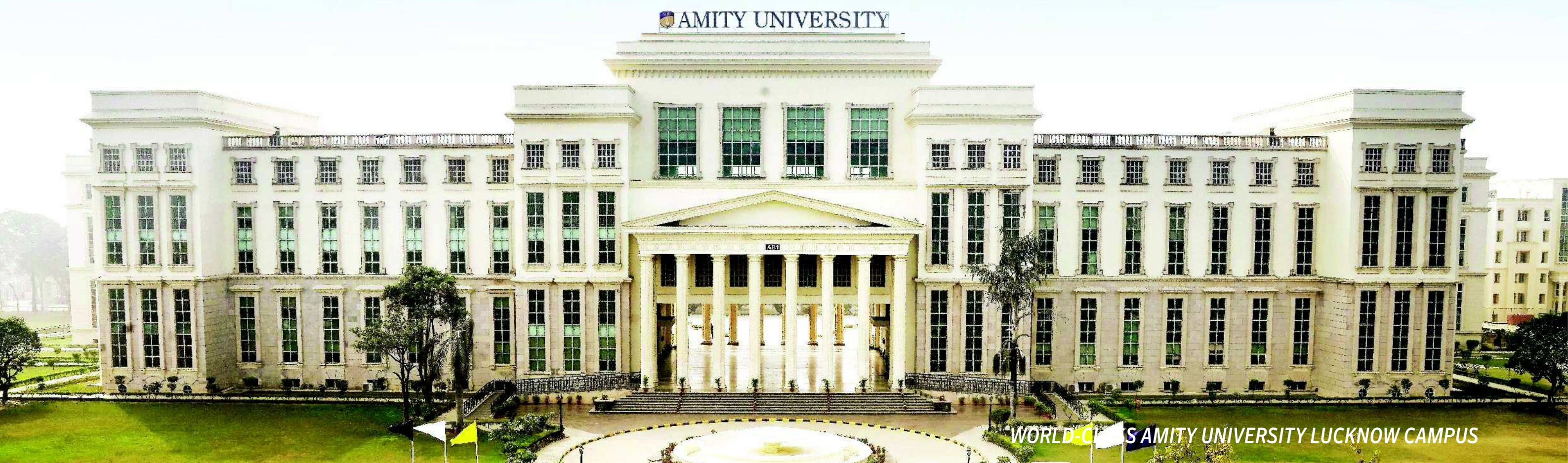
Dr. Shalini Singh Visen's research strengthens the AFAF vision of creating sustainable, resilient, and value-driven food systems. By integrating plant physiology, biotechnology, and agronomy, her work directly contributes to improving crop resilience, farmer profitability and national food.

Team of Amity Food and Agriculture Foundation

AMITY UNIVERSITY
LUCKNOW CAMPUS

DESIGNED AS AN
ECOSYSTEM OF SUCCESS

- Placements in Google, Accenture, IBM, PwC, KPMG, Cognizant, HCL, Capgemini, Bosch..
- 300+ Companies visited for placements
- Unique 3-tier mentorship program
- 8 Centre of Excellence for Quantum Computing, AI & ML, Media Studies, Photonics and Opto-Electronics, Finite Element Matter, Cyber Forensic Information Security...
- University Scopus H-Index 70
- 5-week Study Abroad Program (optional) in New York, Singapore, London, Dubai, France, & Australia
- CEO Dinner series, Industry Mentorship & Conversation Programs
- 2000-seater on-campus hostel facility, separate for boys and girls
- 100 Cutting-Edge Labs & learning studios
- 62+ Student startups incubated by the Amity Incubator
- Faculty credited with 81 patents, 1,183 books/chapters, and 5664 research papers
- 42 Govt. funded research projects in collaboration with CSIR, ICMR, DST, BRNS...
- Modern Library with 75000 Books, 17000 Online Journals & 500 Publications
- Expansive sports complex



WORLD-CLASS AMITY UNIVERSITY LUCKNOW CAMPUS

AWARDS & RANKINGS

RANKED **#1** PVT. UNIVERSITY OF INDIA 2021
THE BEST UNIVERSITIES OF INDIA
August'21 issue

RANKED IN THE BAND **601-800**
THE World University Rankings 2026
THE-WUR Ranking 2026

LISTED **#22** UNIVERSITY IN INDIA 2025
nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK

RANKED **29** IN SOUTHERN ASIA
QS WORLD UNIVERSITY RANKINGS SOUTHERN ASIA | 2026
QS Southern Asia Rankings 2026

RANKED **#12** PVT. MULTI-DISCIPLINARY UNIVERSITY IN INDIA 2023
THE WEEK HANSA RESEARCH SURVEY 2023

AMITY SCHOOL OF ENGINEERING & TECHNOLOGY RANKED **#3** IN NORTH ZONE 2024
TOP T SCHOOL RANKINGS
September 2024 issue

AWARDED AS INDIA'S BEST UNIVERSITY FOR PLACEMENTS
INDIAN EDUCATION AWARD

RANKED ASIA'S ONLY NOT-FOR-PROFIT UNIVERSITY TO GET USA REGIONAL ACCREDITATION
WASC SENIOR COLLEGE AND UNIVERSITY COMMISSION, USA

UG & PG DEGREES

MANAGEMENT
- BBA
- BBA (Business Intelligence & Data Analytics)
- BBA - International
- BBA - 3 Continent
- MBA (Spls. offered - International Business/ Mktg. & Sales/HR/ Entrepreneurship/ Finance)
- MBA (Digital Marketing)
- MBA - International
- MBA - 3 Continent

ARCHITECTURE
- Bachelor of Architecture*
  *(*Approved by COA)*
- Bachelor of Interior Design
- Masters In Interior Design

FINE ARTS
- BFA
- BFA - Animation
- MFA - Applied Arts/ Painting

COMPUTER SCIENCE/IT
- BCA
- B.Sc. - Information Technology
- B.Sc. (IT) (Artificial Intelligence and Data Science) (Honors/Research)
- MCA

SOCIAL WORK
- Bachelor of Social Work
- Master of Social Work

PSYCHOLOGY
- B.A. (H) - Applied Psychology
- B.Sc. (H) Clinical Psychology*
  *(*Approved by RCI)*
- *M.A. (Clinical Psychology)*
  (RCI Regulated)
- M.A. - Counselling Psychology / Clinical Psychology
- Professional Diploma in Clinical Psychology*
- M.Phil. - Clinical Psychology*
  *(*Approved by RCI)*
- *PG Diploma in Counselling Psychology*

ENGINEERING
- B.Tech. - Internet of Things/ Artificial Intelligence/ CSE/ Elec. & Comm./ Mechanical/ Civil/ Aerospace/ IT/ Electrical & Electronics
- B.Tech. (CSE / Civil/ Mechanical / ECE) - 3 Continent
- B.Tech - CSE (Data Science)
- B.Tech. - CSE (International)
- M.Tech. - CSE / Electronics & Communication / Automobile / Embedded System Technology/ Environmental Engg. /Mechatronics/ Computer Network and Information Security/ Electric Vehicle Technology / Electric Vehicle Technology for Working Professionals
- M.Tech. (Data Science)
- M.Tech. (Computer Sc. & Engg.)- International
- M.Tech. (CSE) Weekend

MEDIA & COMMUNICATION
- B.A. - Journalism & Mass Communication
- M.A. - Journalism & Mass Communication/ Advertising & Marketing Management
- B.A. (Journalism & Mass Communication) - 3 Continent

APPLIED SCIENCES
- Bachelor of Statistics
- B.Sc. (H) - Chemistry/Physics/ Maths
- Master of Statistics
- M.Sc. - Data Sciences/ Applied Physics/ Applied Chemistry/ Applied Maths/ Environmental Science

EDUCATION/SPECIAL EDUCATION
- B.El.Ed.*
- B.Ed.*
- M.Ed.* *(*Approved by NCTE)*
- Integrated B.Com. B.Ed. Special Education#
- Integrated B.Sc. B.Ed. Special Education#
- Integrated B.A. B.Ed. Special Education#
- B.A. B.Ed. Spl.Ed. (ID-PS) ISITEP#
- B.Ed. - Special Education (Learning Disability)#
  (#Approved by RCI)

LAW
- B.A., LL.B. (H)* 5 yrs.
- BBA, LL.B. (H)* 5 yrs.
- B.Com., LL.B. (H)* 5 yrs.
- LL.B.* 3 yrs.
  *(*Approved by BCI)*
- LL.M.
- LL.M. - Criminal Law
- LL.M. - Cyber Law & Cyber Security

BIOTECHNOLOGY
- B.Tech. - Biotechnology
- B.Sc. (H) - Biotech./ Microbiology
- M.Tech. - Biotechnology
- M.Sc. - Biotech./ Microbiology

FASHION
- B.Des. - Fashion Design
- B.Des. - Fashion Communication
- B. Des. (Fashion Design) - 3 Continent
- M. Design - Fashion & Textiles

COMMERCE
- B.Com. (H)
- M.Com.

PHARMACY
- B.Pharm*
- Pharm.D*
- M.Pharm - Pharmaceutics*/ Pharmacology*
  *(*Approved by PCI)*

ENGLISH LITERATURE
- B.A. (H) - English
- M.A. - English

HOSPITALITY
- Bachelor of Hotel Management
- BBA - Tourism Management
- MBA (Hospitality Management)
- Master of Travel & Tourism Mgmt.

LIBERAL ARTS
- B.A. (H) - History/ Political Sc.
- M.A. - History/ Political Sc.

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ISMPP 5th International Conference

on

"Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation"

April 08-10, 2026

Jointly Organised by

Indian Society of Mycology and Plant Pathology
RCA, MPUAT, Udaipur, Rajasthan, India

and

Amity Food and Agriculture Foundation
Amity University, Uttar Pradesh, Lucknow Campus

Venue

Amity University
Lucknow Campus

Malhour (Near Railway Station)
Gomti Nagar Extension, Lucknow-226 028 Uttar Pradesh (INDIA)
Mob:+91- 8826588007; E-mail : ismpplko5@gmail.com; Website:https://www.amity.edu/lucknow/

THE ISMPP

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Dr C D Mayee

Dr C Manoharacharya

Dr S S Chahal

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Amity University Uttar Pradesh
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Secretary, ISMPP
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Invitation

Dear Colleagues,

It gives me immense pleasure and a deep sense of privilege to invite you to the 5th International Conference of Indian Society of Mycology and Plant Pathology (ISMPP) on the theme "Pathogens, Plant Health and Food Security: Recent Advances for Climate-Resilient Agriculture and Landscape Conservation" from April 8-10, 2026, in the historic and cultural capital of Uttar Pradesh, Lucknow, India.

The conference is jointly organized by the ISMPP, Rajasthan College of Agriculture (RCA), MPUAT, Udaipur, and the Amity Food and Agriculture Foundation, Amity University, Lucknow Campus.

The ISMPP is a premier professional academic organization that has been steadfastly serving the cause of mycology and plant pathology since its inception in 1971. Over the past 55 years, ISMPP has achieved multifaceted growth, particularly through the high-quality scientific research via its flagship publication, the Journal of Mycology and Plant Pathology. During this illustrious journey, ISMPP has successfully organized four Global Conferences as well as three Asian Congresses, fostering scientific exchange and international collaboration.

I am confident that this congress will serve as a confluence of thought leaders and practitioners in agro-intelligence, plant pathology, biotechnology, policy reform, landscape architecture, and sustainability, working together to develop resilient technologies, progressive policies, and innovative management strategies for food value chains in a rapidly changing global environment. A key objective of the conference is to deliberate on how enabling policy frameworks and institutional support can empower rural communities and enhance agricultural sustainability.

The conference will also highlight agro-scaping as a transformative tool for disease management and food security. Core themes including climate adaptive cropping systems, ecosystem restoration, rural landscape transformation, flood resilient agricultural design, and the aesthetic and cultural dimensions of agrarian landscapes emphasize the importance of holistic and sustainable land stewardship. By integrating digital innovations, smart technologies, and ecological design principles, the congress aspires to bridge traditional wisdom with frontier science.

Through active engagement among policymakers, scientists, entrepreneurs, extension professionals, and farming communities, the congress seeks to co-create strategies that strengthen global food resilience and promote sustainability.

The Indian Society of Mycology and Plant Pathology under the aegis of Amity University, will be providing a platform for marathon discussions, interactions and cross fertilization of ideas amongst internationally reputed renowned plant protection specialists, biotechnologists, plant molecular biologists to arriving to some conclusions pertaining to the problems most importantly constraining in achieving the food security for the world populations.

I consider it a great honour, and extend this invitation with all humility, to members, scientists, students, scholars, public and private entrepreneurs, extension workers, social activists, planners, and heads of organizations to participate actively and in large numbers in this important Asian academic event, and to contribute meaningfully toward addressing the pressing challenges facing agriculture today.

I look forward to welcoming you and meeting you personally at the conference.

Yours cordially,

(Lalit Mahatma)
President
Indian Society of Mycology & Plant Pathology, Udaipur

TECHNICAL PROGRAMME

THEMES

A. The Frontiers of Technology

1. Digital Plant Pathology: AI, ML, & Smart Surveillance
2. The 'Omics' Revolution: Genomics, Transgenics & Gene Editing
3. Nanotechnology & Next-Gen Therapeutics

B. Integrated Disease Management & Ecology

4. Bio-Intensive IDM/IPM: Biocontrol, Endophytes & Green Chemistry
5. Soil Health, Nematology & The Root Microbiome
6. Eco-Pathology: Natural Farming, Agro-Scaping & Climate Resilience

C. Food Security & Value Addition

7. Post-Harvest Pathology, Mycotoxins & Food Safety
8. Applied Mycology: Innovations in Mushroom Cultivation & Nutraceuticals

D. Policy, Trade & Entrepreneurship

9. Global Biosecurity: Quarantine, WTO, & Transboundary Pathogens
10. Lab to Land: Agri-Business, Start-ups, Policy & IPR

SUBMISSION OF ABSTRACTS

The official language of the conference will be English. There will be oral and poster presentations. Abstracts should be electronically typed in MS Word on A4 size paper with 3 cm margins on all sides. The abstract should not exceed 300 words. The title of the paper, names of author(s) and their address (es) should be typed in each word capital letters. The abstract should be properly edited and typed with single line spacing. The deadline for receipt of abstracts is **05 March 2026**. The abstracts should accompany the registration fee receipt. Abstracts of both invited and offered papers will be printed and distributed to participants. No participant is expected to be an author of more than two abstracts. The authors shall send abstracts by email to **Dr. Shalini Singh Visen**, Organizing Secretary, ISMPP 5th International Conference, Amity University Lucknow Campus, Lucknow, UP at E-mail: **ismpplko5@gmail.com** mentioning details of the title of the technical sessions, self email ID, contact number and full postal address.

GUIDELINES FOR POSTER PRESENTATION

Poster should be prepared in advance and should be brought in person by the participants. The size of poster should be 0.75 m (width) × 1.0 m (length). Poster should be legible from a distance of 1–2 m. It will be binding for participating authors in oral and poster presentation session(s) to publish full length research paper in the society's journal, Journal of Mycology and Plant Pathology. Please bring a soft copy of research paper during the conference or email to secretaryismpp@gmail.com.

Address for Conference Participation

Prof. (Dr.) Shalini Singh Visen

Organizing Secretary

Director, Amity Food & Agriculture Foundation & Head Research Funded Projects

Amity University

4th floor, Academic Block 2, Malhour (Near Railway Station)

Gomti Nagar Extension, Lucknow-226 028 UP (INDIA)

Mob: +91- 8826588007 **E-mail : ismpplko5@gmail.com**

Important Dates

Abstract submission	05 March, 2026
Acceptance of Abstract	15 March, 2026
Registration	05 March, 2026
ISMPP Awards	10 Feb., 2026
Accommodation booking	05 March, 2026

ISMPP ANNUAL AWARDS–2024 & 2025

The eligibility and criteria details may be downloaded from www.ismpp.org.in

1. **PP Singhal Memorial PI Industries Award Competition:** The Society will hold oral presentation competition on the theme "Plant disease control by chemical methods and strategies based on epidemiological investigations" for the members of the society. There will be two cash awards of ₹25,000/– for winner and ₹15,000/– for runner up.

2. **Smt Guman Devi Verma Memorial Best Woman Scientist Award Competition:** The Society will hold oral presentation competition on the contributions related to aspect of Mycology and Plant Pathology for the women scientists only. There will be cash awards of ₹10,000/– for winner.

3. **PR Verma Awards Competition For M Sc and Ph D Students:** The Society will hold oral presentation competition for M Sc (Ag) Plant Pathology and Ph D (Ag) Plant Pathology student's thesis presentation, separately. There will be two cash awards of ₹6,000/– for Ph D award winner and ₹5,000/– for M Sc award winner.

4. **YL Nene Outstanding Plant Pathology Teacher Award:** The society invites nominations for Y L Nene Outstanding Plant Pathology Teacher Award for the year 2024 & 2025.

   Nomination

   i. Three well known Plant Pathologists, who have been the students of the nominee, will jointly or individually nominate their teacher for the award, giving brief CV of the nominee and one page statement justifying the nomination.

   ii. Award committee member can nominate a teacher by providing relevant information about the nominee.

5. **Prof S S Chahal Life Time Achievement Award:** The society invites nominations for Prof S S Chahal Life Time Achievement Award for the year 2024 & 2025.

   Nomination

   i. Every year, the nominations will be made from the previous ISMPP lifetime achievement awardees, former presidents and secretaries of the ISMPP along with brief CV of the nominee.

   ii. The nominations will be valid for 2 years.

   iii. The previous life time achievement awardees will not be nominated again.

6. **Prof H C Dube Outstanding Young Scientist Award:** The society invites applications for Prof HC Dube Outstanding Young Scientist Award.

7. **Fellowship of The Society (FISMPP)**

   - Members having ten years standing membership and at least 10 publications in JMPP during the preceding ten years *i.e.* from the year 2015 onwards will only be admitted as Fellow of the Society.
   - Members should have contribution to the society as Zonal Councillor/ President, Editorial Board Member, inducting of new members *etc.*
   - Members must submit one copy of bio–data and list of publications ₹5,000/– as registration fee.

8. **R Prasada Best Published Research Paper Award:** The award is given to the best research articles published in JMPP for each recognized section.

9. **Prof Krishna Sahai Bilgrami Best Poster Presentation Award:** The Society has introduced this award in the sacred memory of a renowned Plant Pathologist Late Dr K S Bilgrami. This award will be presented to the best poster presentation during the conference, which will be judged by three member team of subject specialists. It will be binding for award winner author to publish full length research paper in the society's journal, Journal of Mycology and Plant Pathology.

10. **Presidential Address by** Dr Lalit Mahatma, NAU, Navsari (President ISMPP)

11. **N Prasad Memorial Award Lecture***

12. **R Prasada Memorial Award Lecture***

13. **V P Bhide Memorial Award Lecture***

14. **P R Verma Memorial Award Lecture***

15. **B B L Thakore Memorial Award Lecture***

16. **Y L Nene Memorial Award Lecture** by awardee of Y L Nene Outstanding Plant Pathology Teacher Award

HOW TO APPLY

Award competition abstract, applications and nominations may please be sent to The Secretary, Indian Society of Mycology and Plant Pathology, Department of Plant Pathology, RCA, MPUAT, Udaipur, Rajasthan (India), latest by **10 February, 2026** at e-mail id **secretaryismpp@gmail.com.**

For details please visit ISMPP
website "https://www.ismpp.org.in/criteria-for-ismpp-awards/"

Address for ISMPP Awards

Prof. (Dr.) Pokhar Rawal

Secretary, ISMPP

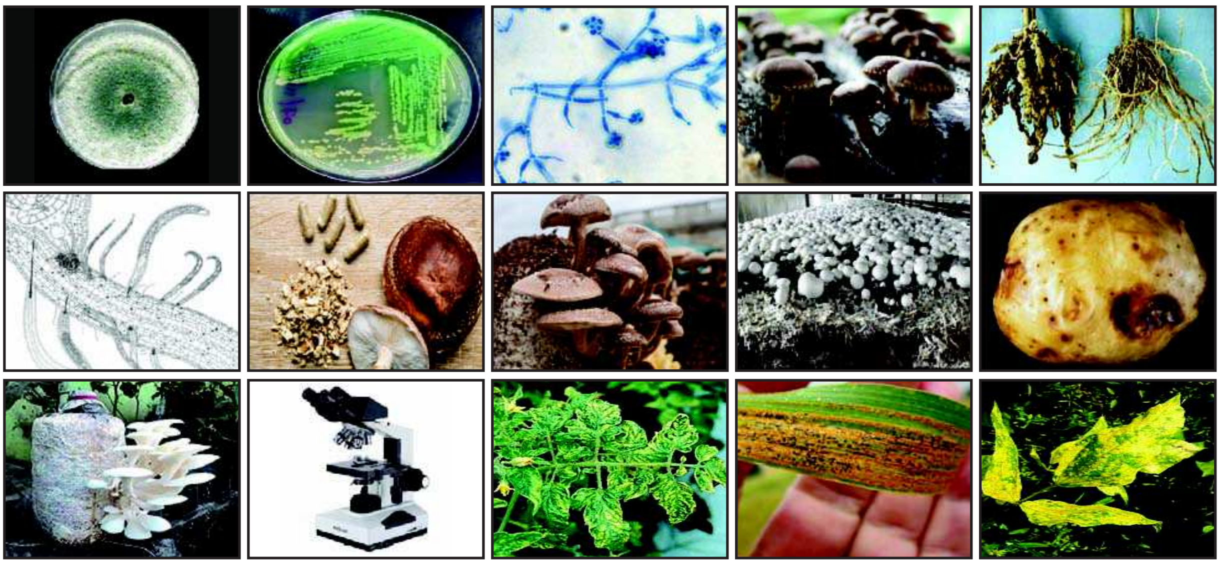
Department of Plant Pathology

Rajasthan College of Agriculture

MPUAT, Udaipur 313 001 Rajasthan (India)

Mob. : +91-9460030583 Tel. +91-294-2423792 (O)

E-mail: secretaryismpp@gmail.com



About the ISMPP

Creation of the Indian Society of Mycology and Plant Pathology (ISMPP) was a dream of Plant Pathologists of early seventies who were inspired by doyens such as Dr N Prasad and Dr R Prasada. For quite sometimes prior to 1969, a large number of Mycologists and Plant Pathologists felt the necessity of a journal to publish their research findings without delay. This need was obvious due to increasing importance of agriculture and concomitant severe biotic stress due to diseases, an increase in the number of Agriculture Universities and Research Institutions in India after independence. Consequently, an increased output of research on fundamental and applied aspects of Mycology and Plant Pathology was also required. The idea to start a new Journal of Plant Pathology with its head quarter at SKN College of Agriculture, Jobner, Rajasthan was mooted with the establishment of the new Society in December, 1969. The Journal was officially rolled out entitled "Indian Journal of Mycology and Plant Pathology" with first volume in December 1971 as official organ of the society. In 1970 the Society of Mycology and Plant Pathology finally started functioning from Udaipur, Rajasthan. An interim Editorial Board was formed and late Dr N Prasad was requested to shoulder the responsibilities of publication of the Journal as Chief Editor.

During the formative phase of the Society, an academician and industrialist late Shri P P Singhal, founder of Pesticides India Ltd, Udaipur helped generously in various ways. He was the founder "Patron" of the society and initiated an annual prestigious award named as "Pesticides India Award". Till 1981, the Journal was published twice a year in January and July, the periodicity of which was raised to three times in a year *i.e.* April, August & December and now Journal of Mycology and Plant Pathology is being published quarterly (March, June, September & December) since 2010. The Journal is abstracted by various scientific agencies over the world. The society has also started publication of ISMPP News from the year 1995. Dr Y L Nene had been the founder Editor of the Newsletter. The Society endeavored for a new venture of publishing Annual Review of Plant Pathology from year 2002.

The Society has sponsored 42 Annual Conferences till date in almost all the States of India. The society successfully organized three Global Conferences at Udaipur in the year 1995, 2005 and 2012; three Asian Congresses in 2002 at University of Mysore, Mysore and in 2007 at Osmania University, Hyderabad 2024 at SDAU SK Nagar, Gujarat and one International Conference at University of Rajasthan, Jaipur in 2017.

The society has established number of prestigious awards including Y L Nene Out-standing Plant Pathology Teacher Award, Prof H C Dube Outstanding Young scientist Award, Prof K S Bilgrami Best Poster Presentation Award, Fellow of ISMPP (FISMPP), Honorary Fellow Award, PP Singhal Memorial PI Industries Award, Smt Guman Devi Verma Memorial Best Women Scientist Award, P R Verma Award for M Sc & Ph D students, more recently Prof S S Chahal Life Time Achievement Award was instituted from the year 2012 and Dr R Prasada Memorial Best Published Paper Award started from 2015. The activities includes Presidential address, N Prasad memorial lecture; R Prasada memorial lecture; V P Bhide memorial lecture; P R Verma memorial lecture, BBL Thakore memorial lecture and YL Nene memorial lecture by eminent plant pathologists of the country. The Society has more than 1250 members, including annual members, life members and foreign members, institutions and libraries.

The Society holds election and/or nomination every year for the positions of President and Zonal President (North, South, East, West and SAARC Countries). The Organizing Secretary for the annual/Asian/Global conference is nominated as Vice President for the ensuing year. Election and/or nomination to the offices of Secretary and Treasurer are held once in every 3 years. Number of eminent scientists of the country has served the Society in their capacities as Presidents, Secretaries and Treasurer sharing the responsibility of nurturing and continued development all through.

About Amity University

Amity University is a premier non-profit private university with a strong global footprint, committed to excellence in education, cutting-edge research, and innovation-driven knowledge creation. Anchored in academic rigor, industry relevance, and globally benchmarked curricula, the University fosters a multidisciplinary and inclusive learning ecosystem that promotes intellectual curiosity, ethical leadership, and social responsibility.

The University's pedagogy integrates outcome-based education, experiential learning, and research-led teaching, enabling students to develop critical thinking, innovation skills, and global competence. Backed by state-of-the-art infrastructure, advanced laboratories, digital learning platforms, and a vibrant innovation ecosystem, Amity University continuously strengthens its role as a hub for translational research and societal impact.

The Amity Education Group has flourished under the visionary leadership of its Founder President, Dr. Ashok K. Chauhan, whose mission was to establish an internationally benchmarked education system dedicated to nation-building and human capital development. This legacy is further strengthened at the Amity University Lucknow Campus, under the chairmanship of Dr.Aseem Chauhan, where an unwavering commitment to quality education, global standards, innovation, and holistic student development continues to guide institutional growth.

Amity University Lucknow is a 40-acre, state-of-the-art campus, strategically located in the capital city of Uttar Pradesh, seamlessly integrating global education standards with advanced research and innovation facilities. The campus is widely recognized for its guiding philosophy, “We Nurture Talent,” and hosts specialized institutions offering undergraduate, postgraduate, doctoral, and executive programs across a broad spectrum of disciplines.

The University is recognized by the University Grants Commission (UGC) and accredited with an 'A+' grade by NAAC, reflecting its strong governance framework, academic quality, and institutional performance. Several academic programs are approved and benchmarked by reputed international and professional bodies such as WASC and QAA, and the University has been ranked 15th by the National Institutional Ranking Framework (NIRF), underscoring its national standing in higher education.

Amity University Lucknow has demonstrated robust research productivity, with 53 granted patents, 56 registered copyrights, and over 120 externally funded research and consultancy projects. Faculty and researchers have contributed 2300 research publications in Scopus-indexed and other high-impact international journals, along with books, book chapters, and policy-oriented reports. The campus also actively promotes innovation and entrepreneurship through incubation support, industry-sponsored research, start-up mentoring, and technology transfer initiatives.

With academic collaborations and student-exchange partnerships with over 400 international universities, Amity provides extensive global exposure and cross-cultural learning opportunities. Strong linkages with industry, research organizations, and government agencies further enhance employability, skill development, and real-world problem-solving capabilities among students.

The Amity Food and Agriculture Foundation (AFAF) serves as a dedicated center for excellence in research, innovation, and capacity building in the domains of sustainable agriculture, food processing, nutrition, and agri-business. The Foundation adopts an interdisciplinary approach, integrating life sciences, biotechnology, environmental sciences, and engineering to address challenges related to food security, climate resilience, and sustainable resource utilization.

AFAF is actively engaged in funded research projects and technology-driven initiatives in agri-technology, food biotechnology, precision farming, post-harvest management, value addition, and sustainable resource management. The Foundation emphasizes translational research, farmer-centric innovations, industry collaboration, and policy support, contributing meaningfully to rural development, sustainable livelihoods, and national agricultural priorities.

About India

India, the ancient Vedic country of legends, bountiful gaiety lined with Himalayan mountain ranges, with the Everest highest mountain in the world. India depicts a heaven's gift on earth geographically, naturally and represents the wisdom of the yore. In this country of rich cultural heritage and the land of Saints, Plant Pathology had a history which flourish with all the branches of science excelling all through these ages.

About Uttar Pradesh

Uttar Pradesh (UP) is India's most populous northern state, known as the "Northern State," rich in history, culture, and spirituality, home to significant sites like the Taj Mahal, Agra Fort, Fatehpur Sikri, spiritual capital and world's oldest city Varanasi, featuring diverse geography from the Gangetic Plain to hills and significant spiritual importance and serving as a major cultural and economic hub, evolving with modern industrial growth and bordered by several states and Nepal.

Preamble

The world encounters unprecedented challenges in food security, climate variability, and ecological degradation where agriculture stands at the threshold in this era. Ensuring sustainable agriculture and food security requires coordinated action among all relevant stakeholders, including scientists, academics, policymakers, managerial personnel, land-use planners, and farmers, who share the responsibility of developing and implementing effective, evidence-based solutions. The conference "Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation" is convened to advance a shared vision of sustainable development, scientific innovation, and farmer-centric growth. This conference brings together the pillars of agro-intelligence, biotechnology, policy reform, architectural landscaping and sustainability to build resilient technologies, policies and management in food value chains for a rapidly changing world. The intent of the conference is to explore how policy frameworks that empower rural communities can enhance agricultural sustainability. The role of market intelligence, business incubation, FPO development, and KVK-led capacity building in shaping a dynamic and inclusive agri-entrepreneurial ecosystem is also considered as a step to advance the objective of the conference. At the scientific core of the issues lie a connect with mycology, plant pathology, pest risk analysis, disease forecasting, and decision-support systems, supported by innovations such as plant clinics, AI-ML–driven diagnostics and landscape designing for precision agriculture. Breakthroughs in genomics, phenomics, endophytes, and biological agents illuminate new pathways for plant protection and health management, while biotechnological fortification strengthening crop resilience and nutritional value are also invited. Recognizing that landscapes are living systems, the conference highlights agro-scaping as a powerful tool for disease management and food security. Themes such as climate-adaptive cropping, ecosystem restoration, rural landscape transformation, flood-resilient agricultural design, and the aesthetic and cultural dimensions of agrarian spaces underscore the need for holistic, sustainable land stewardship. By integrating digital innovations, smart technologies, and the wisdom of ecological design, this conference aspires to bridge the gap between traditional knowledge and frontier science. Together, policymakers, scientists, entrepreneurs, and farming communities will co-create strategies that uphold sustainability, strengthen global food resilience, and secure a thriving agricultural future for a sustainably developed society.

Climate during the conference

In April, Lucknow experiences hot and dry summer weather, with daytime temperatures often ranging between 37–40°C, while nights remain warm at around 20–26°C. The month is marked by clear skies, intense sunshine, and low rainfall, making it one of the driest periods of the year. Humidity is generally low to moderate, so the heat feels dry, though occasional light showers or dust storms may bring brief relief toward the end of the month.

How to reach Lucknow (for International & Domestic Guests)

By Air:

Chaudhary Charan Singh International Airport (LKO) is Lucknow's main airport, ~14–15 km from Gomti Nagar.

- It has frequent domestic flights to cities like Delhi, Mumbai, Bangalore, Chennai, Kolkata, Hyderabad and international flights to Dubai, Abu Dhabi, Muscat, Jeddah, Sharjah, Bangkok, Kuala Lumpur etc.
- **Airport to City:** Taxi/Uber/Ola available; travel time ~30-40 mins.

By Train

- Lucknow Charbagh Railway Station and Lucknow Junction are major rail hubs connecting all parts of India.
- Trains run to/from Delhi, Mumbai, Kolkata, Chennai, Jaipur, Varanasi, Prayagraj, Kanpur, Lucknow etc.

By Road

- Lucknow is well connected by national highways (NH24, NH25, NH28) making road travel easy from Uttar Pradesh and neighboring states.
- Agra-Lucknow Expressway and Purvanchal Expressway provide high-speed road connectivity from Delhi/Agra and eastern UP respectively.

City Connectivity

Within Lucknow, taxis, app-based cabs, auto-rickshaws, buses, and metro are available for travel to hotel locations and conference venues.

ACCOMMODATION

HOTELS NEAR AMITY UNIVERSITY, LUCKNOW CAMPUS

Luxury / Premium Hotels

1. Hyatt Regency Lucknow
   Vibhuti Khand, Gomti Nagar
   Mobile: +91-522-4261234
   Website: https://www.hyatt.com/hyatt-regency/en-US/lkorl-hyatt-regency-lucknow
2. Taj Mahal Lucknow
   Vipin Khand, Gomti Nagar
   Mobile: +91-74084-10015 (Duty Manager)
   Website: https://www.tajhotels.com/en-in/hotels/taj-mahal-lucknow
3. Novotel Lucknow Gomti Nagar
   Viraj Khand, Gomti Nagar
   (via Accor reservation) +91-522-...? (check website)
   Website: https://all.accor.com/hotel/A8M7/index.en.shtml
4. Hilton Garden Inn Lucknow
   Vibhuti Khand, Gomti Nagar
   Contact via website
   Website: https://www.hilton.com/en/hotels/lkogigi-hilton-garden-inn-lucknow/
5. Renaissance Lucknow Hotel
   Vipin Khand, Gomti Nagar
   Contact via Marriott website
6. Mercure Lucknow Gomti Nagar
   Amar Shaheed Path, Gomti Nagar
   Contact via Accor website
   https://all.accor.com/hotel/C253/index.en.shtml

Mid-Range & Business Hotels

7. Hotel Savvy Grand
   VibhutiKhand, Gomti Nagar
   +91-1800-120-3201, +91-7052162071
   https://savvygrand.com/
8. Dayal Gateway
   VibhutiKhand, Gomti Nagar
   +91-77058-22222, 0522-3108888
   http://www.dayalgateway.com/
9. Hotel Lineage
   Viraj Khand, Gomti Nagar
   +91-522-4313777 / +91-9670887777
   https://www.hotellineage.com/
10. Comfort Inn
    VibhutiKhand, Gomti Nagar
12. Elite Suites Hotel, Gomti Nagar
    Viraj Khand, Gomti Nagar
13. Hotel Ranbirs & The Grand JBR
    Viraj Khand, Gomti Nagar
15. Hotel Aurelia Grand & Hotel Millenia Regency Lucknow
    Malhour, Gomti Nagar

NOTE: For prebooking of accommodation within the campus, the participants are requested to contact the accommodation committee well in advance. The bookings will be on payment and first cum-first serve basis



REGISTRATION FORM

ISMPP 5th International Conference

on

"Pathogens, Plant Health and Food Security: Recent Advances for Climate Resilient Agriculture and Landscape Conservation"

April 08-10 2026

Full Name (Block Letters) ....

Designation .... **Organization** ....

Address ....

....

City .... **PIN** .... **Country** ....

Email: .... **Tel:** .... **Mobile** ....

Name of Accompanying persons (if any) ....

Member of the Society: YES/NO **Whether presenting paper for: Poster/Oral/Award Competition**

Title of the paper: ....

....

Name of presenting author: ....

Accommodation needed or not: ....

Date of Arrival: .... **Date of Departure:** ....

Details of the Demand Draft/Money Transfer/NEFT: ....

....

REGISTRATION FEE

Delegates	Host Institute	Others
Research Scholars / Students	₹ 1000 + GST	₹ 1500 + GST
Faculty / Academicians	₹ 1500 + GST	₹ 3000 + GST
Industry Participants	₹ 5000 + GST	₹ 8000 + GST
Foreign Participants:	₹ 10,000 + GST	₹ 10,000 + GST

Spot registration: Allowed but participants are not guaranteed accommodations.

*Students should produce proof of identity.

The registration fee includes the symposium kit, tea/ snacks during session breaks, working lunch, dinner and transport from guest house/hotel to the venue. It does not include accommodation. Registration kit will not be provided to accompanying person.

Bank Details for Online Registration/Transaction/ NET Banking (NEFT)

Account Name: Amity University Uttar Pradesh, Lucknow Campus

Account Number: 053010100284066

Bank Name: AXIS BANK LTD

Branch Name: M.G. MARG, HAZRATGANJ, LUCKNOW

IFSC Code: UTIB0000053

Important Dates

Abstract submission	05 March, 2026
Acceptance of Abstract	15 March, 2026
Registration	05 March, 2026
ISMPP Awards	10 Feb., 2026
Accommodation booking	05 March, 2026

Registration Link: https://www.amity.edu/lucknow/paymentgateway/RRAC2026

INTERNATIONAL ADVISORY COMMITTEE

- **Mohammad Taherzadeh**, University of Borås, Sweden
- **Ankita Garg**, Aurevia Lifesciences, USA
- **Ambuj Kumar**, Adama Science and Technology University Adama, Ethiopia
- **J. C. Rana**, Alliance of Bioversity International and CIAT
- **L M Suresh**, CIMMYT, Nairobi
- **G. P. Singh**, NBPGR, ICAR, New Delhi
- **S. K. Agrawal**, ICARDA, New Delhi
- **T. R. Sharma**, ICAR, New Delhi

NATIONAL ADVISORY COMMITTEE

- A Basu
- A N Mukhopadhyay
- A N Sabalpara
- Ajit Kumar Shasany
- Akhil Ranjan Garg
- Alka Singh
- Anil Kumar
- AnupamVerma
- Ashok Mishra
- Ashok T Bhattacharyya
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- B L Jalali
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- Bijendra Singh
- C Chattopadhyay
- C D Mayee
- C Manoharachary
- D J Patel
- D K Ghosh
- D P Singh
- D K Srivastava
- Dinesh Kumar
- Dinesh Singh
- G S Saharan
- H B Singh
- H S Shetty
- H S Singh
- J N Sharma
- Iliyas Rashid
- K Muralidharan
- Kailash Agrawal
- Kalyan Mondal
- Karuna Vishnawat
- M K Naik
- M Krishna Reddy
- M P Thakur
- M S Patil
- M S Saharan
- M. K. Awasthi
- Naresh Mehta
- Nutan Kaushik
- P Chowdappa
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- P N Sharma
- P P S Pannu
- Prabodh Trivedi
- Prakasam V
- Prathiba Sharma
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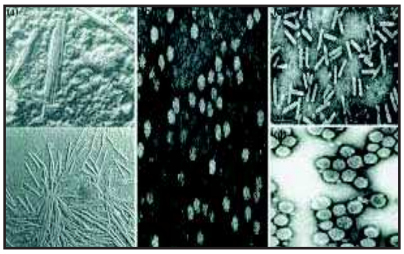
- R K Mittal
- R P Thakur
- R Viswanathan
- Rakesh Pandey
- S Jogaiah
- S K Gupta
- S K Singh
- S L Godara
- S Lingaraju
- S M Paul Khurana
- S Nakkeeran
- S R Niranjana
- S R S Dange
- S SChahal
- T S Thind
- T Damodaram
- Usha Chakraborty
- V I Benagi
- Vijay Laxmi Pandey
- W Selvamurthy





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9. Hospitality Committee

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Mr. Vikram Katoch	M: +91-9415754765	Email: vikramk@it.amity.edu

13. Press & Media Committee

Dr. Shalini Singh Visen	M: +91-8826588007	Email:ssingh29@amity.edu
Dr. Prachi Srivastava	M: +91-9453141916	Email: psrivastava@amity.edu

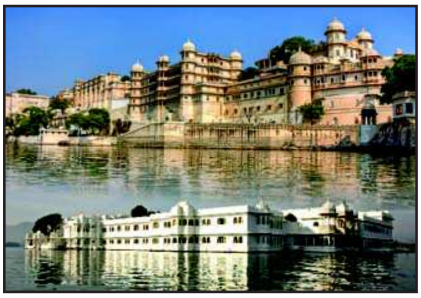
Places of attraction (India)

Tajmahal, Agra

India Gate, New Delhi

Golden Temple, Amritsar
Punjab

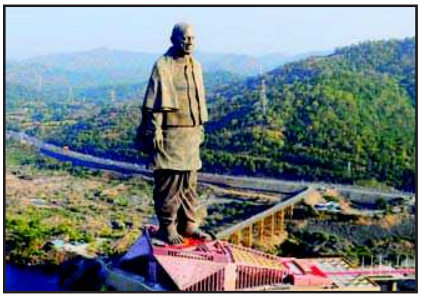
Kumbhalgarh Fort
Rajsamand, Rajasthan



City Palace, Lake Palace
Udaipur Rajasthan

Havamahal
Jaipur, Rajasthan

Prem Mandir
Vrindavan, UP



Statue of Unity
Narmada, Gujarat

Gir National Park
Somnath, Gujarat

Somnath Jyotirling Temple
Gujarat

Mahakal Jyotirling Temple
Ujjain, MP

Goa Beach
Goa

Places of attraction (Uttar Pradesh)

Shri Ram Mandir
Ayodhya, UP

Rani Mahal, Jhansi

Sarnath Temple

Banaras Ghats
Varanasi

Ramnagar Fort
Varanasi

Kashi Vishwanath Temple
Varanasi

Places of attraction (Lucknow)

ChotaImambara
(Imambara Hussainabad)

Bara Imambara

Rumi Darwaza

Husainabad Clock
Tower (Ghanta Ghar)

Dr. Ram Manohar Lohia
Park (Gomti Nagar)

Lulu Mall