Vitalisation effect of *Tuber uncinatum* on experimental plantations

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Introduction

Between 2004 and 2006, 11 experimental *Tuber uncinatum* plantations were established in the framework of a research cooperation between Eötvös University (Hungary) and INRA (French National Institute for Agricultural Research). The certified truffle plants were made by the French Robin Pépinières. Several summer truffle biotypes were used to inoculate four host plants of French origin (*Carpinus betulus*, *Corylus avellana*, *Pinus nigra*, *Quercus* spp.). Photosynthetic activity is known to show the vitality of green plants. Mycorrhiza, a positive ecological relationship between plant and fungus, can improve the photosynthetic capacity by let the plant overcome on some abiotical stresses (improve the nutrient and water uptake, etc.).

Materials and methods

After 3 years of plantation establishments estimations of mycorrhizal colonisation, phenological descriptions of host trees and photosynthetic activity measurements were carried out. To test the vitality of plants had been mycorrhized before, the photosynthetic activity of leaves was measured by fluorescence induction (FMM fluorometer; Barócsi et al., 2009). On sunny days (J_{photon}>1000 µmol m^{-2} s^{-2}), light adapted leaves were measured for 2 min, where steady-state and peak fluorescences were recorded. To model the photosynthetic activity, $(F_v/F_{p690})/(F_v/F_{p740})$ parameter was found to be an adequate parameter (vitality parameter) which incorporates both actual quantum efficiencies, chlorophyll content and PSI/PSII ratio of leaves. On every plant, three developed light-leaf were measured. Regression analysis was performed on data to see the correlation of vitality to mycorrhization.

Figure 1. Measurement with FMM fluorometer

Results

Significant positive correlations between the plant phenological data (plant height, stem-base diameter) and mycorrhization often were found when data from all the orchards were analysed together. Since the ecological factors may differ considerably in each plantations the analysis of phenological data were carried out for each orchard separately (Figure 2.). These results can help to choose the best host plant in a particular truffle orchard.

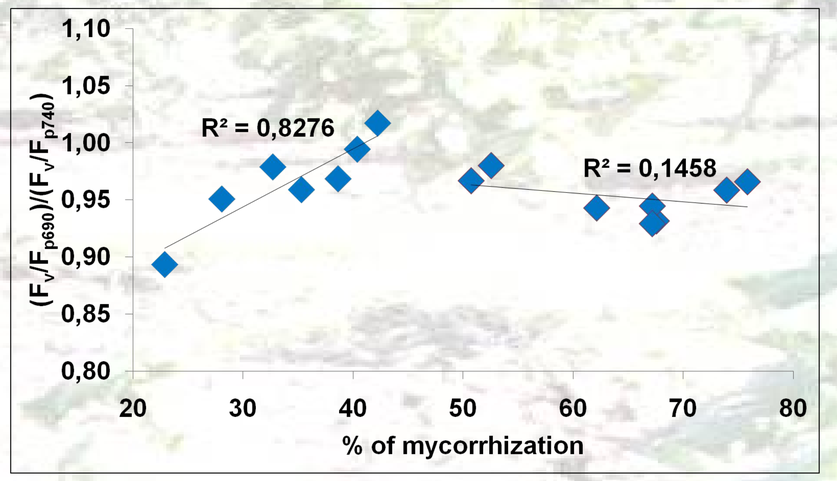


Figure 3. Correlation of the vitality index $(F_v/F_{p690})/(F_v/F_{p740})$ to the % of mycorrhization in *Quercus pubescens* plants mycorrhized by *Tuber uncinatum*.

The vitality of mycorrhized *Q. pubescens* plants increased paralelly to the mycorrhization until reaching 45-50 % of it. Over that the increasing of mycorrhization percentage did not enhance any more the vitality index. The strong correlation between mycorrhization percentage and vitality under 50 % of mycorrhization is also showed the high R^2 value of the linear regression of the plot.

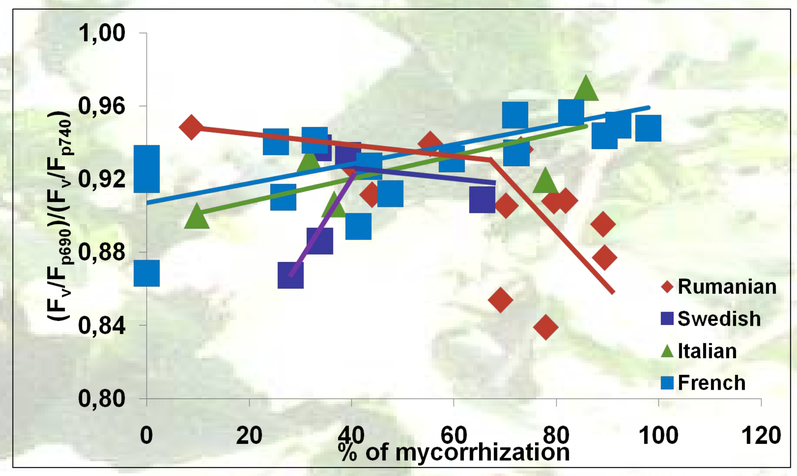
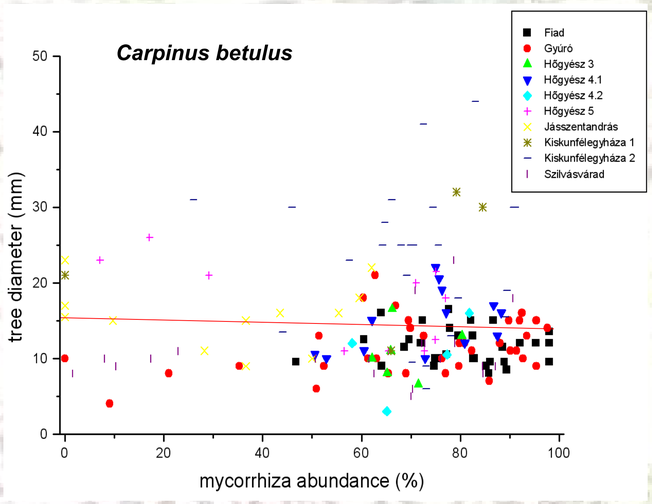


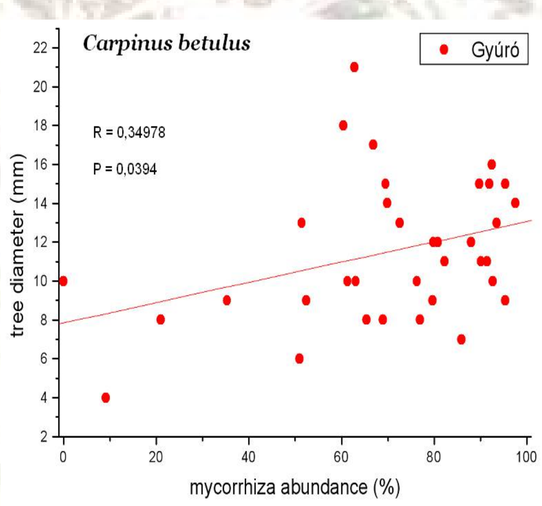
Figure 4. Correlation of the vitality index $(F_v/F_{p690})/(F_v/F_{p740})$ to the % of mycorrhization in *Carpinus betulus* plants mycorrhized by several (Rumanian, Swedish, Italian and French) ecotypes of *Tuber uncinatum.*

The vitality of mycorrhized *C. betulus* plants increased paralelly to the mycorrhization when they had been mycorrhized by Italian and French ecotype of *T. uncinatum*, the Swedish ecotype caused, however, increase in vitality until reaching 50% of % of mycorrhization. In case of Rumanian ecotype of *T. uncinatum*, the mycorrhization and the vitality of plants showed no positive, or over 60% of mycorrhization even decreasing correlation.

In *Quercus robur*, only the Italian ecotype fungus let the vitality parameter increased (R^2=0.442), in other cases no correlation was found between the mycorrhization and the vitality parameter. Nevertheless it should be mentioned that nearly all *Quercus robur* plants were suffered under a strong *Microsphaera* infection as it is a common plant pathogen make diseases on *Q. robur* leaves in the Hungarian Plain.

Figure 2. All examined *Carpinus* datas → *Carpinus* datas from only one plantation





Conclusion

- In *Quercus pubescens*, a clear positive correlation (R^2>0.8) was found between vitality and the percentage of mycorrhization where the mycorrhization remained below 50 %. The higher mycorrhization, however, did not improved the vitality further, or even let the vitality decreased somewhat., showing that the high mycorrhization is not able to be detected by fluorescence induction as it not improoves the vitality over a limit.

- In *Carpinus betulus*, the French, Italian and partially the Swedish ecotype fungus let the vitality improved indicating the positive effect of these fungus ecotypes on *C. betulus* plants.

- In conclusion we can say that low mycorrhization and low vitality are closely connected to each and the positive effect of *T. uncinatum* on the mycorrhized plants is detectable by fluorescence induction in some cases.

References

Barócsi A, Lenk S, Kocsányi L, Buschmann C. 2009. Excitation kinetics during induction of chlorophyll *a* fluorescence. Photosynthetica 47 (1): 104-111