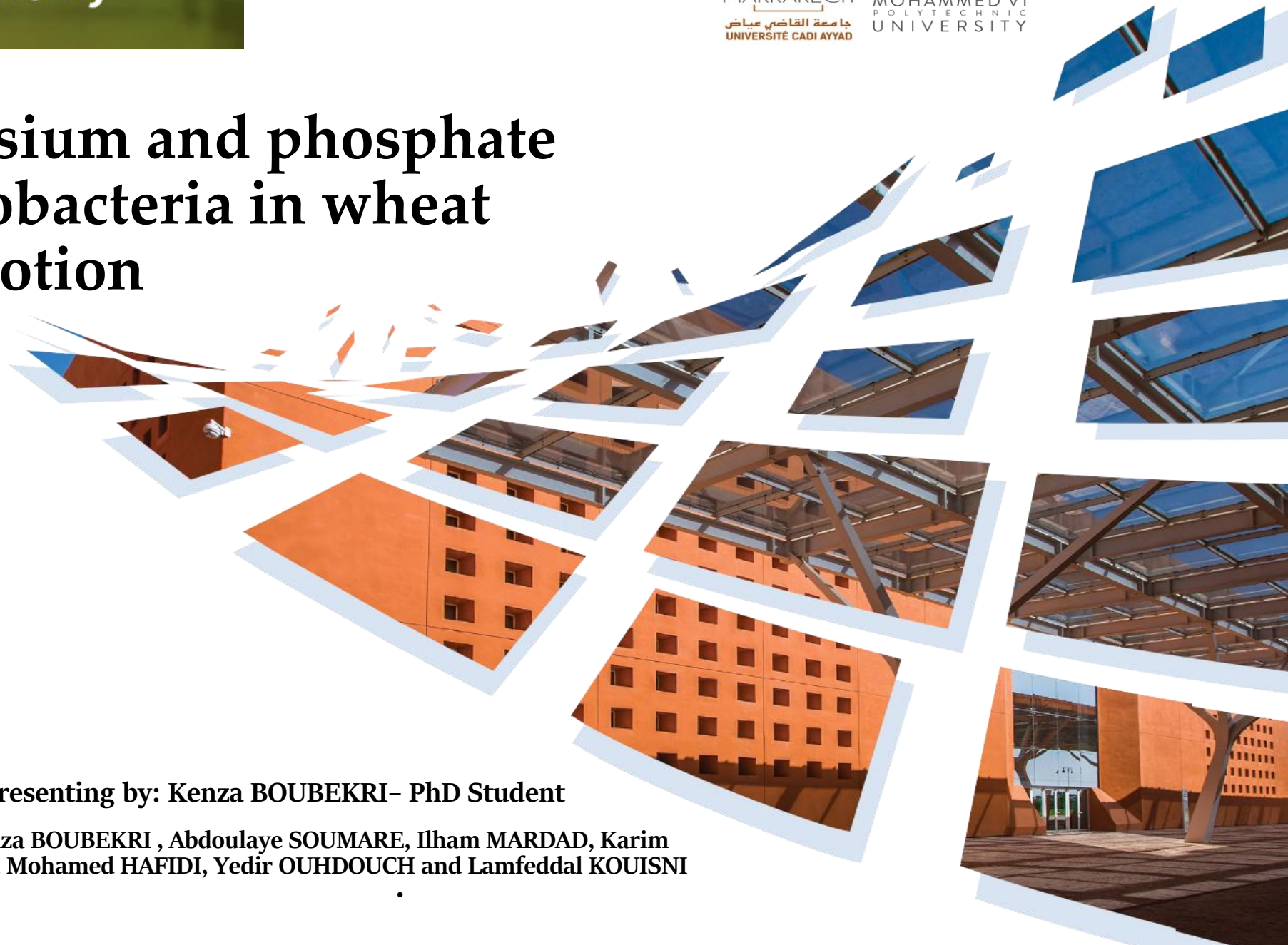
IECAG 2021 The 1st International Electronic Conference on Agronomy
03–17 MAY 2021 | ONLINE

Efficiency of potassium and phosphate solubilizing Actinobacteria in wheat plant growth promotion



جامعة محمد السادس متعددة التخصصات التقنية
MOHAMMED VI POLYTECHNIC UNIVERSITY
UNIVERSITÉ MOHAMMED VI POLYTECHNIQUE

Presenting by: Kenza BOUBEKRI– PhD Student

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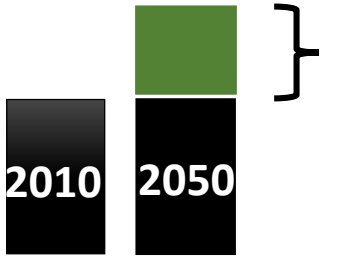
HOW TO SUSTAINABLY FEED A GROWING POPULATION ?

We will need



56 % more food

To feed nearly 10 B people in 2050

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The Desert Rock That Feeds the World

Rock phosphate

Phosphate solubilizing microorganisms

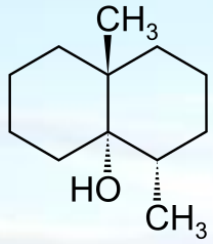
Feed the soil to feed people

WHY ACTINOBACTERIA ?

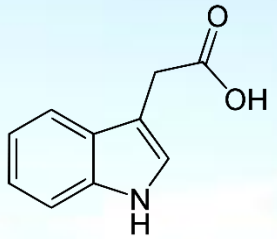
Well adapted for the agronomic application

Plant Growth promoting Traits

Geosmin



AIA production



Actinobacteria

- Phosphate solubilization
- Potassium solubilization
- Play an important role in nutrient cycling

Biocontrol agents

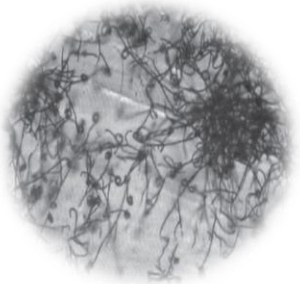
Spore production ➔ Survive in extreme environments

Antibiotic production

Objectives

- 9 Actinobacteria strains isolated from desert soils
- Abilities to solubilize potassium rock as well as 6 different rock phosphates qualities
- Abilities to promote plant growth
- Beneficial effect of Actinobacteria inoculation on wheat plant growth in greenhouse conditions

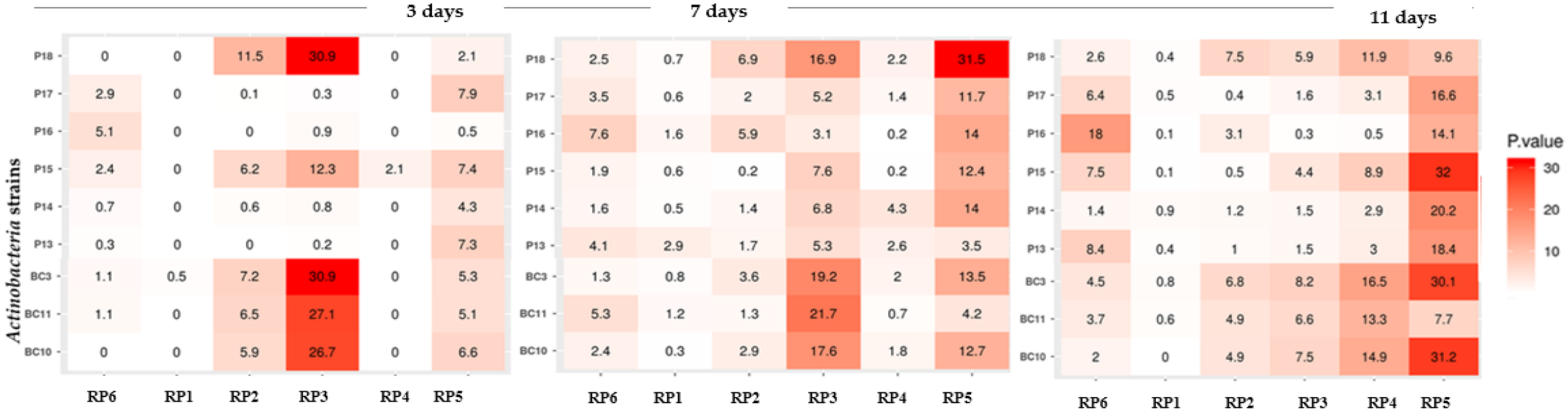
Strain's code	% Sequence identities	Actinobacteria strains
P13	99 %	*Streptomyces fulvissimus*
P14	99 %	*Streptomyces youssoufiensis*
P15	99 %	*Streptomyces microflavus*
P16	99 %	*Streptomyces anulatus*
P17	99 %	*Streptomyces pratensis*
P18	99 %	*Streptomyces alboviridis*
BC3	100 %	*Streptomyces griseorubens*
BC10	99 %	*Streptomyces griseorubens*
BC11	100 %	*Nocardiopsis alba*

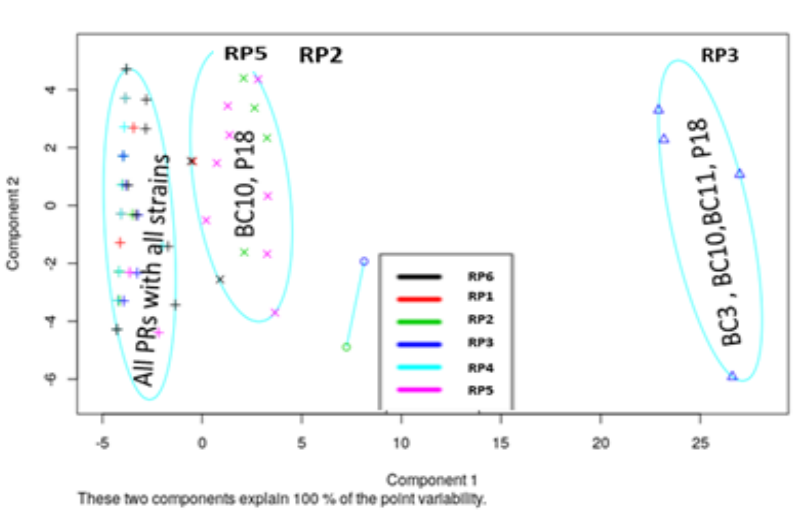


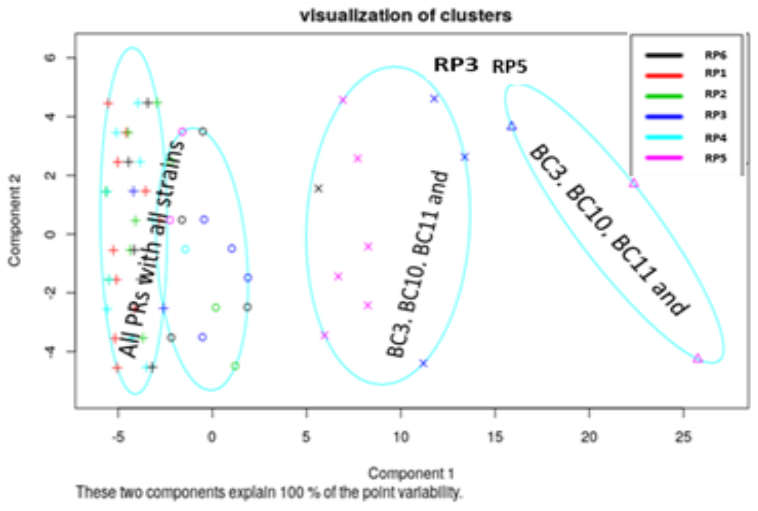
Abilities of Actinobacteria strains to solubilize 6 rock phosphate qualities

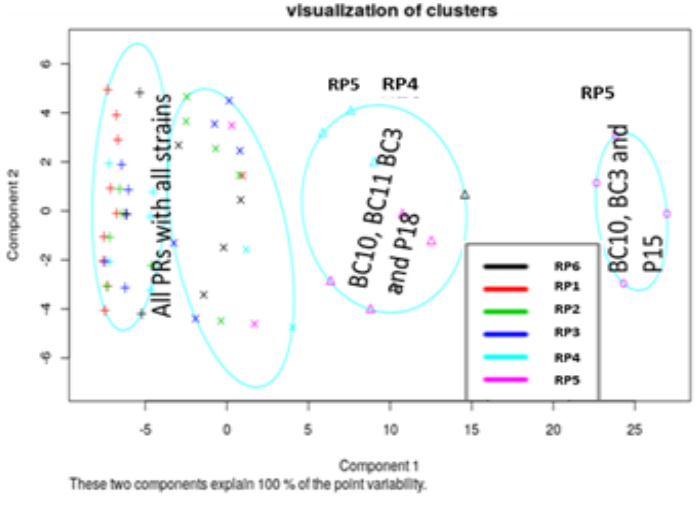
- Maximum solubilizing capacity after 11 days
- Rock phosphates solubilization by Actinobacteria strains ranged from 0.1 to 32 mg /L

- P18 – BC3 – BC10 and BC11 : Most performing strains
- Broad RP solubilization spectrum
- RP5 is the best RP in term of solubilization

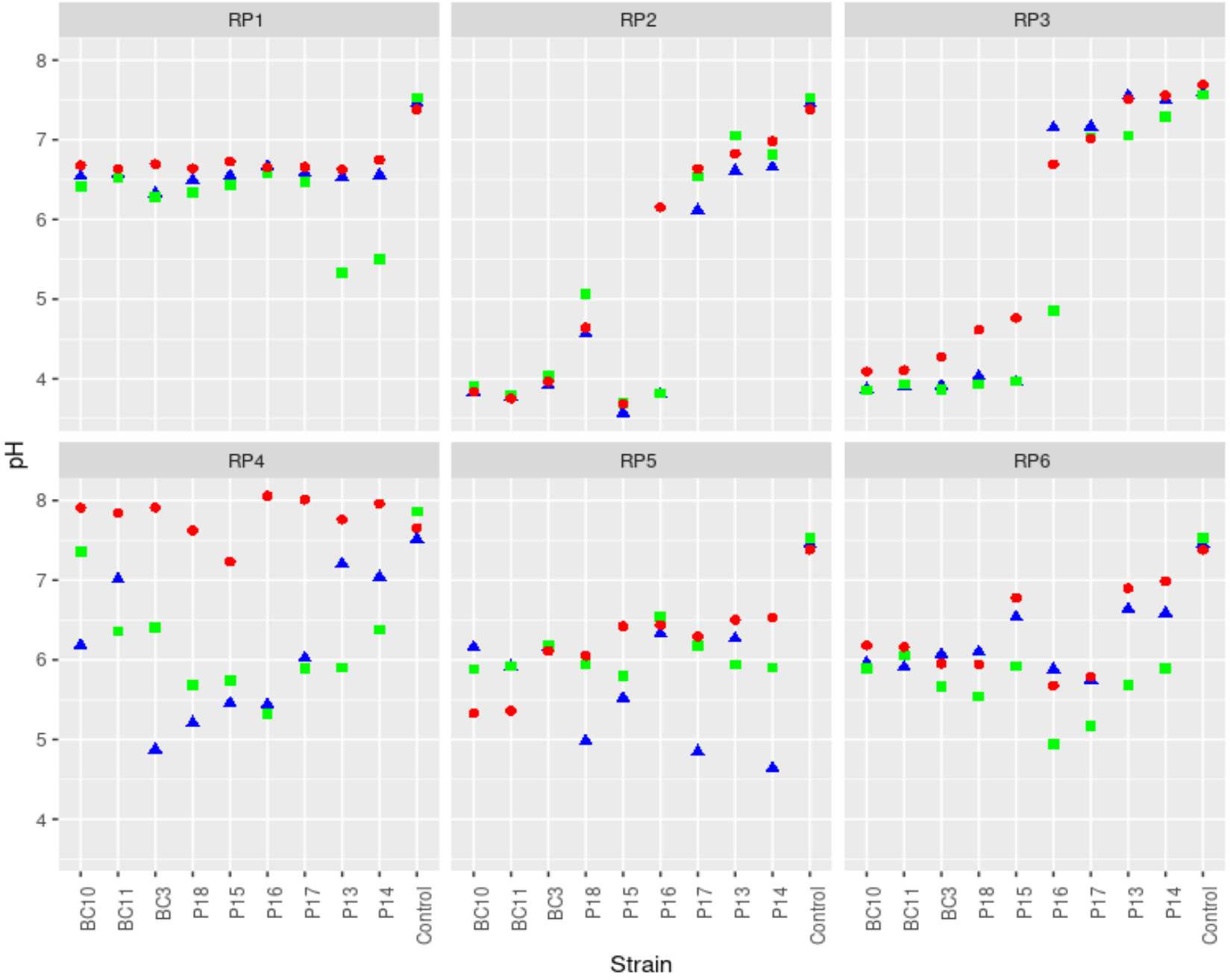








pH variation along with RP solubilization

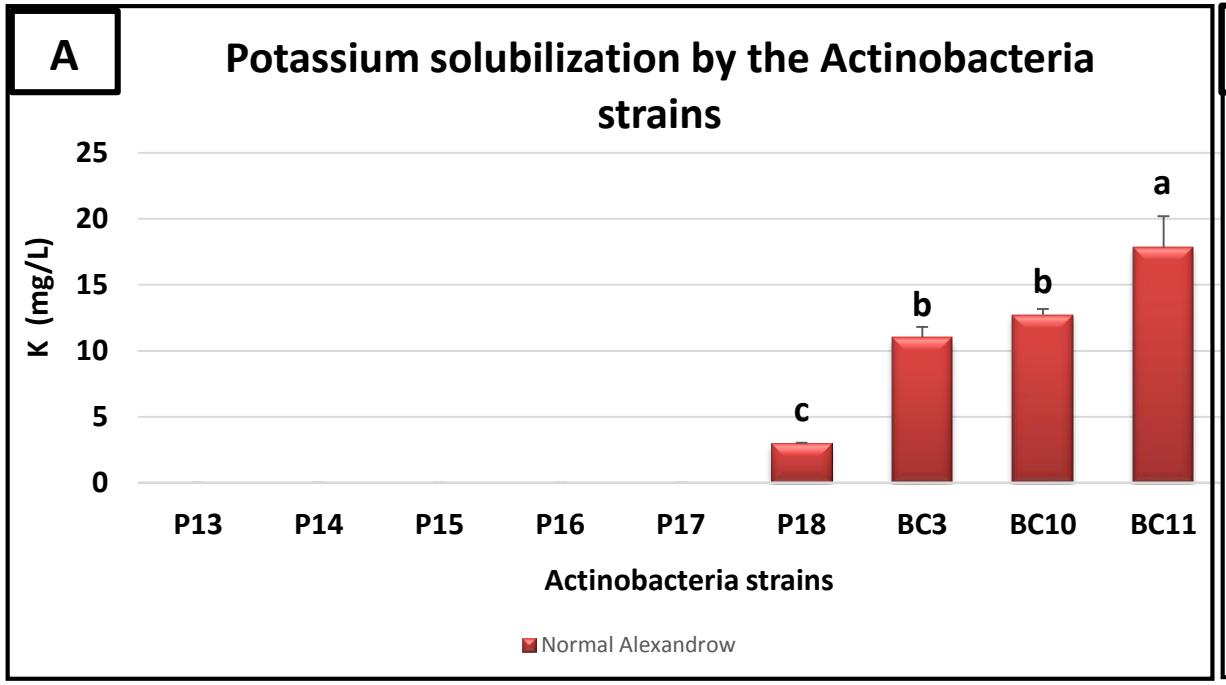


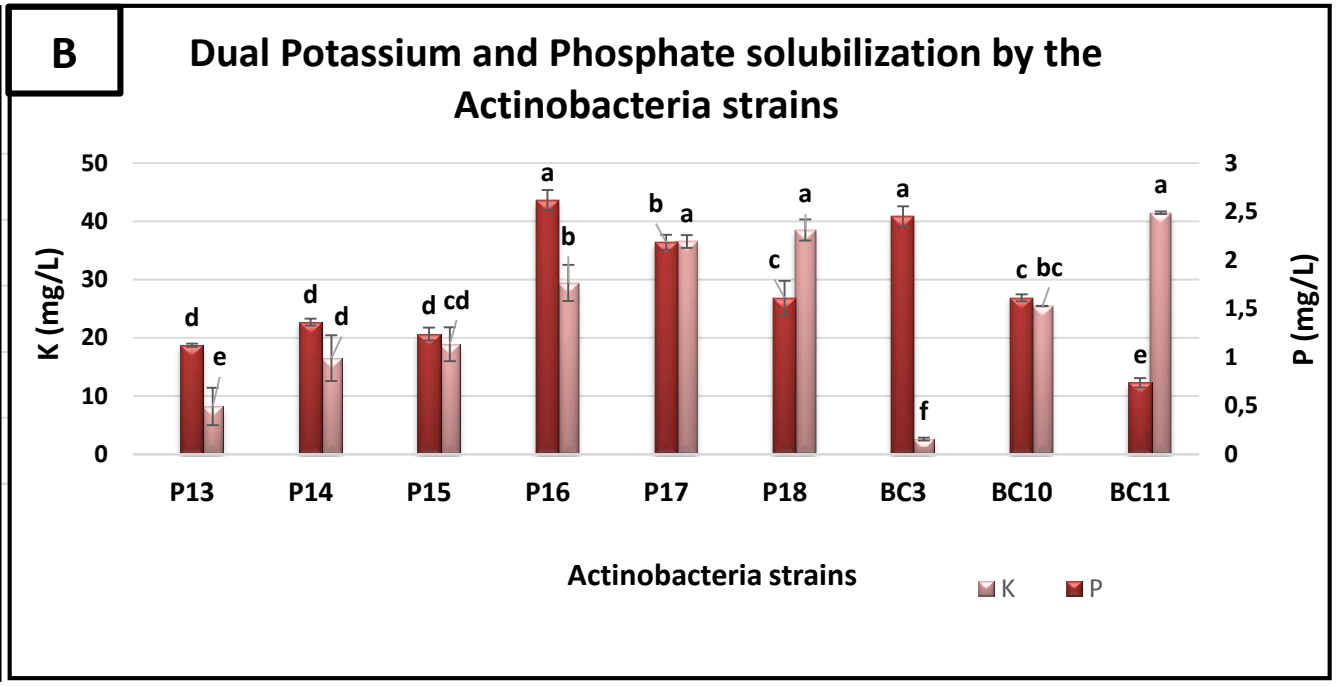
The pH variation was dependent upon both the RP types and the strain used

Date
- 3 Days
- 7 Days
- 11 Days

Involvement of organic acids ?

Potassium rock solubilization





Maximum potassium solubilization : 17.8 mg /L by BC11

Maximum Potassium solubilization : 41.5 mg /L by BC11

Maximum potassium solubilization was recorded in the modified Alexandrov

BC11 ➔ The best performing Actinobacteria in both conditions

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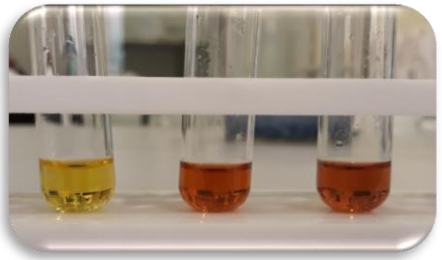
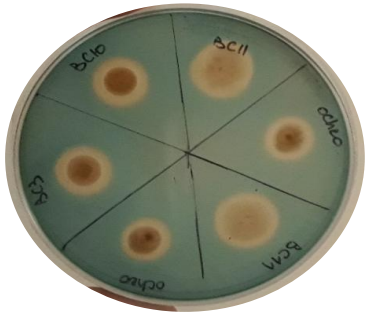
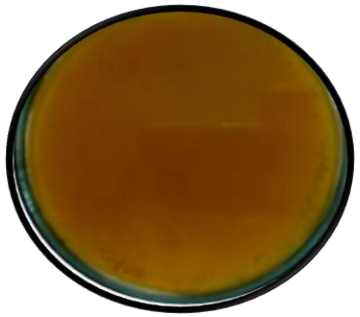
Plant Growth Promoting Traits of Actinobacteria strains



AIA production



Siderophores production



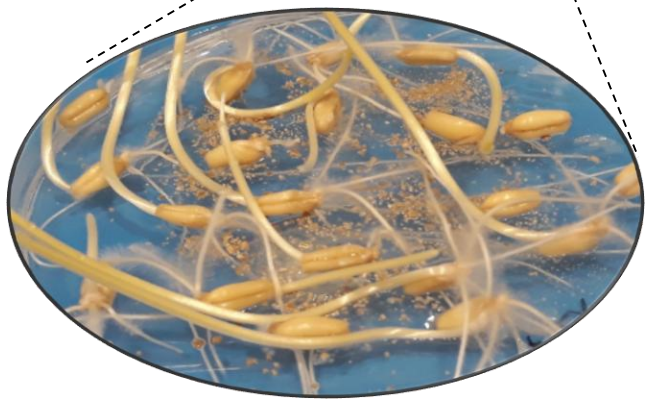
HCN production

Wheat germination test

T -

Strain + RP

T + RP



Great number of root hairs

The most performant ones P18- BC3 –BC10 and BC11

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Effect of the combinaison Actinobacteria -Rock phosphate and mica on wheat plant growth

4 potent strains: P18 -BC3 -BC10 and BC11

- **Plant:** Wheat
- **Culture substrate:** Alcalin soil
- 8 Treatments with 5 replications: 40 pots
- 4 seeds / pots
- 4 g of RP in each pot (1Kg)
- Mica = 4 g / pot
- Hoagland (1/2) / week
- Distilled water each 48 h
- **Duration:** 2 Months
- **Positive control:** T+ (Containing the K and P sources)

T-	T(Mica)	P18	BC3	BC10	BC11	RP	T+
T-	T(Mica)	P18	BC3	BC10	BC11	RP	T+
T-	T(Mica)	P18	BC3	BC10	BC11	RP	T+
T-	T(Mica)	P18	BC3	BC10	BC11	RP	T+
T-	T(Mica)	P18	BC3	BC10	BC11	RP	T+

Agronomic parameters

- **Plant height**
- **Root and shoot weight / Shoot and root dry weights**
- **Root architecture using WinRhizo**
- **P and K content in the soil / roots and shoots**

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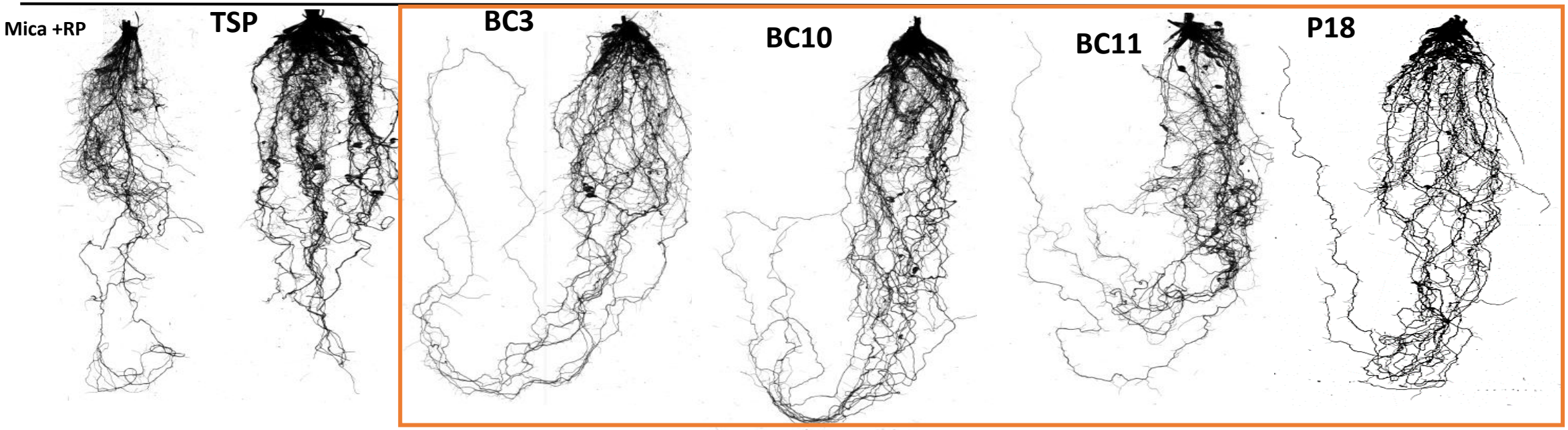
Results



Actinobacteria strains enhance all the agronomic parameters of wheat

Effect of Actinobacteria inoculation on biomass yield and root traits of wheat

Treatments	Shoot length (cm)	Root length (cm)	Shoot dry weight (g /plant)	Root dry weight (g /plant)	Root volume (cm^3)
C-	23.85 ± 0.96 d	46.15 ± 2.57 c	0.2355 ± 0.03 d	0.273 ± 0.042 c	1.12 ± 0.12 e
C+ (TSP)	60 ± 2.96 a	48.12 ± 6.12 bc	3.22 ± 0.35 a	1.154 ± 0.315 a	2.93 ± 0.420 ab
Mica	55.95 ± 1.95 a	49.56 ± 6.24 bc	2.51 ± 0.381 b	1.717 ± 0.407 a	3.131 ± 0.06 a
C (Mica + RP)	32.775 ± 1.77 c	56.32 ±7.41 ab	0.507 ± 0.085 cd	0.29 ± 0.45 bc	1.335 ± 0.255 cde
RP	32.75 ± 3.15 c	50.59 ± 7.70 bc	0.399 ± 0.08 cd	0.282 ± 0.064 bc	1.33 ± 0.18 de
P18	36.55 ± 2.60 bc	57.31 ± 5.06 ab	0.520 ± 0.03 cd	0.426 ± 0.066 bc	1.937 ± 0.2 bcde
BC3	35.7 ± 2.74 bc	68 ± 8.79 a	0.574 ± 0.083 cd	0.45 ± 0.046 bc	2.289 ± 0.68 abcd
BC10	40.5 ± 6.087 b	67.22 ± 9.15 a	0.82 ± 0.12 c	0.761 ± 0.147 b	2.192 ± 0.417 abc
BC11	39.45 ± 3.09 b	69.75 ± 1.68 a	0.84 ± 0.06 c	0.528 ± 0.049 bc	1.89 ± 0.302 cde

BC10 and BC11

➔ **Highest shoot and root lengths**

➔ **Highest shoot and root dry weights**

➔ **Coarse root architecture**

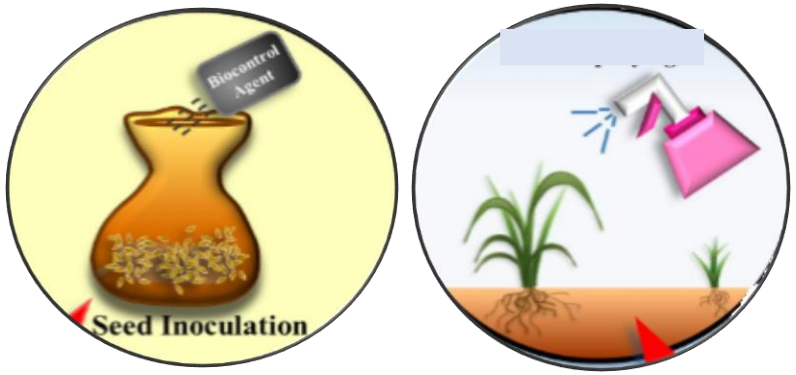
➔ **The most performant ones in term of IAA production**

9 Actinobacteria

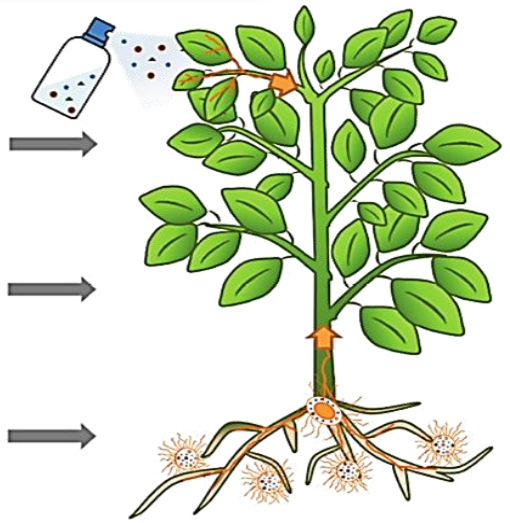
Abilities to solubilize Potassium as well as different qualities of rock phosphates

Plant Growth Promoting Traits

Abilities to promote maize under rock phosphate fertilization in greenhouse condition



BC10 and BC11



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Thank you for your attention