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Indian Phytopath News

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From President's Desk

Seed Treatment as National Mission to Ensure Crop Biosecurity and Agricultural Sustainability

The agricultural sector is highly dependent on the availability and quality of seeds for a productive harvest. According to IMARC Group's latest report titled, "Seed Industry in India: Market Trends, Structure, Growth, Key Players and Forecast 2021-2026", the Indian seed market reached a value of US$ 4.9 Billion in 2020.The Indian seed market has witnessed a major restructuring as a result of the implementation of some progressive policies by the government, owing to which, India has emerged as the fifth largest seed market across the globe. Moreover, the active participation of both, public and private sectors has also played a vital role in laying a strong foundation of the industry.

India's NARS comprising of ICAR Institutes with 26 Crop research Institutes and 37 AICRPs spread across the countries and State Agricultural Universities, is one of the largest public sectors in the world and is engaged in seed production of field crops. Besides, 549 Indian companies and MNCs with 144 companies having R&D facilities are engaged as formal seed sector producing 39.8 million tons of quality seeds. Development of plant varieties, for which seed production is done, has to pass through 3 phases of evaluation. Breeders contribute their best entries on the basis of evaluation for testing in the Initial Yield Evaluation Trial (IET). Entries qualifying from yield, disease and quality point of view in IET are tested in Advanced Varietal Trials (AVT). All these trials are organized at a very large number of locations in different zones of the country, which may occasionally harbour pathogens of regional occurrences.

Such seeds originating in one zone and grown across the different zones either for testing or for cultivation serves the biggest source of transmission of seed borne diseases across the country. Recent occurrences of Karnal bunt of wheat endemic to north zone, in MP (Central zone) may be due to transfer of bunt contaminated seeds from north zone. Similar is the case of domestically quarantined potato cyst nematode once restricted to Nilgiri hills in South zone now exists in northern hills of HP, Uttarakhand and J&K. TR4 of Panama wilt of banana in UP, Bihar and Bengal and Blast like disease of wheat in Bengal and Root knot nematode of guava (*Meloidogyne enterolobi*) in Tamil Nadu, are new diseases reported in the country, possibly due to transboundary movement of seeds and propagating materials. Lots of other diseases viz, CLCuV, grey mildew, rusts, prevalent in cotton in region specific manner or many other diseases of regional significance in other commodities are the potential transboundary threats. Thanks to alertness of ICAR-NBPGR that Downy mildew of soybean (*Peronospora manshurica*) detected in Uttarakhand and *Diaporthe helianthi* in safflower detected in Telangana have been promptly intercepted and destroyed to prevent their spread to other regions of the country. Seeds/ propagating materials of these commodities need strict monitoring, quarantine and mandatory treatment to guard against any chance of transboundary spread and preventing any spread of these invasive species to different states of the country.

About 90 per cent of all food crops grown on earth are propagated by seed (Paul Neergaard, 1977) and Two-

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thirds of losses due to diseases are caused by seed-borne diseases (cf. Cramer, 1967). Fifty one field crops are of major importance, including cereal, pulses, oilseeds, etc. representing by far the greater part of food production. All these crops besides, horticultural crops are vulnerable and may serve as carriers of devastating seed-borne diseases. It is documented that 0.5% infected seeds of CMV can cause 34-53% losses. Similarly, planting 2 seeds of cabbage (out of 10,000 seeds) infected with *Xanthomonas campestris* may cause an epidemic of Black rot of Cabbage.

Healthy and disease free seeds are key to successful crop production and food security. Despite the potential threat from seed borne diseases, except for regulation to treat wheat seeds with specified seed dresser against loose smut, flag smut and Karnal bunt in Punjab and Haryana there is no mandatory legislation of seed treatment for protection from seed borne infection in the country. The draft Seed Bill 2019 that the Ministry of Agriculture & Farmers' Welfare is expected to table in the forthcoming sessions of parliament, must make seed treatment with a suitable safe chemical or bio pesticides mandatory for protection of seeds from infection. Treated seeds would not only protect crops from seed borne infection and prevent its spread to disease free zones but also may serve to protect healthy seeds from soil-borne infection. Seed dressing with protectants would not only be economical but it will also not pose any residue problem, biosafety hazard or phytotoxicity that may result from post-emergence application or soil drenching for management of plant diseases. Formulations of five fungicides and six insecticides besides, some biopesticides, individually or in combination have been approved by CIBRC for seed treatment of some cereals, pulses, oilseeds, commercial crops and vegetables against few specific diseases. For sustainable seed security it is high time that Govt/NARS brings all crops propagated through seeds or vegetative propagules, under the net of mandatory seed treatment. This can be achieved through label expansion of the already existing pesticides following guidelines for group MRL. In national interest industry, agricultural scientists and policy makers must work together towards achieving this endeavour.

P.K. Chakrabarty
President
Indian Phytopathological Society

Editorial

Higher Education in Agriculture under New Education Policy of India

Education is fundamental right of every citizen for achieving full human potential and promoting national development. Universal high quality education is the best way for maximizing and harnessing the talents of the country. India is going to have highest population of young people in the world over the next decade and providing the youth high quality educational opportunities will determine the future of our country. As the new National Education Policy (NEP) commits to change the entire design of agriculture education, it holds a wide scope in the preparation of professionals with significant skills who can deliver strength to agriculture sector to fight against certain odds like low productivity, high cost of production, soil erosion, water scarcity, post harvest management, market problems etc. In India, the agriculture centric education system of NEP will end the inferior image of farmer, in comparison with any other occupation. Central Govt. has decided to invest 6 percent of GDP in education. This expenditure will definitely boost the technical research and innovation in this most needy sector.

India received its new education policy on 29th July 2020. It was in 1986 that the previous education policy was implemented. With time, the situation and methods of teaching and learning have changed. Information and communication technology has impacted all the aspects of life today including education. Therefore, it is imperative to incorporate ICT, digitization, artificial intelligence in the New Education Policy. It introduces a multidisciplinary education system where student shall be able to study subjects of different streams simultaneously. Additionally, rich heritage of ancient and eternal Indian knowledge has been a guiding light for this Policy. Agriculture education should begin from primary school level and reaching to multidisciplinary university level. Therefore, a holistic and multidisciplinary education would aim to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. This agenda of global education development is also reflected in Goal 4 of Sustainable Development Goals (SDGs) which is “ensure inclusive and equitable quality education and promote

lifelong learning opportunities for all" by 2030. With this in mind, many agricultural universities including Indian Agricultural Research Institute have initiated the process of transformation in well structured manner.

Rashmi Aggarwal
Chief Editor, IPS Newsletter

Research Highlights

First draft genome sequence of *Bipolaris sorokiniana* causing spot blotch of wheat from India

Rashmi Aggarwal[1]*, S. Sharma[1], K. Singh[1], M.S. Gurjar[1], M.S. Saharan[1], S. Gupta[1], B.M. Bashyal[1] and K. Gaikwad[2]
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Spot blotch caused by *Bipolaris sorokiniana* is one of the most devastating diseases of wheat in the warmer areas of the world. First draft genome of *B. sorokiniana* strain BS_112 from India sequenced using the Ion Torrent, Illumina HiSeq, and Nanopore platforms. The genome size was estimated at 35.64 Mb with an average G-C content of 50.20%. The BUSCO evaluation of completeness of the *B. sorokiniana* genome sequence assembly predicted that it was complete to about 97.6%. The gene prediction was performed using the AUGUSTUS tool version 2.2.5 with the reference *B. sorokiniana* ND90Pr (GenBank accession number AEIN00000000). A total of 10,460 genes were predicted with an average gene density of 250 to 300 genes/Mb, which covers around 98% of predicted genes. The average gene length was 435 to 545 bp, the maximum gene length was 8,506 bp, and the minimum gene length was 50 bp. Gene ontology (GO) annotations of the genes were determined using Blast2GO version 2. Out of 10,460 annotated genes, 1,024 (3,491), 493 (4,165), and 1,274 (7,784) genes (hits) were for biological processes, cellular components, and molecular functions, respectively. The *B. sorokiniana* genome was interrogated with the Pathogen Host Interactions (PHI) database version 4.3 (10), and in total, 3,627 genes were found to be homologous to proteins in the PHI database with an E value of _1e-05. (https://doi.org/10.1128/MRA.00308-19)

Insights of *Bipolaris sorokiniana* secretome - an *in silico* approach

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The plant pathogen, *Bipolaris sorokiniana* (teleomorph: *Cochliobolus sativus*), is of global concern as it attacks many economically important cereals and grasses. In silico secretome analysis of *C. sativus* strain ND90Pr performed using established secretome prediction pipelines. Total 196 probable secretory proteins from the *B. sorokiniana* proteome identified. Characterization of the predicted secretome revealed proteins that may have probable functions in degradation of the plant cell wall, lipids, proteins, and nucleic acids, as well as in pathogenesis and metabolism. Further, the PHI-database analysis identified 38 proteins having a possible role in pathogenicity and virulence. It may provide evidences for development of new management strategies targeting the vital fungal secretory proteins. (https://doi.org/10.2478/s11756-020-00537-4)

Analysis of phytopathogenic fungi in some important crop plants using morpho-molecular tools-Foldscope and ITS region

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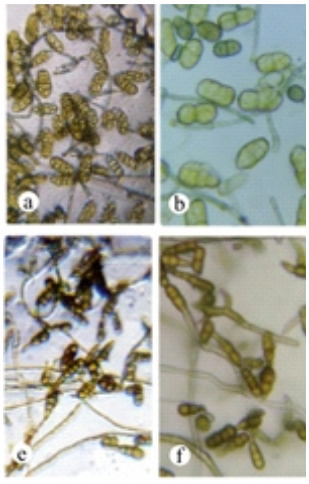
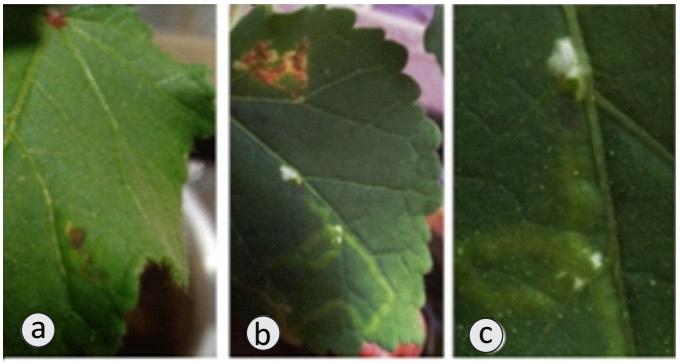


Phytopathogens were analyzed and characterized using Foldscope-an origami-based paper microscope. Diseased leaves, fruits, vegetable parts were visualized and fungal isolates were acquired from various vegetable, fruit, and ornamental plants. The first report wherein phytopathogenic fungi from broccoli, gerbera, guava, okra, and orange as host plants have been successfully identified with Foldscope as a tool and studied to the extent where cell wall-degrading enzymes, pathogenicity, and ITS region sequencing have been established. Results



acquired through Foldscope upon comparing and validating with lab based morphological analysis and ITS sequencing, have enabled to establish with confidence that this low cost affordable paper microscope can be efficiently used for the detection of following pathogens causing diseases in the host plants like *Alternaria alternata* in guava, *Alternaria* sp. in gerbera, *A. brassicicola* in broccoli, *Colletotrichum gloeosporioides* in okra, *Curvularia asianensis* in guava and *Alternaria* sp. in citrus.
(https://doi.org/10.1007/s11557-020-01640-1)

Design a duplex PCR assay for simultaneous detection of chickpea chlorotic dwarf virus and peanut witches' broom phytoplasma in chickpea

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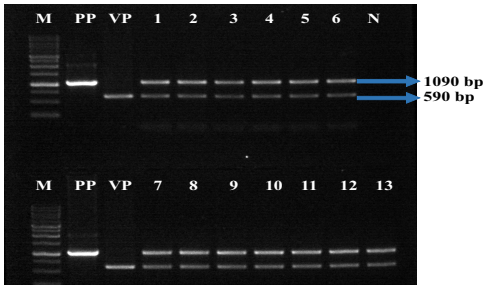
A duplex PCR assay was developed by optimizing PCR reaction components and cycles for the simultaneous detection of chickpea chlorotic dwarf virus (CpCDV) and a peanut witches' broom (PWB) phytoplasma associated with the chickpea stunt disease. Two sets of CP specific primer pair (MCPF/MCPR) for CpCDV and *tuf* gene primer pair (TUF-II-F2/TUF-II-R1) for phytoplasma were used. Different concentrations of the PCR components such as primers, *Taq* polymerase and PCR annealing temperature were optimized for amplification of CpCDV and phytoplasma DNA in the duplex PCR assay. Expected amplicons of 590 bp for CpCDV and 1090 bp for phytoplasma were consistently amplified from the symptomatic chickpea tissues in single and duplex PCR assays (Fig.). This duplex PCR assay was found equally efficient and sensitive in detecting single or mixed infection of CpCDV and PWB phytoplasma in 148 symptomatic chickpea stunt samples in two states of India. The results indicate the robustness and reliability of detection of virus and phytoplasma indexing in chickpea samples associated with CpS disease. The designed duplex assay can also be useful for further resistance screening of chickpea genotypes, epidemiological studies and in planning appropriate disease management strategies
(DOI: 10.5958/2249-4677.2019.00123.3)



Duplex PCR assay results for idnentification of phytoplasma and CpCDV showing expected amplicons from symptomatic chickpea isolates; Lane M: 1kb ladder, Lane VP: CpCDV, Lane N: Negative control, Lane 1to 13: Samples positive for both CpCDV and phytoplasma

RsolaniDB: Developmet of a dedicated, comprehensive, and user-friendly web resource for *Rhizoctonia solani* pangenome analysis

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Rhizoctonia solani Kühn is a collective name for a group of soilborne and multinucleate basidiomycetous fungi, which are classified into 13 Anastomosis Groups (AGs) with interspecific subgroups having distinctive host range and pathogenicity, and heterogenous genetic composition. A database of pangenomes, predicted transcriptomes and protein sequences of 12 *R. solani* isolates covering 7 AGs and selected subgroups and isolates [AG1-IA, AG1-IB, AG1-IC, AG2-2IIIB, AG3-PT (isolates 1AP, and 1A1), AG3-TB, AG4-HG-I (isolates Rs23 and R-118), AG5, AG6, and Ag8], and associated genomic analytic tools have been developed jointly by the KAUST and the USDA-ARS. Six previously reported *Rhizoctonia* genomes by other workers have also been included in the RsolaniDB. This comprehensive database stands as a valuable platform for hosting, visualizing, and analyzing highly diverse genome assemblies and their annotated components, with tools for gene enrichment and pathway analysis, sequence retrieval and visualization.
Links: http://rsolanidb.kaust.edu.sa/RhDB/;
https://doi.org/10.1101/2020.12.18.423518

Invasive/Emerging Pests/New Reports

Aster yellows phytoplasmas association with a little leaf disease of papaya in Kerala

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Symptoms of papaya little leaf were observed in papaya plants in Vellayani, Thiruvananthapuram, Kerala, India with a disease incidence of 4%. Phytoplasmas were detected in the symptomatic papaya leaf samples by nested polymerase chain reaction with primer pairs amplifying 16S rRNA and *sec*A genes. Pairwise sequence comparison and phylogenetic analysis of these gene sequences indicated the presence of phytoplasmas related with strains in the aster yellows ribosomal group. *In silico* RFLP analysis using the *i*PhyClassifier of the 16S rDNA sequence allowed the detected phytoplasma classification into the 16SrI-D subgroup. This is the first report of 16SrI-D subgroup association with a papaya little leaf disease.

(DOI: 10.5958/2249-4677.2019.00123.3)

Phytoplasma symptoms observed on papaya plants: in (a) papaya little leaf symptom and in (b) papaya little leaf making a whorl on the canopy

Symposia/Workshop: Organized

- Division of Plant Pathology, FOA Wadura, SKUAST-K, J&K organized 21 days activity based online training programme on apple diseases/disorders & their real time management during 30-09-2020 to 20-10-2020 which was sponsored by NAHEP, SKUAST-K, under the course directorship of **Dr. Tariq Rasool Rather**, Asstt. Professor, FOA, Division of Plant Pathology, SKUAST-K, J&K.
- International E-Conference was organized on "Multidisciplinary Approaches for Plant Disease Management in achieving Sustainability in Agriculture" from 6-9th, October, 2020 by **Prof. V. Devappa** and his team, Department of Plant Pathology, College of Horticulture, Bengaluru, Karnataka. Altogether, 1,758 participants from 110 different Universities/Institutions all over the world registered for the conference.
- **Dr. B. Srinivasulu**, Director of Extension, Dr YSRHU and Dr. K. Sesha Kiran, Assistant Professor (Plant Pathology), College of Horticulture, V.R. Gudem, Dr. YSRHU organised Webinar on "Advances in Plant Pathology with reference to Diagnosis and Management" on 16th September, 2020 on behalf of Plant Protection Advisory Cell (PPAC).
- Two National Web Conferences entitled "Mushroom Production and its Sustainable Trade" and "Mushroom Production-A Profitable Avocation for Youth and Farmers" were organized by the Department of Plant Pathology, BUAT, Banda (U.P.) on 5-6th Oct, 2020 and on 19th-23rd Oct, 2020, respectively.
- A training program on "Mushroom Production" was organized by the Department of Plant Pathology, BUAT, Banda (U.P.) on 9-10th Dec, 2020.
- Department of Biotechnology, Fergusson College, Pune (Autonomous) organized a International E-conference on Foldscope and its applications (INECFAIA-2020) during 20-21, June 2020.

IPS Zonal Symposia 2020-21

IPS Southern Zone Symposium

A symposium on "Advances in Crop Health Management" was jointly organized by ICAR-Indian Agricultural Research Institute, Regional Station, Wellington, The Nilgiris, Tamil Nadu and The Indian Phytopathlogical Society (South Chapter) on December 01-02, 2020. More than 150 participants participated in the events. The major recommendations include:

1. The hot spot locations for biotrohpic pathogens of wheat, rice and other major food and nutritional security crops should be strengthened to identify durable resistant varieties in India.
2. Holistic understanding of function of genes by

combining biochemical, molecular and cell-biological research is the need of the hour by moving away from only genetics based approach.
3. Precautionary measures about off-targets effects of resistance governing genes in development of disease resistant varieties.
4. Diagnostic techniques for detecting plant pathogens should be based on sensitivity, need, purpose and cost involved. A combination of biological and molecular diagnostics will serve better.
5. To undertake more research on use of ICTs in Plant Pathology which may aid in rapid diagnosis of field problems which may lead to better management options.
6. Research on formulation of biopesticides and biostimulants should be strengthened. The market potential of bio-formulations which can be catalysed through public-private partnership mode.
7. Care to be taken by the plant pathologist while recommending of beneficial micro-organisms and banned chemicals for the management of diseases.
8. Generation of the toxicological data is very important for bio-control agents prior to field testing and emphasized for standard protocol for data generation.

IPS North-Eastern Zone Symposium

A symposium on "Plant Disease Management: Experiences and Aspirations" was organized by Department of Plant Pathology, SASRD, Nagaland University, Medziphema campus on December 07-08, 2020. More than 43 participants participated in the events. Following recommendations are emerged from the deliberations:

1. Lacunae of plant pathological research to be found out keeping in view the threat of food and nutritional security in the north-east.
2. Prioritization of plant pathological research and education is to be done in the north-east region in the backdrop of climate change scenario.
3. Biosecurity and agroterrorism issues to be given more consideration in the north-east as it borders with many countries.
4. Development of mycoparasites/microbial-consortia bioinoculants of endophytic nature for plant disease management in organic agriculture are to be intensively pursued.
6. Harnessing the benefits of nanoparticles for plant pathogen management in en eco-friendly manner should be studied.

IPS Delhi Zone Symposium

Indian Phytopathological Society (Delhi Zone) in association with Division of Plant Pathology, ICAR-IARI jointly organized one day Delhi Chapter Zonal Symposium (Virtual) on "Modern trends in systematics and bio-prospecting of fungi" December 16, 2020 at Division of Plant Pathology, ICAR-IARI, New Delhi. The symposium was attended by 74 delegates all over India including large number of scientists from ICAR institutes namely IARI, NCIPM, NIPB, NBPGR, IIMR and other Delhi-based Institutes like Indian Institute of Technology, Delhi etc. Majors recommendations of the symposium are:

1. More and more fungal species needs to be identified and reported from India and traditional taxonomy should be supported with molecular identification.
2. Students' research in the discipline of Mycology should be encouraged and more number of students and faculty should be trained in the area of mycology.
3. The success of *in vivo* research on biocontrol should be translated in a product and field level to harness its benefit.

IPS Northern Zone webinar

Indian Phytopathological Society (Northern Zone) in association with Indian Society of Plant Pathologists, Ludhiana, and Department of Plant Pathology, PAU, Ludhiana jointly organized one day webinar on "Combating Rusts and Karnal Bunt of Wheat: Past and Future Strategies" December 18, 2020. The symposium was attended by 97 delegates all over India. The Major recommendations from NZ Brainstorming session:

1. Formation of working groups : Disease wise and the Coordinator of each working group will present the achievements every year in the IPS Symposium.
2. Major emphasis should be given to strengthen the domestic quarantine to restrict the diseases of quarantine importance into respective areas.
3. Seed exchange for experimental purposes should be treated against the seed borne diseases like Karnal Bunt.
4. Need to work out the easy and efficient screening system for Karnal Bunt Screening.
5. Need to relook at the epidemiology of the rust diseases in wheat under Indian conditions.

Awards/Honours/Promotions

- **Dr. Phatik Tamuli**, Associate Professor & Head, Department of Botany, Darrang College, Tezpur, Assam awarded the prestigious INSA Teacher Award, 2020 by Indian National Science Academy, New Delhi.
- **Dr. G.P. Rao**, Principal Scientist, Division of Plant Pathology, IARI, New Delhi awarded as Fellow of Royal Association for Science-led Socio-cultural Advancement (RASSA) Society, New Delhi.
- **Dr. Gireesh Chand**, Professor (Plant Pathology) College of Agriculture, Central Agricultural University, Pasighat, East Siang (Arunachal Pradesh) was awarded as Fellow of Scientific & Educational Research Society (SERS) for the year-2020 in the recognition of his contribution in the field of crop diseases and their management.
- **Dr. Atul Kumar**, Principal Scientist, Division of Seed Science & Technology, ICAR-IARI, New Delhi have been bestowed with Best Nodal Officer IARI (Hindi) for the year 2019-20 by IARI Hindi cell.
- **Prof. C. Manoharachary** has been conferred with Fellowship of Mycological Society of India for his valuable contributions in the field of Mycology and Plant Pathology in 2020.
- **Mr. Amit Kumar Kesharwani**, Senior Research Fellow (Pursuing Ph.D.), Division of Plant Pathology, ICAR-Indian Agricultural Research Institute, New Delhi honoured with "Junior Scientist Award" on account of overall achievements and accomplishment in the field of Agriculture & Plant pathology in National Webinar on "Prospective, Priorities and Preparedness of Sustainable Agriculture Development in India" organized by Dr. Ram Avatar Shiksha Samiti (DRASS), Pilibhit, U.P. during December 28-29, 2020.
- **Dr. Satish Kumar Sain** promoted as Principal Scientist (Plant Pathology) at ICAR-Central Institute for Cotton Research - Regional Station, Sirsa (Haryana) w.e.f. 18.11.2018.
- **Dr H.B. Singh** joined as Distinguished Professor, Department of Biotechnology, GLA University, Mathura on August 01, 2020.
- **Dr. Shamarao Jahagirdar** joined as Dean, Pandit Jawahar Nehru College of Agriculture & Research Institute, Govt. of Pondicherry affiliated to Central University Pondicherry on 24th December 2020 for a period of three years.

Announcement for IPS Award 2021-22

The online system has been developed for application of various awards instituted by the Society from 2020-21 and only the online application will be considered from this year.

Online application for the awards of the Society is invited from the eligible members of the Society. The last date for submission of application February 25, 2021. Detailed guidelines and online application form are available on the IPS website: https://ipsdis.org/awards

The online application has been developed in two steps. In the first step, the applicant has to fill the ONLINE FORM and SAVE the application. In the second step, the attachments have to be uploaded for each claim, failing which, the marks will not be given for that claim. After completion of the form and attachments, please download and check the complete form in pdf format and save it for future correspondence. If the application is OK then submit OR you can edit/modify the application before submission. Application once submitted cannot be edited in any cases.

List of awards:

1. Mundkur Memorial Award
2. Jeersannidhi Award
3. M.K. Patel Memorial Young Scientist Award
4. J.F. Dastur Memorial Award
5. A.K. Sarbhoy Memorial Award
6. Sharda Lele Memorial Award
7. K.C. Mehta and Manoranjan Mitra Award
8. B.N. Chakraborty and Usha Chakraborty IPS Best Teacher Award
9. Prof. A.N. Mukhopadhyay Oration Award
10. D.P. Misra and R.N. Pandey IPS Best Women Scientist Award
11. Fellow of Indian Phytopathological Society (FPSI)

Important Instructions:

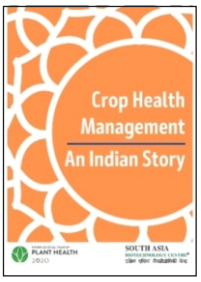
Before Login, please check and ensure your email and mobile number are correct on members databse available on IPS website: https://ipsdis.org/allmembers. If the email /mobile number is not correct, please write a mail to the Secretary, IPS (email: ipsdis@yahoo.com) to update your email and mobile number, failing of which, members will not get the OTP for login.

Interested members can login the website first time using OTP and can create password for subsequent login.

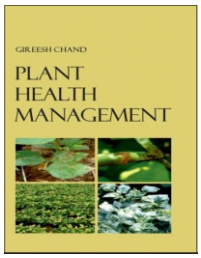
Application: The intending applicants are required to submit one copy of application to Secretary, Indian Phytopathologigcal Society, Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi 110012, INDIA, on or before March 7, 2021. All the supporting documents are required for each claim.

Books Published

1. **Crop Heath Management - An Indian Story**
   Authors: C.D. Mayee, Govind Gujar, Yashika Kapur and Bhagirath Choudhary
   Published by: South Asia Biotechnology Centre (SABC)
   Published: 2020
   ISBN: 978-93-5426-746-8

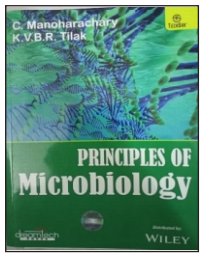


2. **Plant Health Management**
   Editor: Gireesh Chand
   Published by: New India Publishing Agency, New Delhi
   Published: 2020
   ISBN: 978-93-89130-15-7

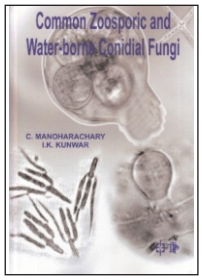


3. **Fungal Biotechnology and Bioengineering**
   Editors: Abd El-Latif Hesham, Ram Sanmukh Upadhyay, Gauri Dutt Sharma, C. Manoharachary and Vijai Kumar Gupta
   Published by: Springer International Publishing
   Published: 2020
   ISBN: 978-3-030-41869-4

4. **Principles of Microbiology**
   Authors: C. Manoharachary and K.V.B.R. Tilak
   Published by: Wiley
   Published: 2020
   ISBN: 978-093-89976-45-8



5. **Common Zoosporic and Water-borne Conidial Fungi**
   Authors: C. Manoharachary and I.K. Kunwar
   Published by: Today & Tomorrows Printers and Publishers
   Published: **2020 or 2018**
   ISBN: 9788170196204



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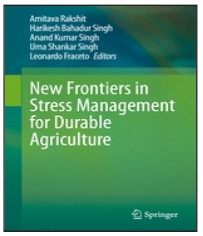

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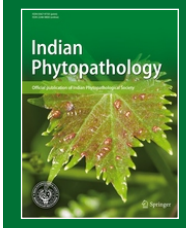
Necrology

Prof. Rama Shankar Dwivedi, a distinguished mycologist, plant pathologist and soil microbiologist passed away on 11 January, 2020 at his residence in Varanasi after a brief illness.

Dr. Ashok Gaur, Former Principal Scientist, Division of Seed Science & Technology, ICAR-IARI, New Delhi, passed away on 14th December 2020.



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