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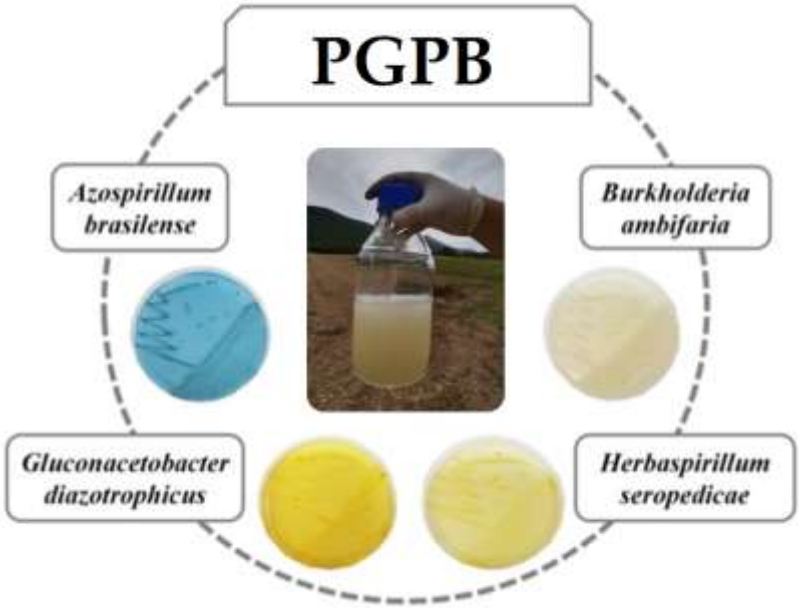
GLOBAL SYMPOSIUM ON SOIL BIODIVERSITY | 19-22 April 2021

Application of bacterial biostimulants in productive landscapes of *Allium cepa L.*

Programma Operativo Regionale (POR-FESR) - Azione 1.1.1
Progetti di Ricerca Industriale e Sviluppo Sperimentale
delle Imprese afferenti ai Domini individuati nella RIS3 della
Regione Abruzzo - INNOPAQ CUP C43D18000130007

Bacterial biostimulants

Also known as plant growth promoting bacteria (PGPB) represent a sustainable technique to improve crops productivity.



PLANT GROWTH-PROMOTING MECHANISMS

DIRECT

production of auxin, cytokinin, gibberellin, nitrogen fixation, phosphorous solubilization, and sequestration of iron by bacterial siderophores.

INDIRECT

Inhibition of pathogenic fungi and bacteria (i.e. antibiotics, cell wall degrading enzymes, competition, hydrogen cyanide, induced systemic resistance, quorum quenching, siderophore ACC deaminase).

Olanrewaju et al., **2017**. https://doi.org/10.1007/s11274-017-2364-9

Material and Methods

In vitro study

Seed adhesion and persistence by Scanning Electron Microscopy

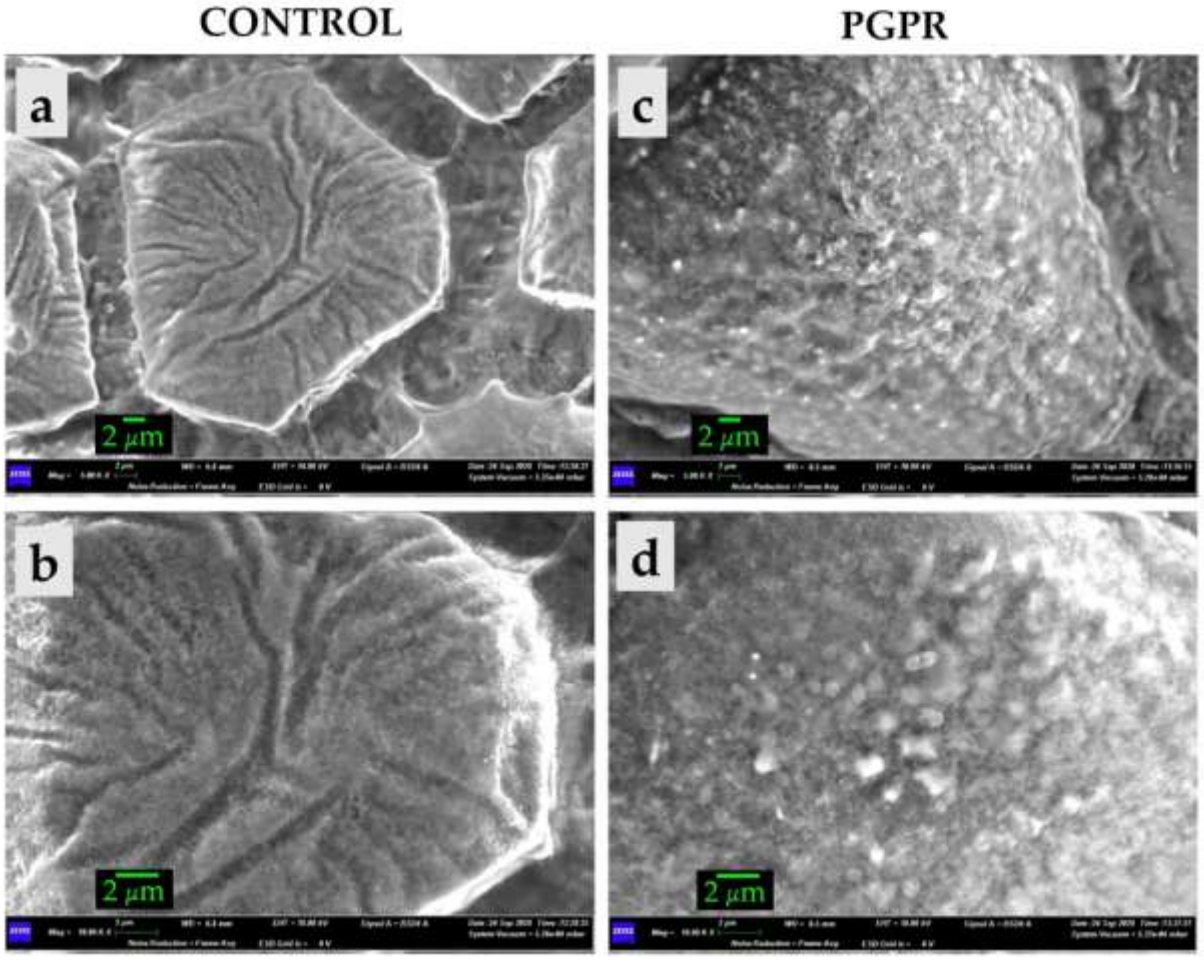
Open field experiment

Crops monitoring (height, dry matter, and chlorophylls dynamics and yields)
Bulbs quality (dry matter, total phenolic contents, antioxidant activity)
Soil fertility status (16S rRNA analysis, Physico-chemical properties)



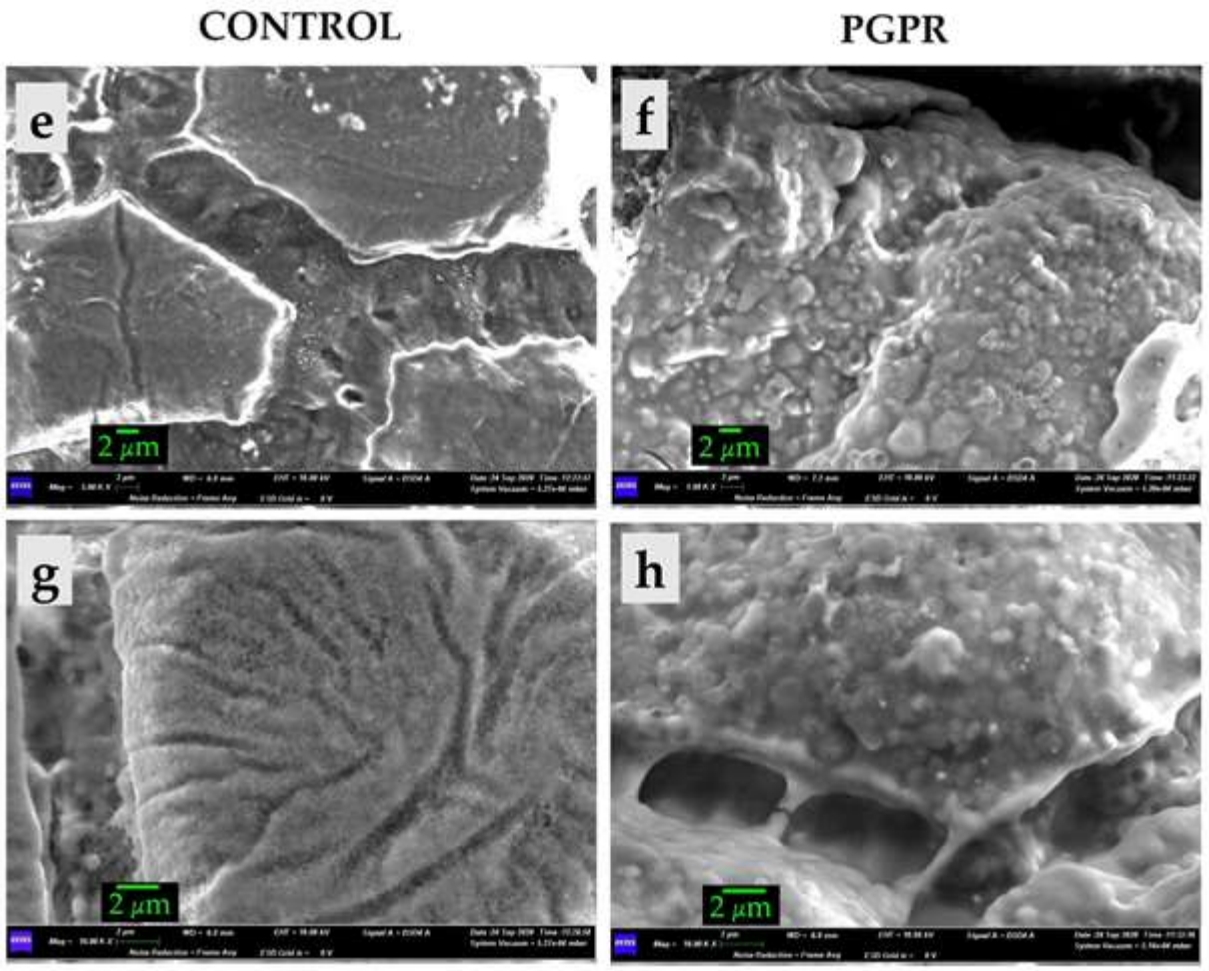
Pellegrini et al., **2021**.
https://doi.org/10.3390/microorganisms9030639

Results – seed inoculation



Scanning electron microscope (SEM) micrographs obtained for **Control (a,b)** and **PGPR (c,d)** *Allium cepa* seeds the same day of the inoculation. Magnitudes: 5000 (a,c) and 10,000 (b,d,)

Results – seed inoculation



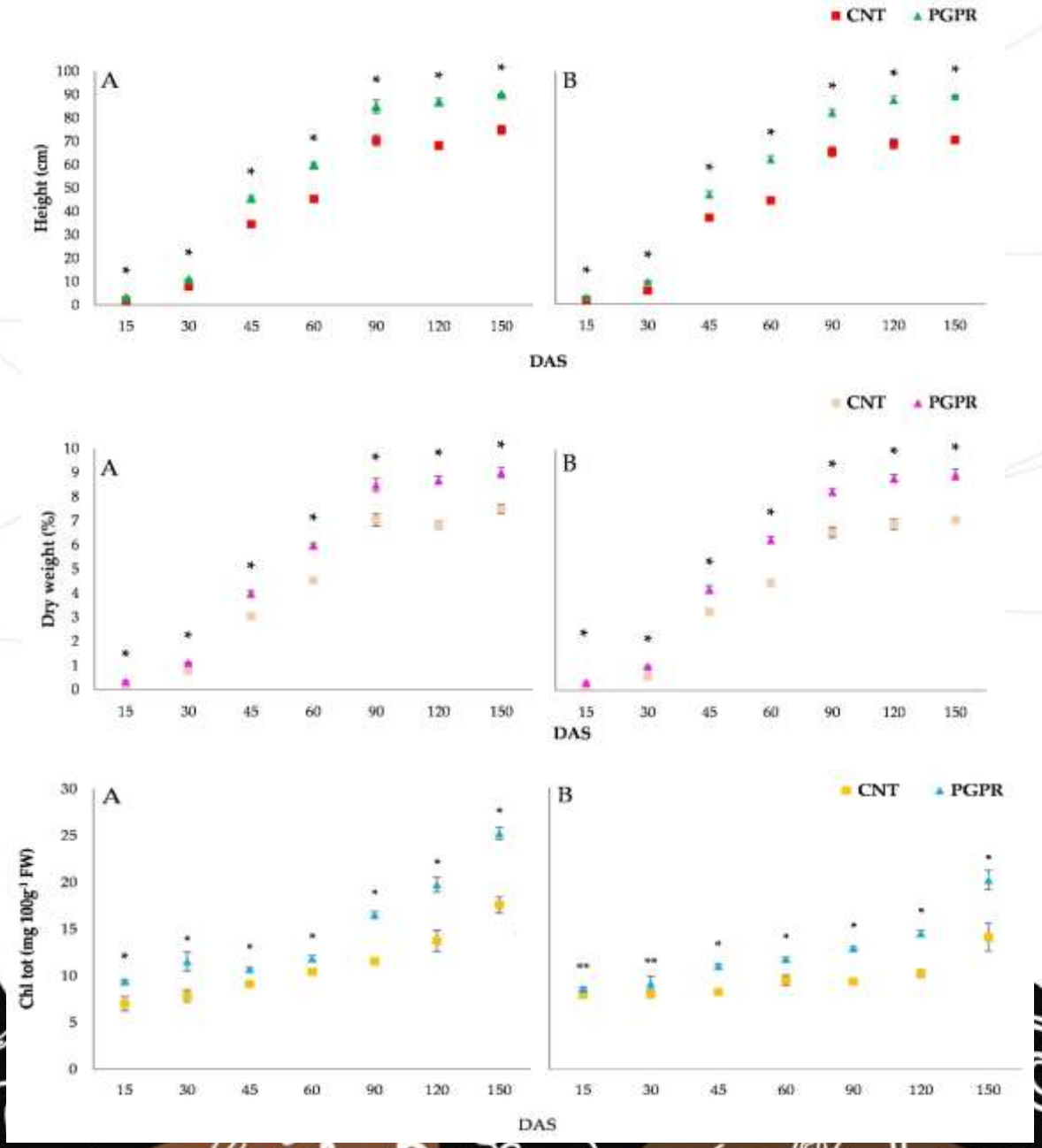
Scanning electron microscope (SEM) micrographs obtained for **Control** (e,g) and **inoculated** (f,h) *Allium cepa* seeds after 30 days from the inoculation.

Magnitudes: 5000 (e, f) and 10,000 (g, h)

Shelf-life → 60 days

Results – Crops growth monitoring

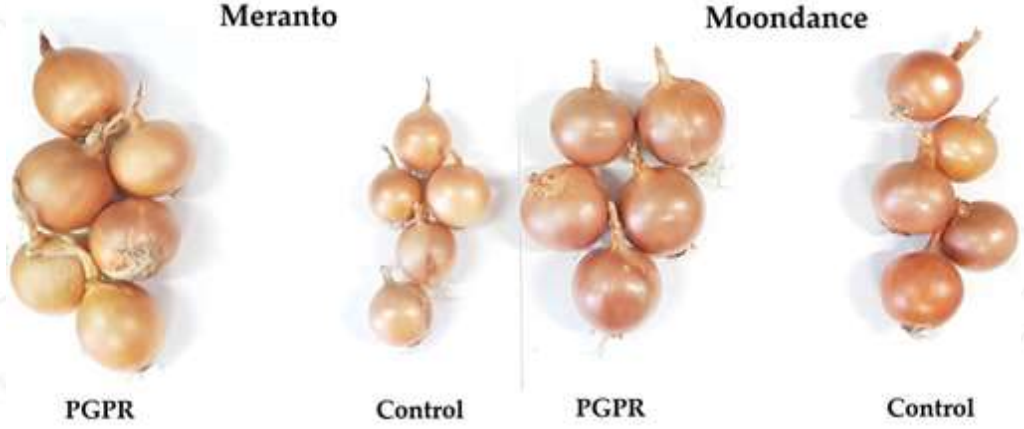
Dynamics of **Height, Dry weight,** and **Chlorophylls** in **Meranto** (A) and **Moondance** (B) cultivars.



Average increases:

- Height - +18%
- Dry weight - 23+ %
- Chlorophylls - +42%

Results – Crops growth monitoring



Average increases:

- Dry weight - + 3%
- Antioxidant activity - + 25%
- Total phenolic content - + 20%

Table 1. Dry weight, total phenolic content, and antioxidant activity of bulbs of Meranto and Moondance cultivars.

Index		Dry Weight (%)	Total Phenolic Content (mg GAE g-1 DW)	Antioxidant Activity (IC50)
Moondance	Control	14.28	4.76	150.92
	PGPB	14.73	5.96	12.71
	t-test	*	***	**
Meranto	Control	14.21	3.97	93.32
	PGPB	14.70	4.97	75.10
	t-test	*	***	*

t-test: * = $p < 0.001$; ** = $p < 0.01$; *** = $p < 0.05$.

Yield increase +13 %

Results – Soil fertility status

Table 2. Soil chemical analysis for Meranto and Moondance experimental conditions.

Parameter	Moondance			Meranto		
	Pre-Sowing	Control	PGPB	Pre-Sowing	Control	PGPB
pH	7.6	7.7	7.6	7.7	7.7	7.5
Total N (g Kg^{-1})	2.2	2.1	2.2	2.0	1.9	2.0
Total Organic Carbon (g Kg^{-1})	16.8	15.6	18.5	16.5	16.3	18.0
Organic Matter (g Kg^{-1})	29.0	27.0	32.0	28.4	28.0	31.0
Electric Conductivity (µS cm^{-1})	0.45	0.42	0.32	0.40	0.40	0.33
Na^{+} (mg Kg^{-1})	33.0	38.0	15.0	31.0	28.0	18.5
Ca^{++} (mg Kg^{-1})	3022.0	2895.5	3023.2	3132.5	2998.0	3108.5
Mg^{++} (mg Kg^{-1})	148.5	130.5	153.0	145.0	123.2	126.5
K^{+} (mg Kg^{-1})	489.0	383.0	413.5	164.5	138.0	182.2
Available P (mg P_2O_5 Kg^{-1})	323.0	172.0	460.5	282.0	144.2	227.0

Table 3. Ecological indexes calculated from Illumina sequencing results.

Index		Individuals	Shannon-Wiener H′	Chao-1
Moondance	Control	7431	6.15	628
	PGPB	9627	6.33	753
Meranto	Control	4046	5.66	363
	PGPB	5209	5.79	429

Conclusions

- seed inoculation improved plant growth and development, crop yield and quality, and the soil fertility status.

- suitability of this consortium as a biostimulating agent in sustainable agriculture.

- Our results suggest that seed inoculation with this consortium could be used in productive onion landscapes as a biostimulating agent in place of chemical fertilizers

Future perspectives

- Elucidation of the mechanisms of plant-growth improvement and fertility status and changes in the microbial community.

- Suitability of this inoculant application on other plant species and the

- Optimization of large-scale inoculum production procedures as well as the stability of the formulation should be investigated.

Pellegrini, M.; Spera, D.M.; Ercole, C.; Del Gallo, M. *Allium cepa* L. Inoculation with a Consortium of Plant Growth-Promoting Bacteria: Effects on Plants, Soil, and the Autochthonous Microbial Community. *Microorganisms* **2021**, 9, 639. https://doi.org/10.3390/microorganisms9030639

Thank you for your attention

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