

## **NINETEENTH SCIENCE SETU WEBINAR BY NIPGR**

**“Targeting Roots for Future Agriculture”**

**Press Note**

**Date: 10<sup>th</sup> December, 2021, Friday**

**Resource person: Dr. Jitender Giri, Scientist V, NIPGR**

The Department of Biotechnology, Government of India, had planned “Science Setu Webinar” as a virtual platform to connect the Research Institutes with postgraduate and graduate 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 focusing on functional, structural, evolutionary and applied genomics of plants, including crop plants. In celebration of **Azadi ka Amrit Mahotsav to Commemorate 75 years of Independence**, DBT-NIPGR has been organizing Science Setu Webinar Series 2021-2022. Through this webinar program, our students and faculty members virtually gained an amazing opportunity to connect with NIPGR, New Delhi and anticipated the effects of combined stresses of environmental factors on plant life. It was a spectacular opportunity for students at undergraduate and postgraduate level of science background on exposure to plant-based research on much higher level.

**Dr. Amarjeet Singh**, Scientist, NIPGR gracefully introduced the resource person with his warm words. The resource person, **Dr. Jitender Giri**, Scientist V, NIPGR, opened his lecture with the introduction of problems with current agriculture in the context of sustainability. He discussed about the current agriculture, which uses modern high yielding crop varieties, which are highly input-intensive. He explained why future agriculture should be less input-efficient, i.e. crop production with less application of chemical fertilizers. He discussed the importance of roots and his work on the role of secretory acid phosphatases in crop production, improving root architecture and functions in rice. He explained how auxin-binding protein OsRMD regulated the mechanistic details of limited root growth regulation in response to low external phosphorus. He demonstrated the role of auxin biosynthesis, transport and signaling in regulating root hair length in response to low external phosphorus. At the end of his lecture, he concluded that the plants with improved roots can help achieve sustainable agriculture and then he acknowledged his team. In total 41 participants, including faculty of science and students attended the event. Dr. Pinky Agarwal, Scientist, NIPGR attended the questions of the participants and gave vote of thanks. It was a quite exciting and brainstorming experience for everyone.



3:15



Webex



- Problems with current agriculture in the context of sustainability
- The importance of roots
- Technological advancements made in root phenotyping
- Examples of how roots can be manipulated for crop production in poor soils (minimum water and fertilisers inputs)



Jitender Giri



## Green revolution varieties were short and lodging resistance



One of the most significant accomplishments of 20<sup>th</sup> century science was the development of semi-dwarf grain varieties which are deficient in GA synthesis or response



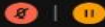
Distinguished plant breeder [Norman Borlaug](#) was awarded Noble peace prize

*"form of agriculture that Borlaug preaches may have prevented a billion deaths."*

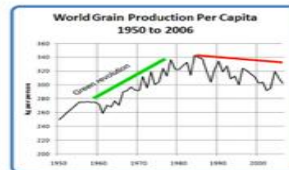


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### Green Revolution: Dwarf varieties; irrigation, chemical fertilisers and mechanized agriculture



Speaking: Jitender Giri

3:18

3:19

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### Phosphate mining



Phosphorite, or rock phosphate: the phosphate content of phosphorite is ~15 to 20%

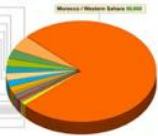


### Phosphorus Crisis

- Phosphorus is key ingredient of life: part of DNA, RNA, ATP & membrane
- Globally phosphate is a limiting nutrient in plant growth: Low availability in natural soils (rarely  $\geq 10\mu\text{M}$ )
- Interaction with soil means up to 80% of P can be unavailable to the plant: roots can absorb only inorganic P (Pi).
- Limited resource – finite amounts of phosphate for fertiliser: Peak phosphorus production estimated for 2070: Phosphorus availability is "the gravest natural resource shortage you've never heard of" New York Times.

World Phosphate Rock Reserves 65,000 million tonnes\*

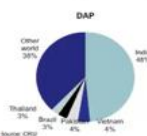
Country	Reserves (Million tonnes)
China	1,200
Morocco	1,100
USA	1,000
Algeria	1,000
Madagascar	1,000
Belgium	1,000
Yemen	1,000
Spain	1,000
Other	1,000



World P-mining: 191 mt per year

India's total P reserves: ~200 mt

India's share in global P import



P-fertilisers supply = food security



Meeting is in progress...

Meeting Info

Dr. Sandeep Singh (Me) | Jitender Giri | Amarjeet Singh | anju chhibbar | chitra bhatia | Ayushi Tiwari

Viewing Jitender Giri's application

### Bengaluru: Bellandur Lake Fire

Participants (41)

- DS Dr. Sandeep Singh (Me)
- NIPGR BIC (Host)
- JG Jitender Giri
- AS Amarjeet Singh
- AC anju chhibbar
- AT Ayushi Tiwari
- CB chitra bhatia
- DB Debjani Basu
- DK Dr. sandeep Kaur
- DC Dr. Subhra Chakr...
- DM Dr. Jayant Meshram
- GG Gagan Gupta

Unmute | Start video | Share | Participants | Chat

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3:25

Webex

### Roots played a greater role in plants evolution and distribution on earth

A

B

C

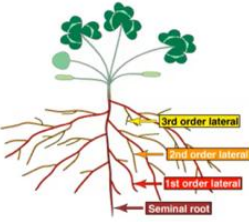
Roots are becoming thinner!!!

Biome	n
Desert	20
Grassland	81
Mediterranean	14
Boreal	12
Temperate	14
Subtropical	13
Tropical	48


- Early land plants had aerial axes, bifurcated but without leaves
- Root like structures "Rhizoids" originated about 400 million years ago
- Later, roots defined the plant distribution in highly competitive ecosystem

Kerrick et al., 2014 Plant Physiol.; Ma et al., 2018 Nature


# Roots



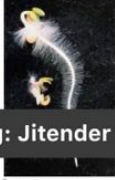
Shallow root




Deep root




Root hairs




Root hairs



Storage roots



Breathing roots (aerial)

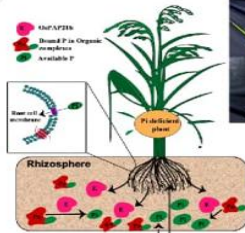



Speaking: Jitender Giri

15:45


Webex

**OsPAP21b** improved plant growth on organic phosphate

- Degradation of biomaterial is slow
- Plants mostly depends on fungi for release of P from decaying biomass
- Reliance on fungi is an ancient strategy

Mehra et al., 2017 Plant Biotechnol J



Jitender Giri





The meeting is unlocked.



### OsRSM1 improved root driven plant growth in P poor soil

**OsRSM1 - Rice Root System Modulator 1**

Lateral roots      Root hair

WT   OsRSM1   WT   OsRSM1

Roots at the bottom of pipes (60-d-old)

High P		Low P	
WT	OsRSM1	WT	OsRSM1
WT	OsRSM1	WT	OsRSM1
WT	OsRSM1	WT	OsRSM1

P levels: 2300 PPM, 4200 PPM

WT OsRSM1      WT OsRSM1

Rich soil      P-poor soil

### ARFCL

A mechanistic framework for auxin dependent Arabidopsis root hair elongation to low external phosphate

Low P →

- Low P responsive root hair elongation needs concerted activities of auxin biosynthesis, transport and response components.
- Disruption of any of these pathways attenuates root hair response to low P
- RSL genes encode bHLH transcription factors



Jitender Giri

Jitender Giri





Jitender Giri is sharing.

This meeting is being recorded.



### Acknowledgements

#### Funding:-



Department of Biotechnology,  
Ministry of Science and Technology  
New Delhi India



National Institute of Plant Genome  
Research, New Delhi India

#### Researchers:-

Dr. Bipin K. Pandey; Dr. Poonam  
Mehra; Dr. Balaji M; Ajji Singh;  
Lokesh Verma; Jyoti; Poonam  
Panchal; Pawandeep S. Kohli; Rumi;  
Kanika

#### Collaborators:

- Prof. M.J. Bennett; UoN, UK
- Prof. Dabing Zhang; SU, China
- Dr. Ranjan Swarup; UoN, UK
- Prof. Jonathan Lynch; PSU, USA
- Dr. R.N. Sundaram, IIRR, India



Jitender Giri



3:14 35

< Chat with everyone

**P** palak 3:13 pm  
Priya, bsc med sem 3, [215303](#)  
kmv jalandhar

**KR** Kamni Rajput 3:13 pm  
kamni bsc med sem 3  
([215314](#))  
Kmv jalandhar

3:14 pm

**Deepika sharma**  
MSc botany  
kmv Jalandhar  
[2110001](#)

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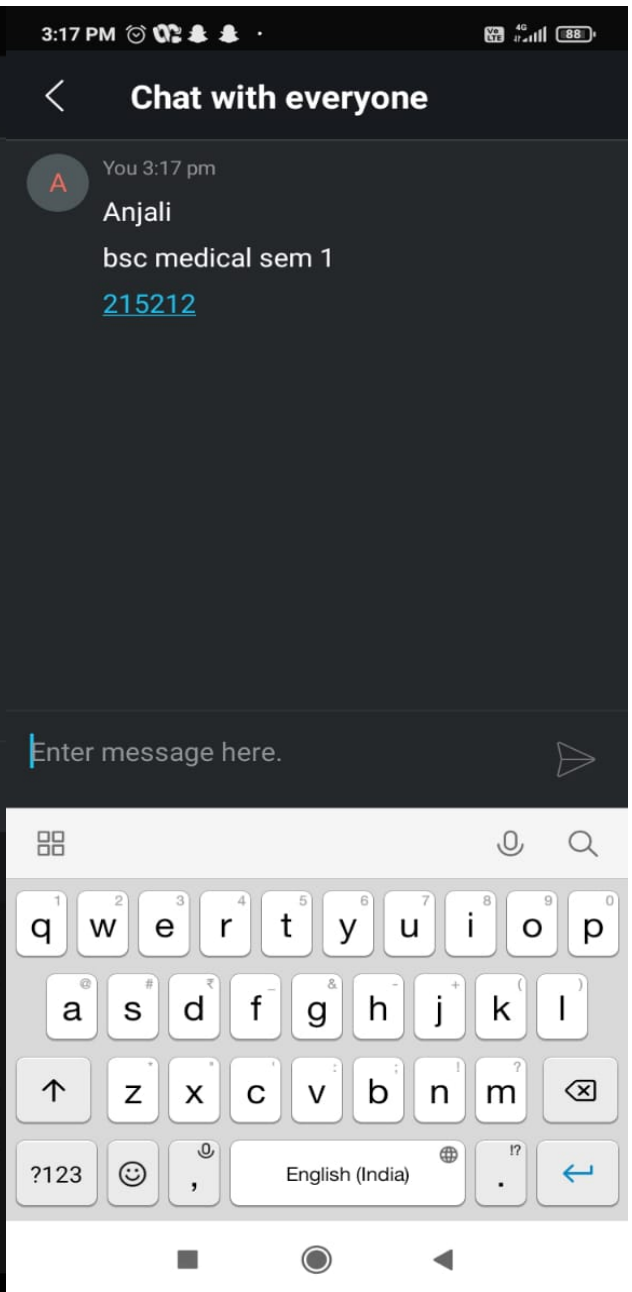
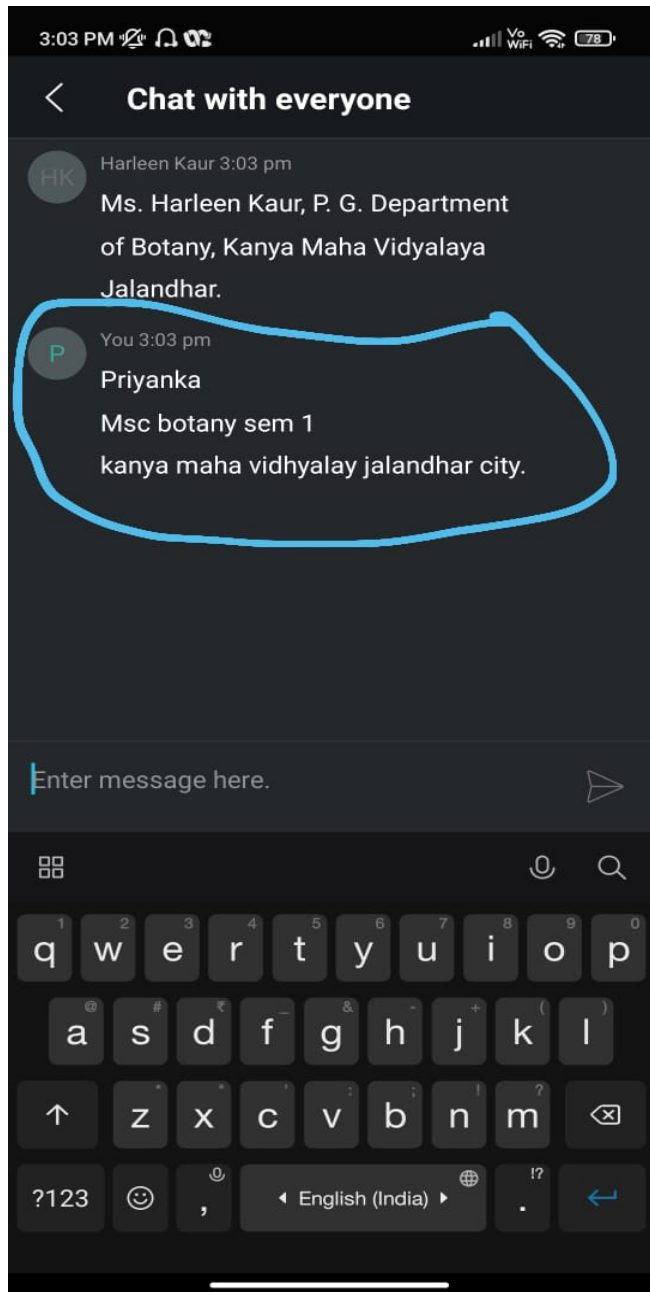
< Chat with everyone

**SK** Shruti Kalia 3:12 pm  
Shruti Kalia  
Kanya Maha Vidhyalaya  
Bsc. medical semester 3  
Jalandhar

**PY** Pragati yadav 3:12 pm  
Pragati yadav (Meerut college,  
Meerut)

**SS** You 3:12 pm  
MEHAK  
MSC BOTANY SEM I  
KMV JALANDHAR

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### Attendance list of Students

Roll No.	Class	Name
215212	B.Sc. Med Sem-1	Anjali
215303	B.Sc. Med Sem-3	Priya
215310	B.Sc. Med Sem-3	Shruti Kalia
215314	B.Sc. Med Sem-3	Kamni
2110001	M.Sc. Botany Sem-1	Deepika
2110007	M.Sc. Botany Sem-1	Priyanka
2110008	M.Sc. Botany Sem-1	Saba Salariya
2110009	M.Sc. Botany Sem-1	Mehak