Microbial Communities as growth engines for Greece

Book of Abstracts

P78.
Effects of endomycorrhizal symbiosis on plant-plant interactions

Christopoulos T., Tsiknia M., Kountouris D., Ehaliotis C.
Agricultural University of Athens, Dept. of Natural Resources and Agricultural Engineering, , Athens 118 55, Greece

Plants are engaged in a diverse set of biotic interactions with soil microorganisms, that may affect coexistence with their plant neighbours. Arbuscular mycorrhizal fungi (AMF) constitute a major monophyletic group (Glomeromycota) of microbial plant symbionts. They colonize the roots and form symbiotic relationships with the majority of terrestrial plant species. There is overwhelming evidence that AM fungi alter plant–plant interactions. In this study we used three plants that represent functionally diverse groups, (a C3 broadleaf plant, a C4 grass, and a legume). Our hypothesis is that for each plant, growth in tri-partite plant community microcosms would influence AMF colonization and sporulation dynamics differently, compared to growth in monospecies microcosms, while *vise versa,* the presence of AMF would alter the plant growth characteristics between monospecies and tri-partite plant microcosms. The three plants that we used are: *Capsicum annum* (common pepper), a C3 plant; *Zea mays* (sweet corn variety), a C4 plant; and *Vigna unguiculata*, a legume. The AMF inoculum that we used is an autochthonous *Funneliformis mosseae,* AMF strain, previously isolated, that is continuously propagated in our lab. The experiment was carried out in greenhouse conditions and plants for both microcosms (monospecies and tri-partite) were placed in different nylon mesh bags (30μm) to allow hyphae translocation and soil solution exchange but to prevent the penetration of plant roots across bags. Several plant traits were monitored, while AMF colonization and sporulation and rhizobium nodulation were determined at harvest (after 90 days). The results will be presented at the conference.

Effects of endomycorrhizal symbiosis on plant-plant interactions

Christopoulos T.[1], Tsiknia M.[1,2], Papadakis I.[1], Ehaliotis C.[1]
[1]*Agricultural University of Athens, Athens 118 55, Greece*
[2] *Phytothreptiki S.A., Athens, Greece*

Introduction

Plants are engaged in a diverse set of biotic interactions with soil microorganisms, that may affect coexistence with their plant neighbors.

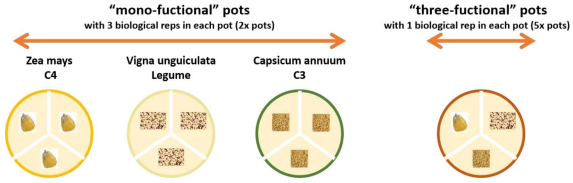
Arbuscular mycorrhizal fungi (AMF) constitute a major monophyletic group (Glomeromycota) of fungal plant symbionts. They colonize the roots and form symbiotic relationships with the majority of terrestrial plants. Interactions of plants with AMF range from strong mutualism to parasitism.

Mycorrhizal benefits received by the plant are determined by the balance between carbon costs vs. nutritional benefits.

In this study we used three plants that represent functionally diverse groups, (a C3 broadleaf plant, a C4 grass, and a legume). We cultivated them seperately (in monospecies microcosms) and all together (tri-partite microcosms) ***to investigate the AMF symbiosis effects on plant coexistence.***

Experimental Design

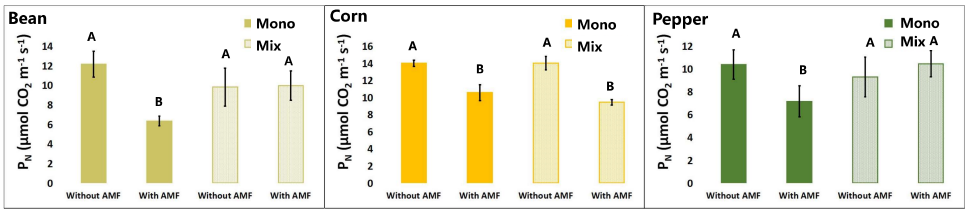
Three plants used:
- ✓ ***Capsicum annum*** (common pepper), a C3 plant
- ✓ ***Zea mays*** (sweet corn variety), a C4 plant
- ✓ ***Vigna unguiculata*** (C3 legume) + its *Rhizobium*



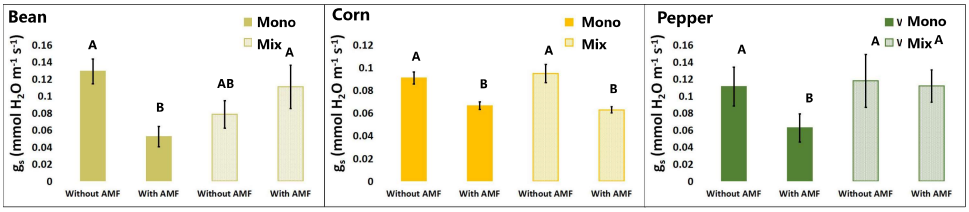
Plant seeds surface sterilized and germinated in a sterile mixture of sand:vermiculite 2:1 v/v.
- Plants transplanted in 3 lt pots, divided in three parts with nylon mesh bags (0.25μm pore size,1lt capacity) filled with the sterile mixture.
- Nylon mesh allows solution exchange. Mycorrhizal hyphae pass through, but not plant roots.
- Autochthonous *Funneliformis mosseae*, AMF inoculum, previously isolated, and continuously propagated in our lab.
- Weekly applications of a modified Hoagland's solution with 10% P strength on the corn and pepper. A Hoagland's solution with 10% P strength and less N used on the beans.
- Duration: 90 days

Results

Net Photosynthesis rate (P_N)

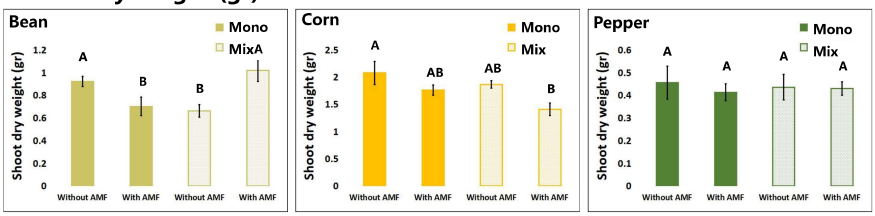


Stomatal conductivity (g_s)



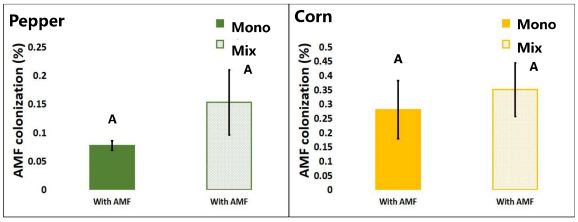
- ✓ AMF inoculation decreased the rate of plant photosynthesis and stomatal conductivity for all three plants in mono-culture.
- ✓ This negative effect was reversed for the two C3 plants in tri-partite cultivation.
- ✓ The negative effect was not reversed for the C4 plant in tri-partite cultivation.
- ✓ Legume's stomatal conductivity tends to be negatively affected in tri-partite cultivation without AMF inoculation.

Shoot dry weight (gr)

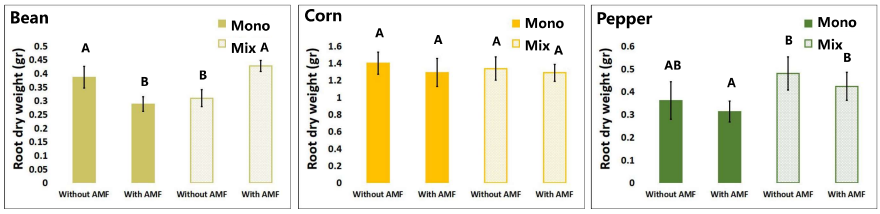


- ✓ Legume plants showed decreased shoot and root biomass under mono-culture when inoculated with AMF. The opposite was observed in tri-partite cultivation.
- ✓ Corn (C4) showed decreased shoot biomass when inoculated with AMF in tri-partite cultivation only. Root biomass was not affected.
- ✓ Peper (C3) plants showed increased root biomass in tri-partite cultivation.

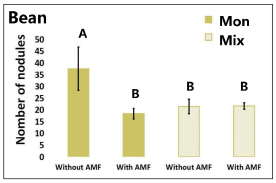
AMF root colonization



Root dry weight (gr)



- ✓ The legume plants showed no colonization (or too low to detect)
- ✓ For corn (C4) and peper (C4) AMF colonization did not differ statistically between mono-culture and tri-partite culture (tended to be higher in tri-patrite).
- ✓ Corn showed higher root colonization than peper in both types of microcosmos.



Nodulation

The number of nodules decreased by co-plantation and AMF inoculation.

Conclusions

- ➢ In general under stress conditions (tri-partite cultivation) the mutualism-parasitism continuum of AMF symbiosis tilts to beneficial results for its host. This indicates that under optimum growth contidions AMF colonization could lead to parasitism *via* carbon drainage.
- ➢ Plants under mono-culture pots, reacted on AMF inoculation, by lowering their photosynthesis and stomatal conductivity, even for the legume plant where no AMF colonization detected.
- ➢ In the case of corn (C4), AMF symbiosis showed parasitic atrributes, decreasing its shoot biomass, rate of photosynthesis and stomatal conductivity when planted in tri-partite microcosms.
- ➢ AMF probably construct a hyphal network among the tree plants and the other two benefit from a parasitic behavior of the AMF on the C4 plant.

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης
MIMIN
T1ΕΔΚ-05301

Acknowledgements: We thank Assistant Professor Omirou M. (The Cyprus Institute) for providing *Vigna unguiculata* seeds and the Rhizobium strain.