

Effect of native strain of *Azospirillum brasilense* in the production of horticultural seedlings in semi-hydroponic system of culture in bag

Abstract

Azospirillum brasilense is a PGPR (Plant Growing Promoting Rhizobacteria) bacterium studied for its ability to promote plant growth. On the other hand, the cultivation of vegetables in soilless systems is becoming especially important, because of the significant decrease in land suitable for agriculture. The objective of this study was to evaluate the effect of inoculation with *Azospirillum brasilense* on the production of pepper (*Capsicum annuum* L.), tomato (*Solanum lycopersicum* L.) and basil (*Ocimum basilicum* L.) in a semi-hydroponic culture system, which we call "bag cultivation". The trials were conducted with two treatments: 1. control (without inoculation) and 2. inoculated with *Azospirillum brasilense*. High levels of survival were obtained, and better-quality seedlings were observed in the inoculated treatments for the species of peppers, tomato and albahaca. It is concluded that the Pi8 strain of *Azospirillum brasilense* exerts a positive effect on the production of these three horticultural species grown in semihydroponic system in bag, so the inoculation of seeds of peppers, tomato and basil of the varieties tested can be considered a convenient tool to increase the production of seedlings.

Keywords: tomato, basil, pepper, PGPR, Catamarca

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Introduction

The need to increase crop production leads us to search for surpassing alternatives, one of them could be the inoculation of seeds of crops with bacteria promoting root development and another of them is the cultivation in semihydroponic systems in bag.

Azospirillum brasilense is a PGPR (Plant Growing Promoting Rhizobacteria) bacterium that promotes plant growth by its ability to fix atmospheric nitrogen, increased root development and produce plant growth regulators, such as indole acetic acid, cytokinins, gibberellins, siderophores, etc.,¹⁻³ which may involve other effects such as: increased absorption of water and nutrients, greater tolerance to stress, such as salinity and drought, resulting in a more vigorous, healthy and productive plant.³ The inoculation of plant growth-promoting rhizobacteria (PGPR) is emerging as an economically feasible biotechnology to increase crop production and in turn, reduce the massive use of fertilizers with the consequent protection of the agroecosystem.⁴ Given the importance of horticultural crops in the region and in domestic economies, it is necessary to work on optimizing their production.

On the other hand, the cultivation of vegetables in soilless systems is becoming especially important, because of the significant decrease in land suitable for agriculture. This system allows to grow all kinds of plants in urban areas of large cities where it is increasingly difficult to find sites with enough surface for the production of profitable horticultural and ornamental species. Which reduces transportation costs due to proximity to consumers. Among the other advantages of the semi-hydroponic system in addition to the possibility of growing at home making an urban garden without requiring large tracts of land and regardless of the quality and agricultural aptitude of the same, is the saving of water, smaller planting frames and being able to be developed in any region, such as cities, mountains, deserts, balconies, terraces, etc.^{5,6} The objective is to assess the effect of inoculation with a native strain of *Azospirillum brasilense* on the production of three horticultural species in a semi-hydroponic culture system, which we call "bag culture".

Material and method

Trials were conducted with a completely randomized design with two treatments: control T1 (without inoculation) and T2 inoculated with *Azospirillum brasilense*. With three repetitions. We worked with seeds tomato (*Solanum lycopersicum* L.) variety Lomitero PG INTA, with basil (*Ocimum basilicum* L.) Hybrid variety and two varieties of Pepper (*Capsicum annuum* L.): Padrón pepper and Pepper variety Trompa de Elefante.

For bag culture, black polyethylene sleeves 60 microns thick (utilized in the manufacture of nursery bags) of 1.2 and 2m in length and 0.15m in diameter, were filled with sterile perlite. Equidistant points were marked and openings for sowing seeds were made with scissors. In treatment 2, the seeds were inoculated with the Pi8 isolation of *A. brasilense*, obtained from the endorizosphere of *Capsicum annuum* (Pimentonero pepper var. Elephant trunk) with a titer of 1.52×10^7 azosp. mL⁻¹ by microscopic count in Neubauer chamber.

The semi-hydroponic culture bags were taken to the culture chamber and irrigated with hydroponic solution. Emergency and survival were evaluated periodically. Pepper and tomato pl height was also evaluated. The results were statistically analyzed by analysis of variance (ANAVA) and the means were compared by Fisher's LSD Test (Minimal Significant Difference) at a significance level of 0.05 using the statistical program InfoStat (Figure 1).⁷

Results and discussion

7 days after planting, the emergence of seedlings from tomato and basil crops began. The results are shown in Figures 2 & 3. High levels of survival (90%) of tomato plants from inoculated seeds were obtained, with statistically significant differences with respect to controls. Similar behavior was determined when evaluating the survival of basil plants. In addition, better quality seedlings were observed in the inoculated treatments for the three species under study (pepper, tomato, and basil), given their size and vigor. Seedlings with

agronomic characteristics like those observed by Andrada et al.,⁸ when cultivating tomato (*Solanum lycopersicum* L.) under greenhouse conditions.

15 days after planting, the emergence of pepper seedlings of the two varieties began, registering significant differences in favor of the inoculated treatment in pepper inoculated and highly significant differences in favor of the inoculated treatment with increases of 55% in Padrón pepper (Figure 4). She observed better quality seedlings in the treatments inoculated in both varieties of pepper. There were no losses of individuals, registering high levels of survival.

These results indicate that this semi-hydroponic bag system saves space, resources and money, being a viable option, particularly for urban production,⁵ and it is possible to complement with biofertilization techniques with PGPR and integrate to produce seedlings. Therefore, these alternatives together generate a very efficient and productive innovative system, which allows obtaining excellent results and with a series of advantages over traditional agriculture (Figures 5&6).



Figure 1 Conditioning of bags for semi-hydroponic cultivation.

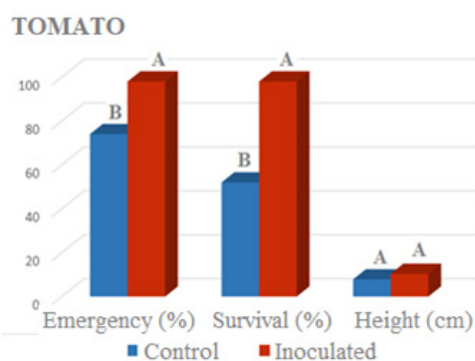


Figure 2 Percentage of emergence and survival of tomato seedlings (*Solanum lycopersicum* L.) variety Lomitero PG INTA.

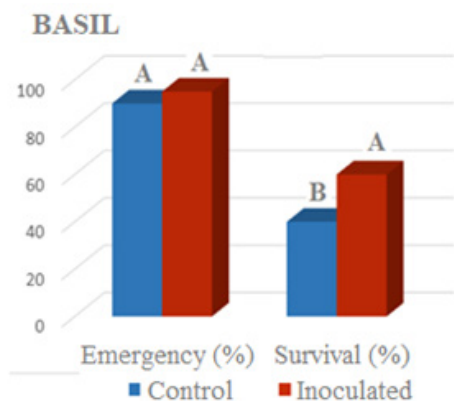


Figure 3 Percentage of emergence and survival of seedlings of basil (*Ocimum basilicum* L.)

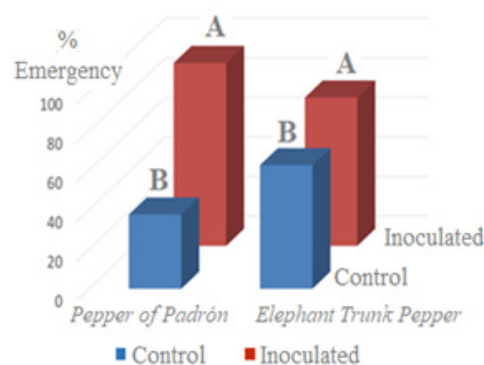


Figure 4 Percentage of emergence of seedlings of Padrón pepper and pepper variety Elephant trunk (*Capsicum annuum* L.).



Figure 5 Bag cultivation of tomato seedlings (*Solanum lycopersicum* L.) variety Lomitero PG INTA and basil (*Ocimum basilicum* L.).



Figure 6 Bag cultivation of seedlings of Padrón pepper and pepper variety Elephant trunk (*Capsicum annuum* L.).

The results of this experience allow to show the feasibility of the production of horticultural, aromatic, ornamental plants, etc., in semi-hydroponic systems in plastic bags with the use of microorganisms that promote plant growth in small spaces where traditional agricultural practices are not possible and thus promote urban and sustainable agriculture.

Conclusion

It is concluded that the Pi8 strain of *Azospirillum brasilense* exerts a positive effect on the production of these three horticultural species, so the inoculation of pepper, tomato and basil seeds of the varieties tested can be considered a convenient tool to increase the production of seedlings.

The cultivation in this semi-hydroponic system with the inoculation of PGPR microorganisms can be considered an innovative practice for the urban production of vegetable seedlings and family gardens.

The inoculation of seeds of horticultural species allows to develop crops in bag in a more sustainable way which can also be applied this biotechnology in crops of marginal areas. In addition to promoting plant nutrition and health, they can be considered a strategy and a solution to serious ecological, economic, and social problems.

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Conflicts of interest

There are no conflicts of interest presented or declared by the authors in this research.

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