Evaluation of PGP bacteria against *Rhizoctonia solani* in *Solanum tuberosum* plants under greenhouse conditions

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Soil is an essential resource and vital part of the natural , where the great diversity of microorganisms that are part of the soil are the invisible engines of fertility, and protecting them against parasites and other pathogens.

Objective

Evaluate the antagonistic effect of Bacillus, Pseudomonas and actinomycetes strains against *R. solani*, in sexual seeds of potato *cultivate Yungay x Ccompis*

Methodology

- The test was carried out in greenhouse conditions of the LEMYB-UNALM.
- Bacteria isolation

Bacterial strains of rhizosphere and phylosphere of *S. tuberosum* were isolated from different regions of Peru (Puno, Cajamarca, Huancavelica, Huánuco and Lima).

- BAC15MB de (Calvo, et al. 2010)
- chemical fungicide (Benomyl)
- negative control (Control -)
- *R. solani* (Control +)

Table 1: Characteristics of the rhizosphere and phylosphere sampling regions of *S. tuberosum*.

N°	Department	Province	Type of sample	Altitude	Latitude	Length	pH	Texture	Structure	Strain
1	Huancavelica	Acobamba	Phylosphere	4185	12°40'37,2''	74°41'1.69''	4.8	Clay loam	Granular	BPP4
2	Lima	Cañete	Phylosphere	70	-13084815	-76354898	7	Loamy	Granular subangular	4BPP6
3	Lima	Cañete	Phylosphere	113	-12.974502	-76.403824	6.8	Clay loam	Granular subangular	4BPP8
4	Cajamarca	Cajamarca	Rhizosphere	3642	7°2'2.36''	78°19'46.21''	4	Loamy	Migajosa	3PSPP8
5	Huancavelica	Tayacaja	Phylosphere	3949	12°14'30.78''	75°3'31.67''	4.7	Loamy	Granular	ACPP02
6	Huancavelica	Acobamba	Phylosphere	4185	12°40'37.2'	74°41'1.69''	4.8	Clay loam	Granular	ACPP03
7	Huánuco	Pachitea	Phylosphere	3155	9°59'42.71''	76°1'27.12''	4.8	Clay loam	Granular	2ACPP04
8	Huánuco	Yarowilca	Rhizosphere	3657	9°53'19.23''	76°29'55.02''	5.7	Clay loam	Granular	2ACPP08
9	Puno	Azángaro	Rhizosphere	4224	14°39'0.4''	70°9'30.04''	4.6	Loamy	Granular	5ACPP5
10	Puno	Azángaro	Rhizosphere	4224	14°39'0.4''	70°9'30.04''	5.6	Loamy	Granular	5ACPP6

Inoculum preparation

BPP4 **4BPP8** **5ACPP5**

The selected strains were sown at 28 ° C x 24 hours for Bacillus and Pseudomona and actinomycetes at 5-7 days.

A colony was taken and seeded in flasks for each strain at 28 ° C x 24 hours in shaker 150 rpm in case of Bacillus and Pseudomonas and actinomycetes in 3 days.

1 mL of each bacterial broth is inoculated into each seedling.

Inoculation of bacterias in *Solanum tuberosum*

Fig. 1 Disinfection of sexual seeds of Solanum tuberosum, cultivar Yungay x Compis was proposed Zuñiga 2012.

Fig. 2 Emergence of sexual seeds of Solanum tuberosum, cultivar Yungay x Compis under greenhouse conditions

Inoculation of bacterias in *Solanum tuberosum*

Fig. 3 emergence of sexual seeds of Solanum tuberosum, cultivar Yungay x Compis under greenhouse conditions

Fig4. Seedling growth at 95 days and reigning with the selected bacteria.

Inoculation of *Rhizoctonia solani* in *Solanum tuberosum*

Disinfection and treatment of wheat for the growth of *R. solani.*

Growth of *R. solani* in vitro at 3 days x 28 ° C

Pieces of agar were placed with wheat mycelium and incorporated into the wheat and left to incubate 3 days x 28 ° C.

Fig 5. Infection of seedlings with wheat grains infected with *Rhizoctonia solani*.

Results y discussion

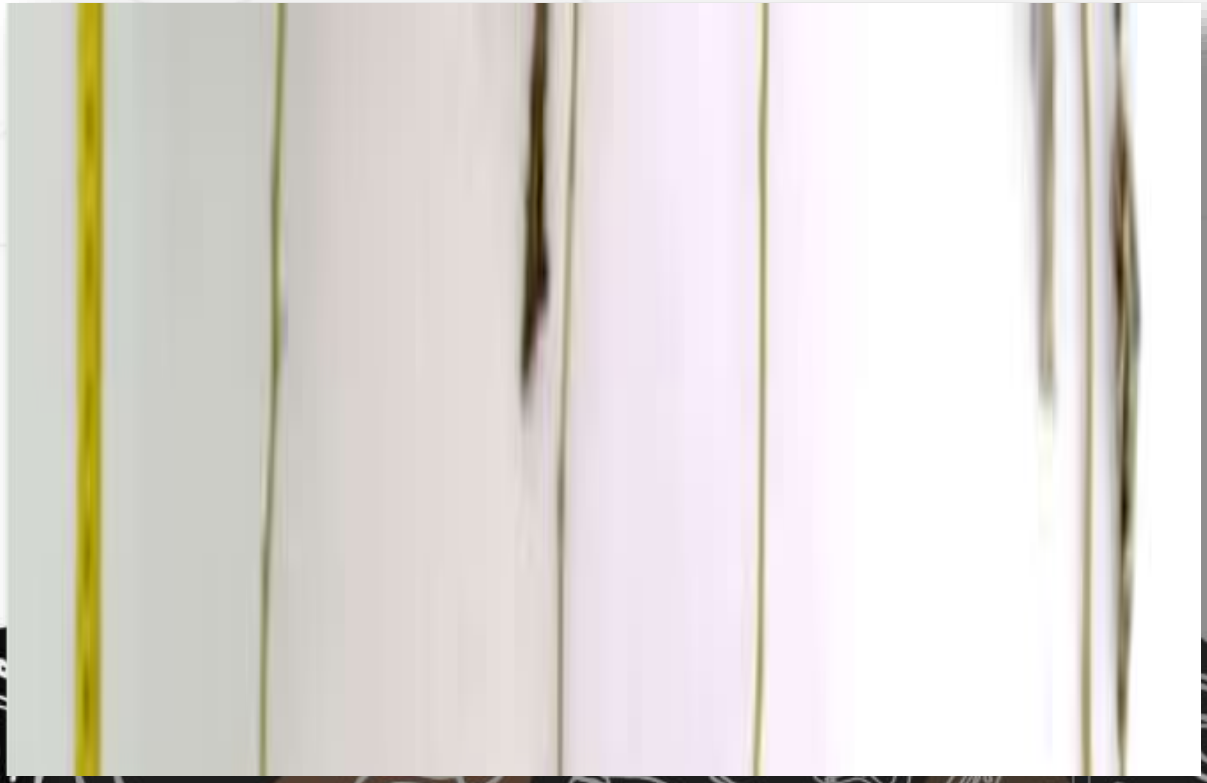
Table 2: Effect of three PGPR strains on the growth of potato plants, under greenhouse conditions.

Treatments	Fresh tuber weight (g)		Dry tuber weight (g)		Chancre (mm)		Plant height (cm)		Chlorophyll (nm)	
4BPP8	11.906	a	1.5081	a	39.93	cd	28.9	a	33.68	bc
BPP4	8.716	b	1.1040	b	19.90	ab	29.6	a	35.94	abc
5ACPP5	8.212	bc	1.0402	bc	25.10	ab	22.88	bcd	35.3	abc
BENOMYL	7.624	bcd	0.9657	bcd	16.26	a	24.56	bc	41.22	abc
CONTROL+	4.898	fgh	0.6204	fgh	55.50	efgh	19.64	cde	37.5	abc
CONTROL -	5.878	cdefgh	0.7445	cdefgh	0	-	23.32	bcd	45.08	a

The means were compared using the LSD test p <0.05.

Fig 6. Infection of the stems in seedlings of *Solanum tuberosum.*

Fig 7. 4BPP8 strain with greater weight of small tuberculles and comparison with different treatments.



- Of the three strains BPP4, 4BPP8 and 5ACPP5 that presented the best fresh and dry small tuber weights other than the positive and negative control, the 4BPP8 strain stood out with 11.9 g of fresh weight and 1.5 g of dry tuber weight (Fig. 7).

- In chancre size (table2), the BPP4 strain was the one that most reduced this damage from 55.5 to 19.9 mm, which does not differ significantly from the chemical fungicide Benomyl (16.26 mm), the other two strains also reduced the damage such as 5ACPP5 at 25 mm and the 4BPP8 at 39 mm.

Conclusions

- It is demonstrated at the greenhouse level that the PGPR strains studied can be excellent alternatives for the biological control of *R. solani* compared to other commercial options (chemical fertilizers or fungicides).

- In addition to improving plant growth, tuber production is also increasing.

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