Science Setu Webinars by NIPGR

Harnessing plant associated microbes for sustainable agriculture

Press- Note

Date: 25-06-2021, Friday

Resource person: Dr. Gopaljee Jha, Scientist IV, NIPGR

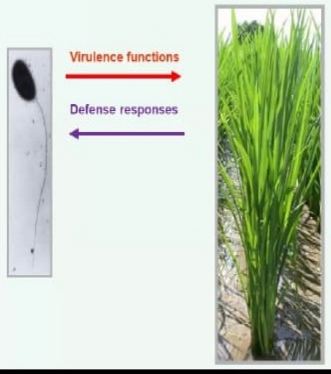
The Department of Biotechnology, Government of India, has planned "Science Setu" as a virtual platform to connect research Institutes with undergraduate students. Under this, our college has been assigned to National Institute of Plant Genome Research (NIPGR), New Delhi. NIPGR is an autonomous institution aided by the Department of Biotechnology. Research at NIPGR focuses on functional, structural, evolutionary and applied genomics of plants, including crop plants. Through the Science Setu program, our students and faculty virtually connect with NIPGR, New Delhi and got to know about the multifarious kinds of plant based research. It is a unique opportunity for science students at undergraduate and postgraduate level to get an exposure to high-level research.

Dr. Pinky Aggarwal, Scientist, NIPGR gave welcome note on this event. **Resource person: Dr.GopaljeeJha, Scientist IV, NIPGR** started his lecture by enlightening our knowledge on the concept of plant microbe interactions resulting into disease induction in host tissues. He discussed about the importance of research providing novel insights for disease control.He talked about the rice plant defense mechanism upon perception of T2SS effector molecules. He stressed on the absence of R-genes against various pathogens. He discussed about the concept of using a bacteria to feed on fungi. He focused on the plant microbiome to understand the plant microbe complex interaction. He also discussed about the discovery of microscope and encouraged budding scientists to study microbiome interaction with the help of affordable foldoscope. He also talked about the different beneficial microbe cultured in lab. He concluded his lecture by discussing about the Synthetic community (SynCom) of beneficial microbes and the consortium for promoting plant defense against diseases. Faculty of Science and total 60 science students attended the event. Dr. Pinky Agarwal and Dr. Amarjeet Singh, Scientists, NIPGR attended the questions of the participants and gave vote of thanks. It was an intellectual and exciting experience for all the participants.

- Importance of plant diseases
- How basic research is providing novel insights for disease control
- Relevance of plant associated microbes (microbiome)
- Harnessing microbes for sustainable agriculture

- Although we produce enough food but still ~800 million go hungry
- We are expected to produce 60 percent more food by 2050

Attack and defense is pivotal in plant-pathogen interactions



Type 2 secretion system (T2SS) is required for virulence of Xoo

1 = wild type
2 = T2SS⁻ mutant
3 = mutant + complementing clone

T2SS of Xoo secretes various cell wall degrading enzymes:

- Cellulase
- Cellobiosidase
- Lipase/Esterase

Xoo utilizes these enzymes to establish disease in rice

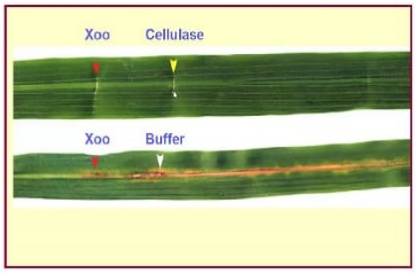
Rice mounts strong defense response upon perception of the T2SS effectors

Browning is due to plant defense response

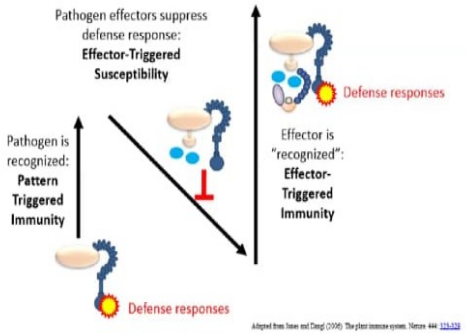
Rice mounts strong defense response upon perception of the T2SS effectors

Browning is due to plant defense response

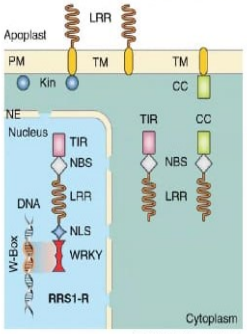
The pre-treatment with T2SS effector induces resistance to subsequent infection by Xoo



The zig-zag model of plant – pathogen interactions

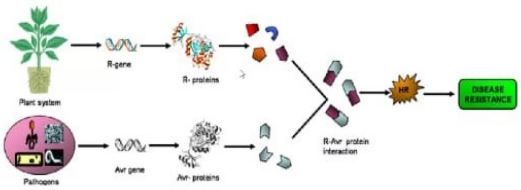


Plants have different types of disease resistance (R) genes



TRENDS in Plant Science

R-protein directly or indirectly recognizes pathogenic effector (avr protein) and provides disease resistance



One or more *R*-genes are deployed in conventional breeding programs to impart disease resistance

A collaborative effort of CSIR-CCMB and ICAR-IIRR

Challenges

- Pathogens can breach *R*-genes and render them ineffective
- *R*-genes are not available against many of the pathogens

Sheath Blight: A serious rice disease

Caused by a fungal pathogen *Rhizoctonia solani*

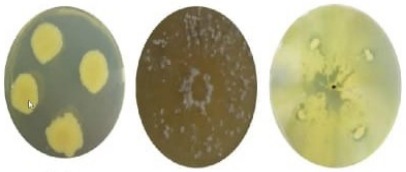
Severe yield losses (can go upto 70%)

No rice variety is resistant to the disease

Our lab has been exploring multipronged approach to impart sheath blight disease tolerance in rice

Identified a novel fungal eating bacterium, *Burkholderia gladioli* strain NGJ1 from rice

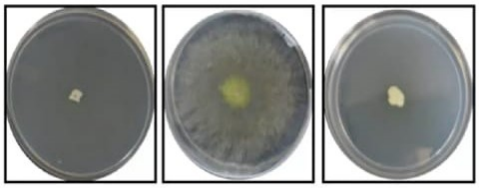
Burkholderia gladioli strain NGJ1 demonstrates mycophagous property



NGJ1 (Bacteria) | *R. solani* (fungi) | NGJ1 + *R. solani* (bacteria feeding on fungi)

Swain et al. 2017; Nature communications

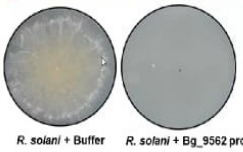
NGJ1 deploys a prophage-tail like protein to feed on fungi



Wild type | Mutant | Complement

Swain et al. 2017; Nature communications

Treatment with purified Bg_9562 protein prevents the growth of *R. solani* on laboratory media



R. solani + Buffer *R. solani* + Bg_9562 protein

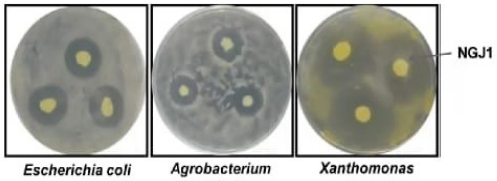
Bg_9562 protein has broad spectrum antifungal activity

Patent protected

The Bg_9562 protein treatment is effective in controlling sheath blight disease in rice

R. solani *R. solani* + Bg_9562 protein

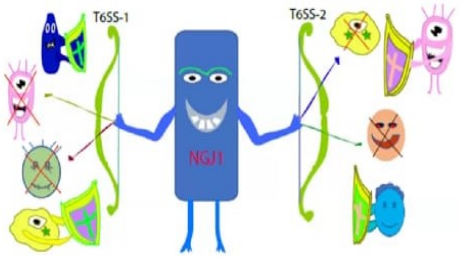
NGJ1 demonstrates strong antibacterial activity



Escherichia coli *Agrobacterium tumefaciens* *Xanthomonas oryzae*

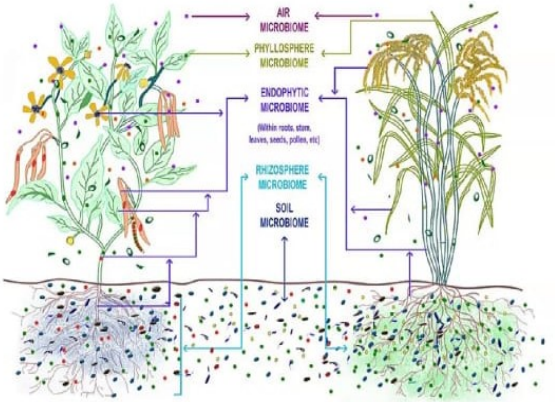
NGJ1 inhibits the growth of a large number of co-habiting bacteria

The NGJ1 deploys different antibacterial toxins to kill co-habiting bacteria

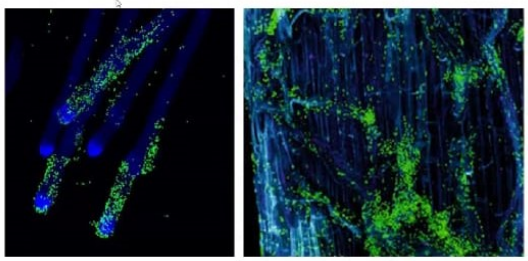


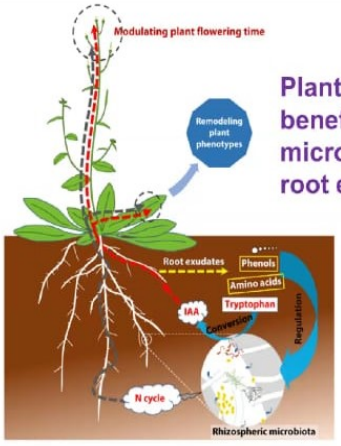
Yadav et al. 2021; EMBO reports

Plant microbiome

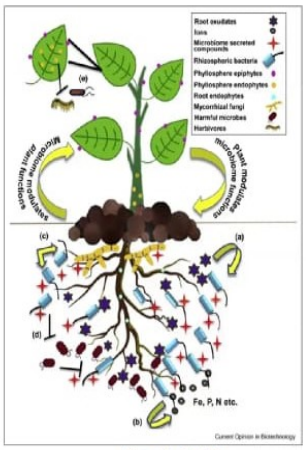


Holobiont: Plant and microbes together regulate the growth and development of plants





Plant recruits beneficial microbes through root exudates



Das et al. 2021

Complex interaction shapes the dynamics of microbiome

Microbiome influences plant functions

How to visualize and study microbes

Antonie van Leeuwenhoek
(Father of microbiology)

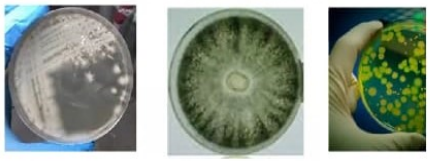
Microscope

Foldoscope

Electron microscope

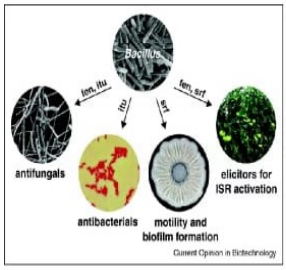
Culturable microbes

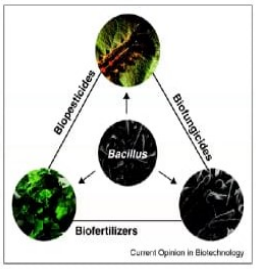
Beneficial microbes



Bacillus *Trichoderma* *Pseudomonas*

Prospecting microbes for sustainable agriculture





Perez-Garcia et al. 2011

Synthetic community (SynCom) of beneficial microbes for sustainable agriculture

Consortium of beneficial microbes are used for promoting plant growth and protection against diseases

Control SynCom treated

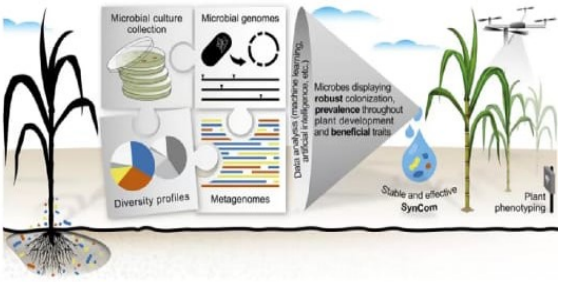
Un-culturable microbes

- They are enriched in various bioactive compounds such as antimicrobials, secondary metabolites, industrially important enzymes, etc
- Efforts are being made to identify novel bioactive molecules and upscale their production

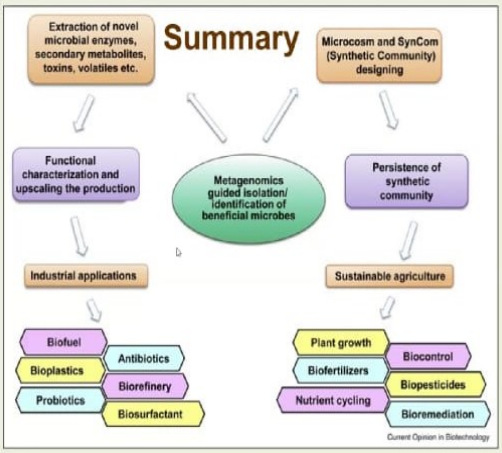
Road ahead....

- With advancement of DNA sequencing technology, it is possible to assemble the microbial genomes that are associated with the plants
- Genome guided identification of beneficial microbes enriched in bioactive compound
- Prediction of synergistic and antagonistic interactions between microbes

Designing SynCom for climate resilience agriculture



Summary



Acknowledgement

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