



PhytoFuRa Publication No. III

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*Outreach Project on
Phytophthora, Fusarium & Ralstonia
Diseases of Horticultural and Field Crops*



**Research Publications from
PhytoFuRa Outreach Project
2009 - 17**



Outreach Project on
Phytophthora, Fusarium and Ralstonia
Diseases of Horticultural and Field Crops (PhytoFuRa)



**ICAR - Indian Institute of Spices Research
(Two times winner of Sardar Patel Outstanding ICAR Institution Award)
Kozhikode, Kerala, India.**

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PREFACE

Wilt pathogens viz., the oomycete pathogen - *Phytophthora* spp., the fungal pathogen - *Fusarium* spp. and the bacterial wilt pathogen - *Ralstonia solanacearum*, have an enormous impact on the national economy. They cause havoc to a number of horticulture and field crops of the country ranging from vegetables, fruits, spices, plantation crops, ornamentals, pulses and oil seeds. On the other hand our understanding of these pathogens has tremendously improved with the advances in sequencing and genomic techniques. To harness the power of these new generation technologies and to bring in more synergy in our efforts to deal with these pathogens, Indian Council of Agricultural Research (ICAR) launched an Outreach Project on *Phytophthora*, *Fusarium* and *Ralstonia* Diseases of Horticultural and Field Crops (PhytoFuRa) in the year 2008. Research was carried out under six thematic areas - biodiversity, diagnostics, epidemiology, genomics, host resistance, disease management and HRD. The project was operational initially in 19 centres distributed in ten states with Indian Institute of Spices Research (ICAR-IISR) as the lead centre and subsequently during 12th Five Year Plan, three more centres were added.

The PhytoFuRa Project was one of the flagship program of ICAR with a total outlay of ₹ 34.1 crores (2009 - 2017). It dealt with a wide range of crops including apple, banana, black pepper, brinjal, chickpea, chilli, citrus, coconut, cocoa, colocasia, ginger, guava, oil seeds, pigeon pea, potato, rubber, safflower, seed spices, sugarcane and tomato. The inter-institutional collaboration under this project was unique and exemplary. The PhytoFuRa portal (<http://www.phytofura.net.in>) facilitated better and faster interaction and sharing of resources among the investigators and research fellows.

Scientific articles published in peer reviewed journals are very important means of distributing research findings for the foreseeable future. Research publications continue to be a good indicator to assess the outcome of a project. During the span of last eight to nine years, PhytoFuRa project has contributed 170 research papers in peer reviewed journals and many more are in the pipeline. One third of these publications appeared in high impact factor journals which is a good measure of the outcome of this key project. This publication is a bibliography of the research publications and scientific presentations made in Seminars/Symposia by the investigators of this project.

We take this opportunity to salute the stewardship shown by Dr. M. Anandaraj in ably leading the project since its inception and brilliantly coordinating more than 80 scientists across the country. We thank all the investigators of the project for their commendable contribution. We would like to place on record our sincere gratitude to Dr. S. Ayyappan (Former Secretary, DARE & Director General, ICAR) and Dr. Trilochan Mohapatra, the present incumbent for their valuable guidance and keen interest in the project. The support and guidance received from former Deputy Director Generals (Horticultural Science) - Dr. H.P. Singh and Dr. N.K. Krishna Kumar, and Dr. A.K. Singh, the present Deputy Director General (HS) are gratefully acknowledged. The financial support for the project received from ICAR is gratefully acknowledged.

Editors

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उपमहानिदेशक (बागवानी विज्ञान)

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FOREWORD

The pathogens, viz. Phytophthora spp., Fusarium spp. and Ralstonia solanacearum, cause serious diseases in a number of agri-horticultural crops leading to enormous economic losses in India. Our understanding of the host plant-pathogen interactions and other associated factors are crucial for developing sound disease management strategies. Fostering meaningful collaborations and pooling of resources in research programmes and making full use of frontier technologies is the need of the hour for enhancing efficiency. Realizing this, the Indian Council of Agricultural Research (ICAR) has supported a national level Outreach Project on Phytophthora, Fusarium and Ralstonia Diseases of Horticultural and Field Crops (PhytoFuRA) during 2009-17 at 19 Centres across the country covering six thematic areas viz. biodiversity, diagnostics, epidemiology, genomics, host resistance, disease management and the human resource development.

The project has immensely contributed to our understanding of the biology, diversity and ecology of these three pathogens of immense economic significance at national level. The concerted efforts of the collaborating institutions have largely helped in rolling out several effective field management strategies for diseases caused by these pathogens in a number of agri-horticultural crops. In addition to standardization of management technologies, the project has also accomplished several milestones of high academic value.

I am glad that the ICAR-Indian Institute of Spices Research, Kozhikode, the lead center, has compiled and brought out three crisp publications covering technologies, protocols and scientific publications that reflect the achievement of this high impact project for the benefit of stakeholders. I take this opportunity to appreciate the efforts made by the scientists associated with planning, execution, monitoring and evaluation of the project which led to such significant outcomes. I wish that the outcome presented in this compilation will suitably be scaled up at field and help in fine tuning further research in this sector.

New Delhi
21.11.2017

(Anand Kumar Singh)

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Research Papers

Phytophthora

		NAAS rating
1	Anandaraj M and Umadevi P 2016. The post genomic era: Novel approaches for studying plant diseases and their management. <i>Indian Phytopathology</i> 69(4s): 260 - 265.	5.90
2	Bawage S, Nerkar S, Kumar A and Das AK 2013. Morphological and molecular description of <i>Phytophthora insolita</i> isolated from citrus orchard in India. <i>Journal of Mycology</i> , 2013: 247951, http://dx.doi.org/10.1155/2013/247951 .	-
3	Bhardwaj V, Sharma R, Dalamu, Srivastava AK, Baswaraj R, Singh R and Singh BP 2015. Molecular characterization of potato virus Y resistance in potato (<i>Solanum tuberosum</i> L.). <i>Indian Journal of Genetics and Plant Breeding</i> 75(3): 389-392.	-
4	Chakrabarti SK, Singh BP, Thakur G, Tiwari JK, Kaushik SK, Sharma S and Bhardwaj V 2014. QTL mapping underlying resistance to late blight in a diploid potato population <i>Solanum spgazzinii</i> × <i>S. chacoense</i> . <i>Potato Research</i> 57: 1–11.	7.13
5	Chandel P, Tiwari JK, Ali N, Devi S, Sharma S, Sharma S, Luthra SK and Singh BP 2015. Inter-specific potato somatic hybrids between <i>Solanum tuberosum</i> and <i>S. cardiophyllum</i> , potential sources of late blight resistance breeding. <i>Plant Cell Tissue and Organ Culture</i> 123:579–589. DOI 10.1007/s11240-015-0862-8	8.00
6	Chandra Mohanan R, Prabha KP and Sharadraj KM 2013. Production technology of coir pith cake formulation of <i>Trichoderma harzianum</i> . <i>Journal of Plantation Crops</i> 41(2): 214-218.	5.54
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10	Das AK, Kumar A, Ingle A and Nerkar S 2011. Molecular identification of <i>Phytophthora</i> spp. causing citrus decline in Vidarbha region of Maharashtra. <i>Indian Phytopathology</i> 64 (4): 342-345.	5.90
11	Das AK, Kumar A, Nerkar S and Bawage S 2012. First report of <i>Phytophthora insolita</i> in India. <i>Australasian Plant Disease Notes</i> 7: 131 – 132. DOI: 10.1007/ s13314-012-0066-6.	-
12	Das AK, Kumar A, Nerkar S and Bawage S 2012. First report of <i>Phytophthora lacustris</i> in India. <i>Journal of Plant Pathology</i> 95 (2): 447.	7.27
13	Das AK, Nerkar S, Kumar A and Bawage S 2016. Detection, identification and characterization of <i>Phytophthora</i> spp. infecting citrus in India. <i>Journal of Plant Pathology</i> 98 (1): 55-69	7.27
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- 8 Bindu Roy C 2015. Towards understanding the extent of genetic diversity of *Phytophthora* spp. infecting rubber (*Hevea brasiliensis*) and deploying molecular markers for resistance breeding. *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 9-12 Sept. 2015, Indian Institute of Horticultural Research, Bangalore.

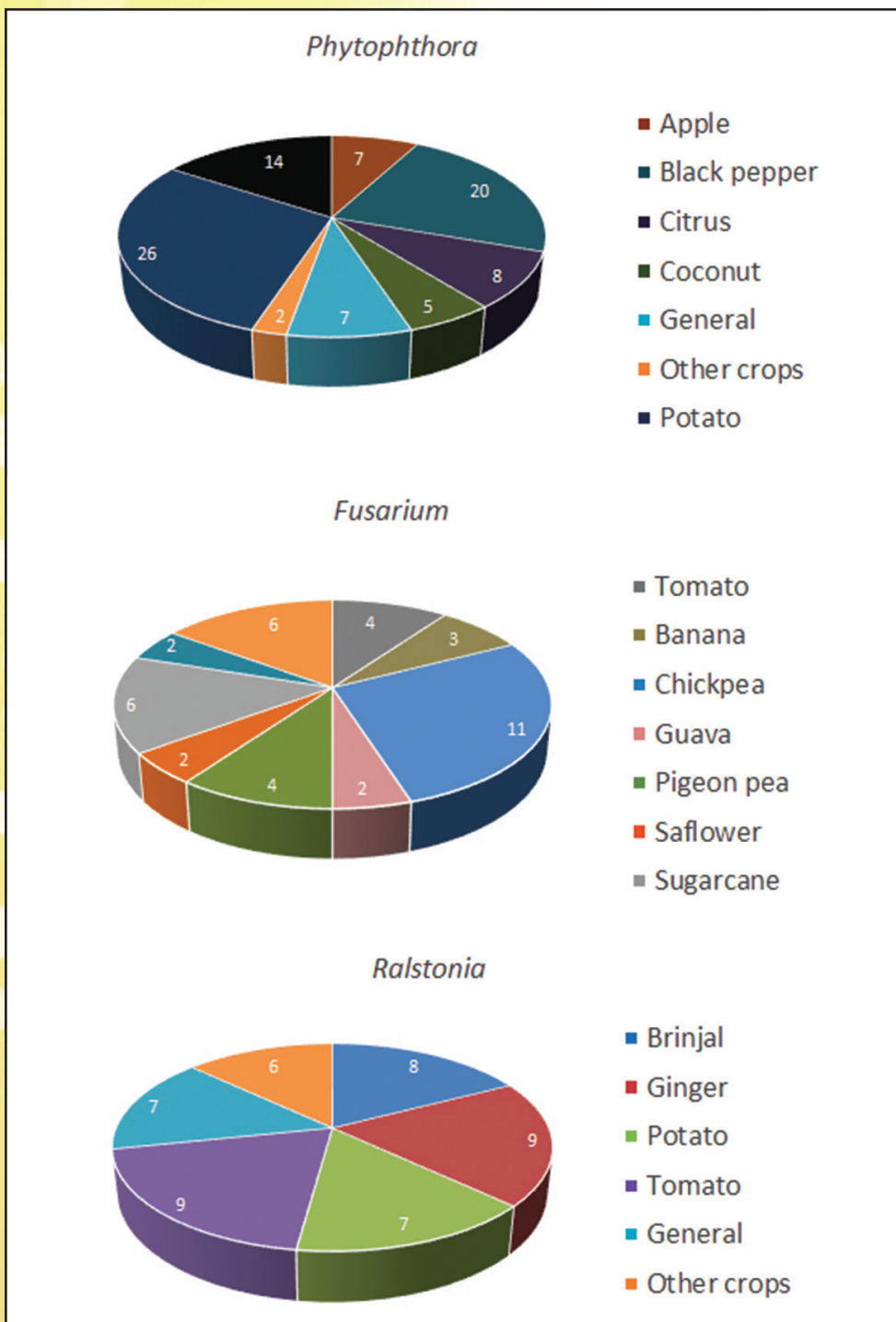


Fig. 1 Crop wise distribution of research papers published in PhytoFuRa Outreach Project.

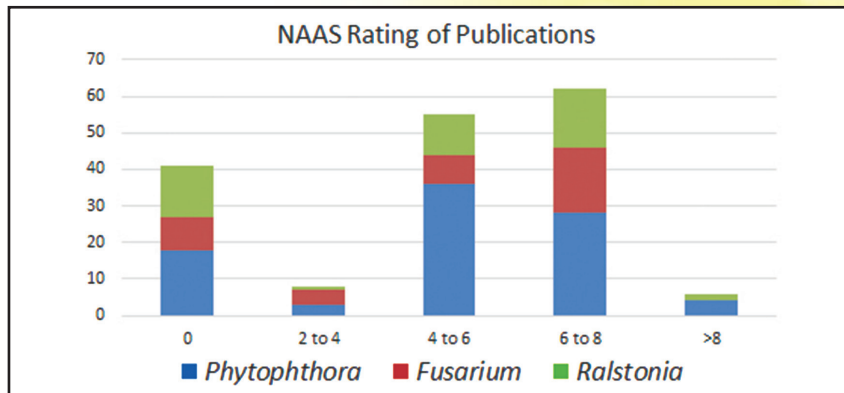


Fig 2a : NAAS rating of research publications from PhytoFuRa Outreach Project

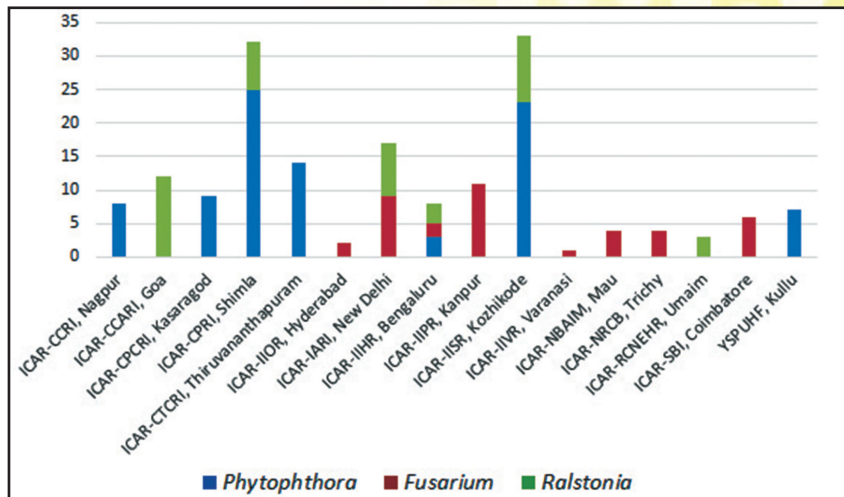


Fig 2b : Institute wise research papers published from PhytoFuRa Outreach Project

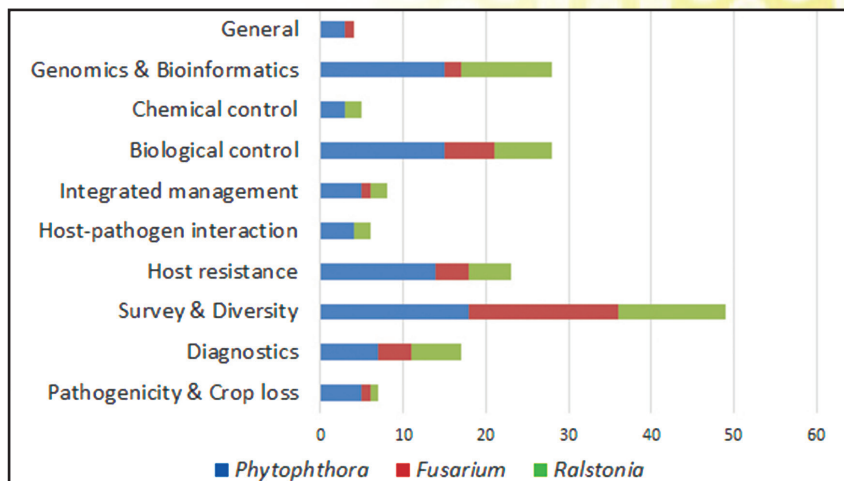


Fig 3 : Distribution of research papers in major theme areas of PhytoFuRa Outreach Project

- 9 Bindu Roy C 2016. Targeting disease resistance loci conferring tolerance to major leaf diseases of rubber tree through QTL mapping using high density genetic linkage map with DArT markers. 38th Annual Conference and National Symposium on Challenges Towards Plant Health Under Changing Climate Scenario for Sustainable Agriculture, 24-26 Nov. 2016, Bidhan Chandra Krishi Viswavidyalaya, Nadia, Kolkata, West Bengal.
- 10 Bindu Roy C 2016. Genomics of *Phytophthora* – host pathogen interaction at the cellular and molecular level. National Workshop on 'Taxonomy, Biodiversity, *Ex situ* Conservation and Application of Fungi', 7 May 2016, Agharkar Research Institute, Pune, Maharashtra.
- 11 Bindu Roy C 2016. Diseases of rubber (*Hevea brasiliensis*) and their management. Advances in Disease management Technologies in Horticultural Crops, 7-8 Dec. 2016, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, HP.
- 12 Bindu Roy C, Bikku B, Anuja S N, Jayasree M and Saha, T 2016. Transgressive segregation for resistance to *Phytophthora* pathogen in an interspecific hybrid population of rubber (*Hevea brasiliensis*). 6th International Conference on Plant, Pathogens and People – Challenges in Plant Pathology to Benefit Humankind, 23-27 Feb. 2016, Indian Phytopathology Society, New Delhi.
- 13 Bindu Roy C, Bikku B, Kilian A, Jayasree M and Saha T 2016. Construction of a high density genetic linkage map using SNP and *silico* DArT markers and QTL mapping for disease resistance in rubber tree (*Hevea brasiliensis*). 22nd Biennial Symposium on Plantation Crops (PLA-CROSYM 22), 15-17 Dec. 2016, ICAR-Central Plantation Crops Research Institute, Kasaragod.
- 14 Chandramohan R 2012. Role of fungicides in the integrated management of coconut diseases occurring in India. Second International Conference on Agrochemicals Protecting Crops, Health and Natural Environment, 15-18 Feb. 2012, ICAR-Indian Agricultural Research Institute, New Delhi.
- 15 Chandramohan R and Prabha K P 2011. Status of cocoa *Phytophthora* in India. *Phytophthora 2011 - International Workshop, Seminar and Exhibition on Phytophthora Diseases of Plantation Crops and Their Management*, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala, India.
- 16 ChandraMohan R, Prabha KP and Sharadraj KM 2014. Coir pith products for plant protection - production technology and disease management. International Conference on Biosciences: State-of-Art Advancements, 11-12 September 2014, Lakesong Resort, Kumarakom, India.
- 17 ChandraMohan R and Sharadraj KM 2011. Climatic factors versus incidence of bud rot diseases of coconut in India. *Phytophthora 2011 - International Workshop, Seminar and Exhibition on Phytophthora Diseases of Plantation Crops and Their Management*, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala, India.
- 18 ChandraMohan R, Merin Babu, Prathibha V Hand Saratbabu 2011. Recent developments in the integrated management of *Phytophthora* diseases of coconut and arecanut. *Phytophthora 2011 - International Workshop, Seminar and Exhibition on Phytophthora Diseases of Plantation Crops and Their Management*, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala, India.
- 19 Cissin J, Bhai RS, Nirmal Babu K and Anandaraj M 2012. Molecular profiling of *Phytophthora* isolates from black pepper using EST-SSR markers. National Symposium on Heading towards Molecular Horizons in Plant Pathology: Host Resistance, Pathogen Dynamics, Diagnostics and Management, 16-17 November 2012, Sugarcane Breeding Institute, Coimbatore.
- 20 Cissin J, Vinitha KB, Suraby EJ, Suseela Bhai R, Nirmal Babu K and Anandaraj M 2011. Genetic diversity analysis of *Phytophthora* isolates from black pepper in India using SSR markers. *Phytophthora 2011 - International Workshop, Seminar and Exhibition on Phytophthora Diseases of Plantation Crops and Their Management*, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala, India.

- 21 Das AK 2010. Development of molecular diagnostics for *Phytophthora* and citrus greening bacterium and their use in quality planting material of citrus production. National Conference on Production of Quality Seeds and Planting Material- Health Management in Horticultural Crops, 11-14 March 2010, NewDelhi.
- 22 Das AK 2011. Diagnostics of other pathogens in citrus: status and requirement. National Consultation- cum- Training on Diagnostics in Horticultural Crops, 16 -17 April 2011, ICAR- Central Potato Research Institute, Shimla, HP.
- 23 Das AK 2011. Citrus *Phytophthora*: Advances in taxonomy, identification and diagnosis. *Phytophthora* 2011 - International Workshop, Seminar and Exhibition on *Phytophthora* Diseases of Plantation Crops and Their Management, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala.
- 24 Das AK 2012. Recent advances in identification and diagnosis of *Phytophthora* spp. with special reference to citrus. National Symposium on Blending Conventional and Modern Plant Pathology for Sustainable Agriculture, 04-06 December 2012, ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka.
- 25 Das AK 2015. Development of highly sensitive molecular diagnostics for *Phytophthora* and greening, two economically important diseases of citrus. 36th Annual Conference & National Symposium on 'Challenges and Management Approaches for Crop Diseases of National Importance – Status and Prospects', 12 – 14 February 2015, Agricultural College and Research Institute, Madurai, Tamil Nadu.
- 26 Das AK 2015. *Phytophthora* diseases of citrus in India. *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 9-12 Sept. 2015, Indian Institute of Horticultural Research, Bangalore.
- 27 Das A K and Anandaraj M 2015. Diversity and management of *Phytophthora* spp. attacking citrus. National Symposium on Sustainable Citrus Production: Way Forward 27-29 Nov. 2015, Indian Society of Citriculture and CCRI, Nagpur, Maharashtra.
- 28 Das AK, Bawage S, Nerkar S and Kumar A 2012. *In vitro* efficacy of *Trichoderma harzianum* against *Phytophthora nicotianae* causing root rot in citrus. National Dialogue on Citrus Improvement, Production and Utilization, ICAR-National Research Centre for Citrus, Nagpur, Maharashtra.
- 29 Das AK, Kumar A, Bawage S and Nerkar S 2011. *In vitro* efficacy of *Trichoderma* spp. isolates against *Phytophthora nicotianae* causing root rot in citrus and their molecular characterization. *Phytophthora* 2011: International Workshop, Seminar and Exhibition on *Phytophthora* Diseases of Plantation Crops and their Management, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala.
- 30 Das AK, Kumar A, Nerkar S and Bawage S 2010. Genetic diversity among isolates of *Phytophthora* spp. causing citrus decline in central India as revealed by DNA sequence analysis of ribosomal ITS region. National Seminar on Citrus Biodiversity for Livelihood and Nutritional Security, 4 -5 October 2010, NRC for Citrus, Nagpur.
- 31 Das AK, Kumar A, Nerkar S and Bawage S 2010. Morphological and cultural diversity of *Phytophthora* spp. causing root rot and gummosis in citrus. National Seminar on Citrus Biodiversity for Livelihood and Nutritional Security, 4 -5 October 2010, NRC for Citrus, Nagpur.
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- 33 Das AK, Kumar A, Nerkar S and Bawage S 2010. Molecular diagnosis and genetic diversity of *Phytophthora* spp. causing root rot and gummosis in citrus. National Symposium on Molecular Approaches for Management of Fungal Diseases of Crop Plants, 27 – 30 December 2010, IIHR, Bangalore.

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- 36 Das AK, Kumar A, Nerkar S and Kadam R 2013. Isolation, characterization and biocontrol potential of NRCfBA-44, a native *Trichoderma harzianum* strain against *Phytophthora* root rot of citrus. National Citrus Meet, 12-13 August 2013, National Research Centre for Citrus, Nagpur, Maharashtra.
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- 42 Eapen SJ, Eldhose A, Balaji S, Vinod TK and Anandaraj M 2015. PhytoWeb: A database for *Phytophthora* diseases of horticultural crops. Third International Symposium on *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 09-12 Sept. 2015, ICAR-IIHR, Bengaluru.
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- 48 Hegde V, Senthil Sankar M, Nath VS, Jeeva ML and Misra RS 2010. Studies on isolation of elicitor and bio-control of *Phytophthora colocasiae* causing leaf blight of taro. National Symposium on Changing Plant Disease Scenario in Relation to Climate Change, 22-23 October 2010, ICAR-Indian Institute of Spices Research, Calicut, Kerala.
- 49 Jeeva ML, Veena SS, Nath VS, Sankar S, Shyni B and Misra RS 2015. *Phytophthora* diseases of cassava and taro. Third International Symposium on *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 9-12 September 2015, ICAR-IIHR, Bengaluru, India.
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- 52 Johnson George K, Vijesh Kumar IP, Neema M, Rosana OB, Eapen SJ and Anandaraj M 2015. Incompatible interactions of *Piper colubrinum* with *Phytophthora capsici*: Insights from gene expression studies. Third International Symposium on *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 09- 12 Sept. 2015, ICAR-IIHR, Bengaluru.
- 53 Kaushik SK, Reena Sharma, Vinay Bhardwaj, Sanjeev Sharma and Singh BP 2012. Stacking of late blight resistance genes in potato using MAS. International Conference on Plant Biotechnology for Food Security: New Frontiers, 21-24 February 2012, National Agricultural Science Centre (NASC), Pusa, New Delhi.
- 54 Khan MA, Singh BP, Kaushik SK and Lal Mehi 2014. Evaluation of antifungal potential extracts against potato pathogens. National Seminar on Emerging Problems of Potato, 1-2 November 2014, Central Potato Research Institute, Shimla, H.P.
- 55 Lakshmi Priya P, Nath VS, Veena SS, Anith, KN, Sreekumar J and Jeeva ML 2016. *Piriformospora indica*, a cultivable endophyte for growth promotion and disease management in taro. National Conference on Tropical Tuber Crops for the Sustenance and Welfare of Tribal Communities, 20-22 October 2016, ISRC and ICAR- Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala.
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- 57 Mehi Lal and Yadav S 2014. Efficacy of fungicides against *Phytophthora infestans* in the era of global climate change. Global Conference on Technological Challenges and Human Resources for Climate Smart Horticulture - Issues and Strategies, May 28-31, 2014, Navsari Agricultural University, Navsari, Gujarat.
- 58 Mehi Lal, Yadav S, Gupta A, Hussain T, Singh BP and Kaushik SK 2016. Diversity analysis of *Phytophthora infestans* population in potato crops from Tarai region of Uttarakhand in India. 6th International Conference on Plant, Pathogens and Peoples Challenges in Plant Pathology to Benefit Humankind, 23-27 Feb. 2016, Indian Phytopathological Society, New Delhi, India.

- 59 Monica C, Rosana OB, Eapen SJ and Anandaraj M 2015. Comparative genomics for identification of orthology and phyletic patterns in *Phytophthora* spp. Third International Symposium on Phytophthora: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 09-12 Sept. 2015, ICAR-IIHR, Bengaluru.
- 60 Nath VS, Hegde VM, Jeeva ML, Misra RS, Veena SS and Raj M 2013. Analysis of genetic diversity in *Phytophthora colocasiae* using AFLP and RAPD markers. International Conference on Tropical Roots and Tubers for Sustainable Livelihood under Changing Agro-climate, 09-12 July 2013, Thiruvananthapuram, Kerala.
- 61 Nath VS, Hegde VM, Jeeva ML, Misra RS, Veena SS and Raj M 2013. Rapid and sensitive detection of *Phytophthora colocasiae* responsible for the taro leaf blight using conventional and real time PCR assay. National Symposium on Pathogenomics for Diagnosis and Management of Plant Diseases, 24-25 October 2013, Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala.
- 62 Nath VS, Hegde VM, Jeeva ML, Misra RS, Veena SS and Raj M 2013. Morpho-cultural and molecular characterization of *Phytophthora colocasiae* infecting taro and identification of genes differentially expressed during infection. National Symposium on Pathogenomics for Diagnosis and Management of Plant Diseases, 24-25 October 2013, Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala.
- 63 Nath VS, SenthilSankar M, Archana PV, Jeeva ML, Vinayaka Hegde and Misra RS 2011. Screening of fungicides on suppression of *Phytophthora colocasiae* causing leaf blight of taro. National Seminar on Climatic Changes and Food Security: Challenges and Opportunities for Tuber Crops, 20-22 January 2011, Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala.
- 64 Nath VS, Senthil Sankar M, Vinayaka Hegde, Jeeva ML, Archana PV and Misra RS 2012. PCR based approach for mining of resistant gene analogues and their use for identification of leaf blight resistant gene in taro. Global Aroid Conference, 23-25 January 2012, Regional Centre, Central Tuber Crops Research Institute, Bubhaneswar, Orissa.
- 65 Nath VS, SenthilSankar M, Vinayaka Hegde, Jeeva ML, Misra RS and Archana PV 2011. Role of *in vitro* micropropagation in management of leaf blight of taro. 23rd Kerala Science Congress, 29-31 January 2011, Centre for Earth Science Studies, Thiruvananthapuram, Kerala.
- 66 Nath VS, Shyni B, Jeeva ML and Veena SS 2016. Novel technologies for mining resistance in tropical tuber crops. National Conference on Tropical Tuber Crops for the Sustenance and Welfare of Tribal Communities, 20-22 October 2016, ICAR-CTCRI, Thiruvananthapuram, Kerala.
- 67 Nath VS, Vinayaka Hegde, Jeeva ML, Senthil Sankar M, Archana PV and Misra RS 2010. Evidence of variability among *Phytophthora colocasiae* isolated from multiple spots of single leaf. National Symposium on Molecular Approaches for Management of Fungal Diseases of Crop Plants, 27-30 December 2010, Indian Institute of Horticulture Research, Bangalore, Karnataka.
- 68 Nidhina K, Sharadraj KM, Shwetha PV, Prathibha VH and Vinayaka Hegde 2014. Exploring the biocontrol potential of *Trichoderma* spp. against *Phytophthora* species infecting plantation crops. National Conference on Sustainability of Coconut, Arecanut and Cocoa Farming - Technological Advances and Way Forward, 25-26 August 2014, Central Plantation Crops Research Institute, Kasaragod, Kerala.
- 69 Prabha KP and ChandraMohan R 2010. Incidence of cocoa diseases in Kerala State and major cocoa growing areas of neighbouring states. 22nd Kerala Science Congress, 28-31 January 2010, Kerala Forest Research Institute, Peechi, Kerala.
- 70 Prabha KP and ChandraMohan R 2010. State of art of *Phytophthora* diseases of cocoa in India. Seminar on Strategies for Enhancing Productivity of Cocoa, 28-29 January 2010, Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka.

- 71 Prabha KP and ChandraMohan R 2011. Evaluation of *Trichoderma harzianum* cake treatment in comparison with fungicides for the management of stem canker of cocoa caused by *Phytophthora palmivora* (Butl.) Butl. *Phytophthora 2011 - International Workshop, Seminar and Exhibition on Phytophthora Diseases of Plantation Crops and Their Management*, 12-17 September 2011, Rubber Research Institute of India, Kottayam, Kerala.
- 72 Prathibha VH, Hegde V, Sharadraj KM, Nidhina K, Rachana KE, Rajesh MK and Chowdappa P 2015. Species specific detection of *Phytophthora* spp. infecting coconut, cocoa and arecanut crops using normal multiplex PCR and HRM analysis. 3rd International Symposium on *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management, 9-12 September 2015, ICAR-IIHR, Bangalore, Karnataka.
- 73 Prathibha VH, Hegde V, Sharadraj KM, Nidhina K, Nagaraja NR and Chaitra M 2015. Identification of sources of resistance against *Phytophthora* in arecanut. 3rd International Symposium on *Phytophthora*: Taxonomy, Genomics, Pathogenicity, Resistance and Disease Management. 9-12 Sept. 2015, ICAR-IIHR, Bangalore, Karnataka, India.
- 74 Prathibha VH, Vinayaka H, Sharadraj KM, Nidhina K and Swetha PV 2014. Efficacy of fungicides and biocontrol agents against *Ganoderma lucidum* infecting coconut. International Symposium on Plantation Crops (PLACROSYM XXI): Converging Technologies for Sustainability, 10-12 December 2014, Gateway Hotel, Kozhikode, Kerala, India.
- 75 Prathibha VH, Sharadraj KM, Nidhina K and Hegde V 2013. Evaluation of fungicides and biocontrol agents against *Phytophthora meadii* causing fruit rot, bud rot and crown rot of arecanut. National Symposium on Pathogenomics for Diagnosis and Management of Plant Diseases, 24- 25 October 2013, Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala.
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- 77 Pravi V, Jeeva ML, Archana PV and Senthil Sankar M 2011. Molecular diagnosis of tuber rot disease of cassava. 23rd Kerala Science Congress, 29-31 January 2011, Centre for Earth Science Studies, Thiruvananthapuram, Kerala.
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Fusarium

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Ralstonia

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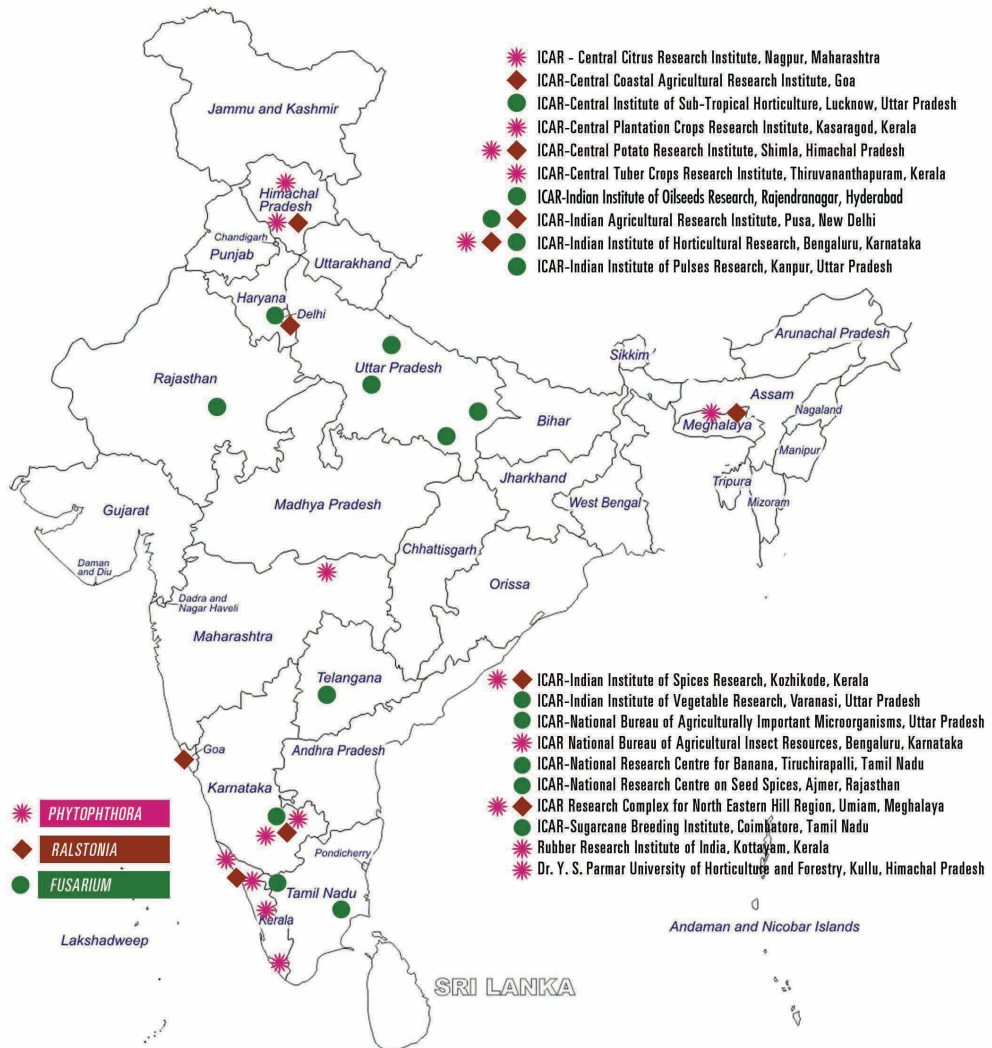
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LIST OF PHYTOFURA CENTRES





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