SCAP
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Soil microbiome favors the performance of almond rootstock seedlings in co-cultivation with barrel medic

El microbioma del suelo beneficia la performance del patrón de almendro en co-cultivo con *Medicago truncatula*

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A B S T R A C T

Soil microbiome influences plant growth and development. Moreover, crop co-cultivation practices have positive impacts on soil microbiome and function. In this study, soil microbiome from an almond field was collected to evaluate its effect on the growth of almond rootstock seedlings planted in pots with or without co-cultivation with *Medicago truncatula*. Four treatments were established: without legume and without microbiome (A); with legume and without microbiome (B); without legume and with microbiome (C) and with legume and with microbiome (D). After six weeks, no significant differences in culturable bacteria density in bulk soil or rhizospheric soil were found among treatments. Evapotranspiration rate per pot and day and plant growth, measured as increase in plant height per day, showed a similar tendency, with higher values found in non-inoculated plants in the first week of treatment, while, inoculated plants showed the highest values at the end of the experiment. *M. truncatula* co-cultivation increased pot evapotranspiration only in non-inoculated plants. Taken together these results suggest that the soil microbiome had a specific beneficial effect on the almond rootstock which could have negatively influenced the performance of *M. truncatula*.

Keywords: *Medicago truncatula*, microbiome, micronutrients, soil.

R E S U M E N

El microbioma del suelo influye en el crecimiento y desarrollo de las plantas. Además, las prácticas de co-cultivo tienen impactos positivos en el microbioma del suelo y su función. En este trabajo, se recogió el microbioma del suelo de un campo de almendros para evaluar su efecto en el crecimiento del patrón de almendro GF-677 en macetas con o sin co-cultivo con *Medicago truncatula*. Se establecieron cuatro tratamientos: sin leguminosa y sin microbioma (A); con leguminosa y sin microbioma (B); sin leguminosa y con microbioma (C) y con leguminosa y con microbioma (D). Después de seis semanas, no se encontraron diferencias significativas en la densidad de bacterias cultivables en el suelo rizosférico y no rizosférico entre tratamientos. La tasa de evapotranspiración por maceta y día y el crecimiento de la planta fueron similares, con valores más altos inicialmente en plantas no inoculadas, mientras que, las inoculadas mostraron valores más altos al final del experimento. El co-cultivo con leguminosa aumentó la evapotranspiración en maceta sólo en plantas no inoculadas. En conjunto, los resultados sugieren que el microbioma tuvo un efecto beneficioso específico en el patrón de almendro. mientras que podría haber influido negativamente en el rendimiento de *M. truncatula*.

Palabras clave: *Medicago truncatula*, microbioma, micronutrientes, suelo.

INTRODUCTION

The use of cover crops is a sustainable strategy to increase yield and ameliorate soil conditions in perennial tree farming systems. The final outcomes in this co-cultivation practices greatly depend on the soil microbiome, that interacts with each crop plant modulating its physiology, growth and development. (Santos & Olivares, 2021) In this work, a pot experiment was carried out to evaluate the effects of the soil microbiome on the performance of almond rootstock seedlings co-cultivated with barrel medic (*Medicago truncatula* cv. Jester). The almond rootstock used was the natural hybrid of peach and almond, INRA-GF-677.

MATERIAL AND METHODS

Soil was collected in an almond orchard near growing trees (distance < 20 cm). Soil microbiome inoculum was prepared from a targeted enriched soil microbiome assessed by planting leeks.

In vitro generated rootstock seedlings were transplanted into 4 L pots filled with tyndalized soil to assess soil microbiome homogeneous conditions among treatments. Before planting, the soil was fertilized with modified Hoagland nutrient solution (50% macronutrients, 25% micronutrients, 100% Fe-EDDHA). (Epstein, 1972). Four treatments were set up in quadruplicate: rootstock growing alone (A), rootstock growing with two barrel medics (B) rootstock growing alone inoculated with microbiome (C) and rootstock co-cultivated with two *M. truncatula* (D). Plant height and pot evapotranspiration were recorded during six weeks. Culturable bacterial density (CBD) was measured at the beggining and at the end of the experiment.

RESULTS AND DISCUSSION

Soil tindalization greatly reduced CBD, with CBD highest values found in the rootstock rhizospheric soil (Figure 1). Nonetheless, no significant differences in bulk soil nor in rhizospheric soil CBDs were found among treatments (Figure 2), at the end of the experiment.

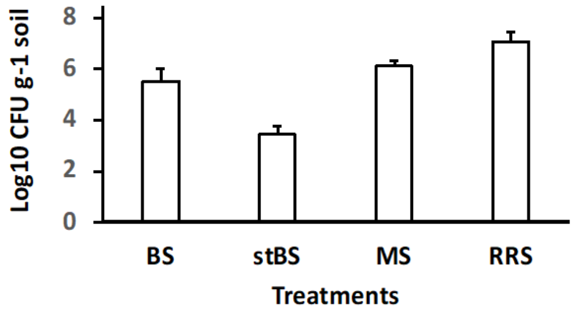

Figura 1 - CBD isolated from bulk soil (BS); sterilized bulk soil (stBS); microbiome soil (MS) and rootstock rhizospheric soil (RRS) before transplanting.

Evapotranspiration rate (ETR) higher values per pot shifted from non-inoculated plants at the beginning of the experiment (Figure 3a) to inoculated ones at the end (Figure 3d).

In a like manner, the non-inoculated rootstocks showed higher values at the beginning of the treatments, especially A-treated plants (Figure 4a).

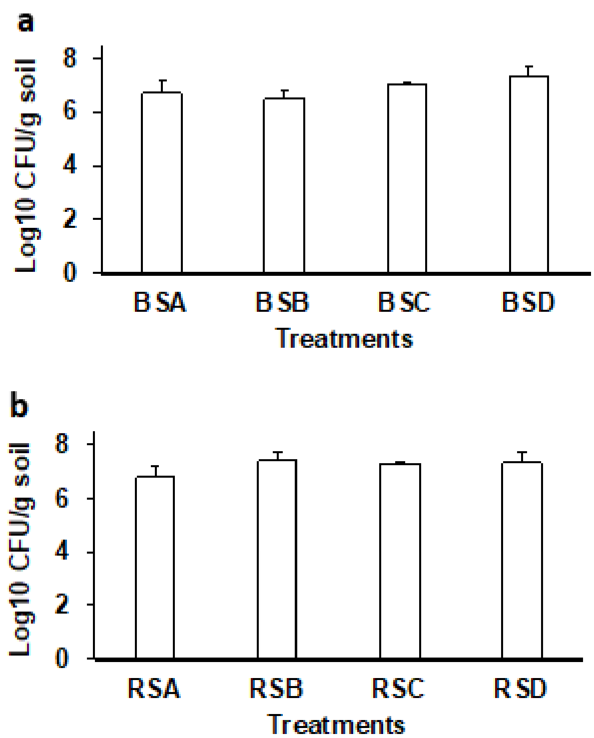

Figure 2 - CBD isolated from the bulk soil (BS) (2A) and the rhizospheric soil (RS) (2B) in the four treatments: A, B, C and D at the end of the experiment.

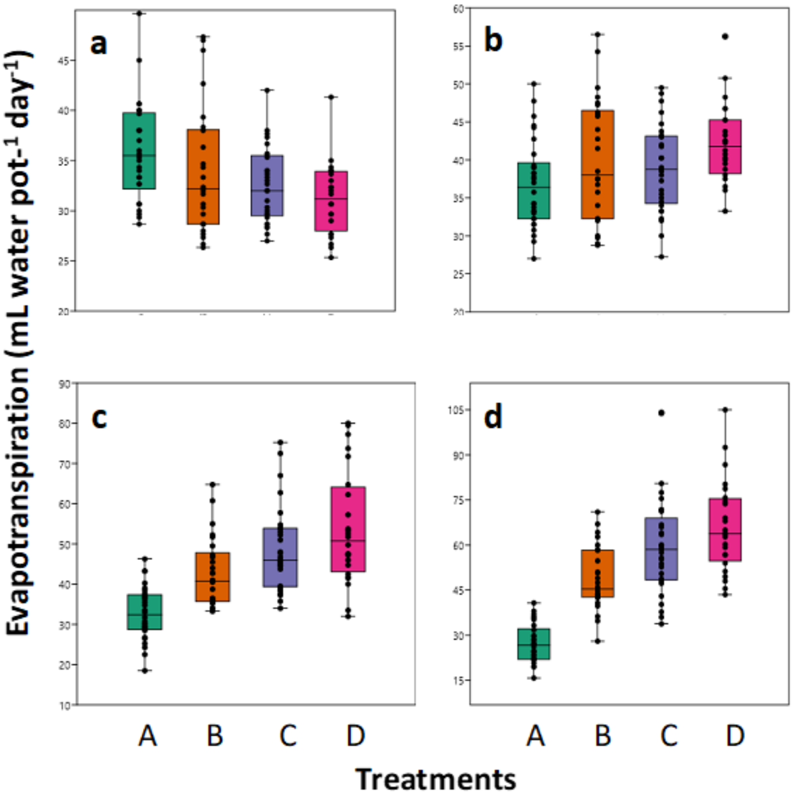

Figure 3 - Evapotranspiration per pot and day during the 1st week after transplanting (a); 2nd week (b);4th week (c); 6th week (d) in the four treatments: A, B, C and D.

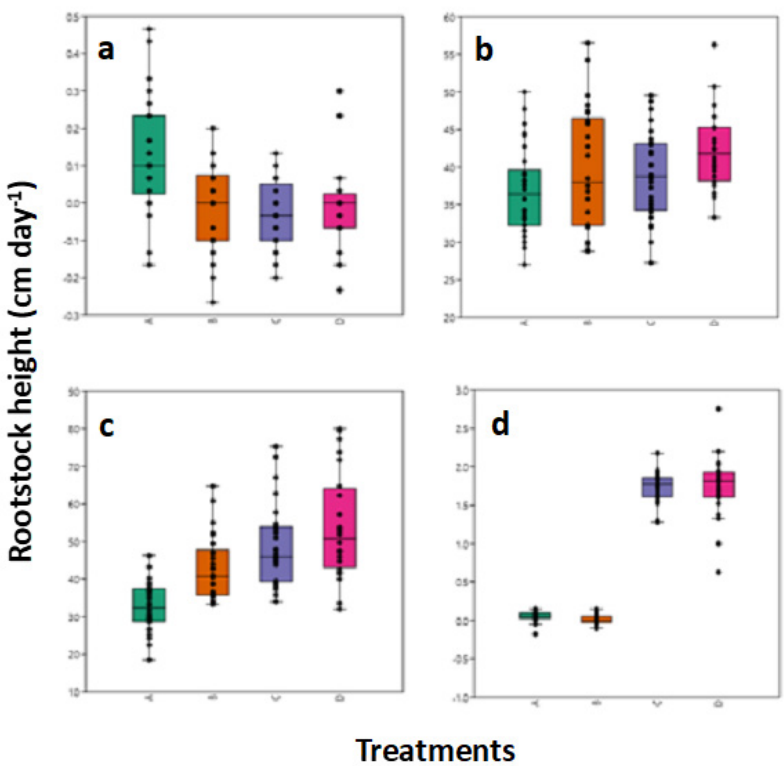

Figure 4 - Rootstock height per day during the 1st week after transplanting (a); 2nd week (b);4th week (c); 6th week (d) in the four treatments: A, B, C and D.

During the following weeks, plants from the B, C and D treatments increased their growth (Figure 4b,c) and, on the 6th week after treatment, the growth of the inoculated plants (C and D) was greater than that of the non-inoculated ones (A and B) which was substantially reduced (Figure 4d).

CONCLUSIONS

In spite of the lack of statistical significance, these results may suggest that the soil microbiome collected from an almond field selectively exerted a stimulated beneficial effect on the almond rootstock performance which could have competitively limited the growth of medic barrel.

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