



SCO-Young Scientist Profile

First Name: SUSHEEL KUMAR

Last Name: SHARMA

**Designation
& affiliation:**

**SCIENTIST
ICAR Research Complex for NEH Region, Manipur
Centre, Lamphelat, Imphal-795004, Manipur, India**

Phone Number: +91-8729974401 / +91-9717876202

E-mail: susheelsharma19@gmail.com



Details of research work carried out in S&T (limit to 200 words)

The main research focus in the field of S & T is in the area of detection, characterization of plant pathogens, development of simplified diagnostics, host-pathogen interactions, development of management modules, new technologies of mushroom cultivation and multidisciplinary research.

A. Detection and characterization of plant pathogens: In the area of detection and characterization of emerging and re-emerging pathogens infecting diverse crops in North East (NE) region of India, the etiological agents of diseases in king chilli, banana, citrus, passion fruit, cucurbits, papaya and rice were characterized. First report of natural host shift of large cardamom chirke virus to chilli and a new potyvirus species associated with yellow mottle and fruit deformation disease of passion fruit are worth mentioning among the numerous new reports of virus and virus-like pathogens.

B. Development of simplified diagnostics for sensitive and robust detection of virus and virus-like pathogens: The development of simplified isothermal detection assays (mainly recombinase polymerase amplification assay) for simplified and robust detection of virus and virus-like pathogens (citrus huanglongbing-associated *Candidatus Liberibacter asiaticus*, citrus tristeza virus, chilli veinal mottle virus, cucumber mosaic virus, passion fruit potyvirus) were successfully accomplished. A simplified multiplex-PCR assay for simultaneous detection of six chilli viruses was developed and validated using large number of field samples. All these are first reports globally to develop and utilize simplified RPA assays and multiplex assays. A sensitive double-antibody sandwich-ELISA (DAS-ELISA) based detection kit was developed for the newly identified potyvirus associated with yellow mottle and fruit deformation disease.

C. Deciphering the host-pathogen interactions: Work on understanding the host-pathogen interactions (rice-*Magnaporthe oryzae*, banana-banana streak MY virus) and use of CRISPR-Cas9 in management of endogenous activable banana streak viruses was accomplished. Small RNA (sRNA) based defense leading to resistance and tolerance in seedy diploid banana of NE India was deciphered. RNAseq analysis identified the novel pathways involving DREB genes, SWEET4 gene and auxin-responsive IAA4 gene and altered membrane proteins in seedy diploid banana exhibiting tolerance to BSMYV. This explains the possible underlying mechanism of delayed BSMYV infection in Bhimkol (BB) compared to susceptible (AAA).

D. Plant disease management: CRISPR-Cas9 mediated targeted mutations in the activable banana streak viruses-like sequences present in *Musa balbisiana* genome have been

undertaken. In addition, an ecological engineering based management module for viral diseases of king chilli and management module for false smut of rice was developed and validated under farmers field.

E. New technologies in mushroom cultivation: A location specific short duration cultivation technology for shiitake mushroom was developed and popularized in the Manipur state in collaboration with state department of Horticulture. This technology has been taken up by many young agripreneurs and could realize higher economic benefits.

F. Multidisciplinary research: As Plant Pathologist in multidisciplinary research, the contribution as co-developer in development of rice variety, RC Maniphou-13, transformation of chicken feather waste to protein hydrolysate using *Chryseobacterium sediminis*, development and popularization of integrated farming system models in hilly terrain of Manipur was made.

Associated SCO-YSC Theme: Agriculture and Food Processing

Statement of Innovation (*Brief information on new innovative ideas including startup / entrepreneurs- limit to 150 words*)

The brief account of innovative ideas conceived and applied in the field of S&T are as below:

Availability of simplified, sensitive, robust and suitable diagnostic which can be applied for on-site detection is a major challenge for emerging and re-emerging plant pathogens. In the view of which, innovative and new methods of isothermal nucleic acid based detection (recombinase polymerase amplification: RPA) were developed for the major challenging plant pathogens (citrus huanglongbing-associated *Candidatus Liberibacter asiaticus*, citrus tristeza virus, chilli veinal mottle virus, cucumber mosaic virus, passion fruit potyvirus). These isothermal diagnostics have advantage of using crude plant sap as template, instead of purified nucleic acid (DNA and RNA) and reaction can be completed at an isothermal temperature of 37 °C in 20-30 minutes. The reaction set up do not require any sophisticated lab set up and can be employed as on-site detection without compromising the sensitivity. The developed RPA assays in addition to being the simple and robust were also cost effective. The testing cost per sample in case of RPA assay was Rs. 214 as compared to Rs. 460 in case of benchmark PCR. Further as an innovative and cost effective method of virus detection, a multiplex-PCR assay was developed for simultaneous detection of six viruses infecting chilli. This assay had reduced the detection cost and time involved to 1/6th compared to routine PCR assays.

New innovative tools to decipher the host-pathogens interactions in case of banana-BSMYV were employed. The role of small RNA based pathways and defense pathways in conferring resistance to diploid seedy banana (*Musa balbisiana*: BB) against BSMYV was elucidated. These are the novel pathways involved in conferring virus resistance.

In the area of plant disease management, an innovative approach employing CRISPR-Cas9 mediated gene editing to mutate the activable endogenous BSV sequences in *Musa balbisiana* (BB) was employed. This innovative study aims at developing *Musa balbisiana* (BB) banana mutants devoid of activable endogenous BSVs. These can successfully be used a parent in genetic hybridization programme of banana. In addition by engineering the ecology of king chilli cultivation by targeting the aphids which act as carrier of viruses, an ecological engineering based field management module was developed.

A short duration, innovative shiitake mushroom cultivation technology was developed and demonstrated as an avenue of agripreneurship development.

Shanghai Cooperation Organization- 1st Young Scientists Conclave (SCO-YSC 2020)
A virtual event organised in India at CSIR-IICT, Hyderabad
Theme: Shaping SCO-STI Partnership: Young Scientists Perspectives

Major awards/ Achievements (*Upto 3 awards*)

- ISCA Young Scientist Award in the section of Agricultural and Forestry Sciences (year: 2018-2019)
- ‘Fakhruddin Ali Ahmed Award’ for Outstanding Research in Tribal Farming Systems-2017 from ICAR, New Delhi (as Associate) (year: 2017)
- ‘Dr. D. N. Borthakur Award’ for Outstanding Research in Hill Farming System for the Biennium 2017-2018 from ICAR-Research Complex for NEH Region (year: 2017-18)
- ‘Best Scientist of Institute Award-2016’ from ICAR-Research Complex for NEH Region (year: 2016)
- Prof. M. J. Narasimhan Academic Merit Medal Award from Indian Phytopathological Society (IPS), New Delhi (Year: 2015)
- IARI-Best Student Merit Medal Award for overall outstanding academic performance in the PhD programme from ICAR-IARI, New Delhi (Year: 2015)

Possible collaboration with SCO countries (*limit to 100 words*)

The possible collaboration with SCO countries

- Development of simplified on-site diagnostics for major emerging and re-emerging plant pathogens (especially plant viruses) and their application in large scale indexing and screening
- Understanding the host-pathogen interactions using next-generation sequencing tools (small RNA sequencing and RNAseq analysis)
- Use of CRISPR-Cas9 in management of plant diseases (by targeting susceptibility factors or proviral factors)

Key words (*relevant to research work conducted as well as proposed innovation, 5-6 words*)

Molecular Plant Virology, Plant-host virus interactions, Virome, Isothermal nucleic-acid based detection, RNAseq analysis, Small RNA based defense