les dossiers
d'**AGROPOLIS**
INTERNATIONAL
Expertise of the scientific community
Special Partnership Issue

Agroecological transformation for sustainable food systems

Insight on France-CGIAR research

Number 26
September 2021

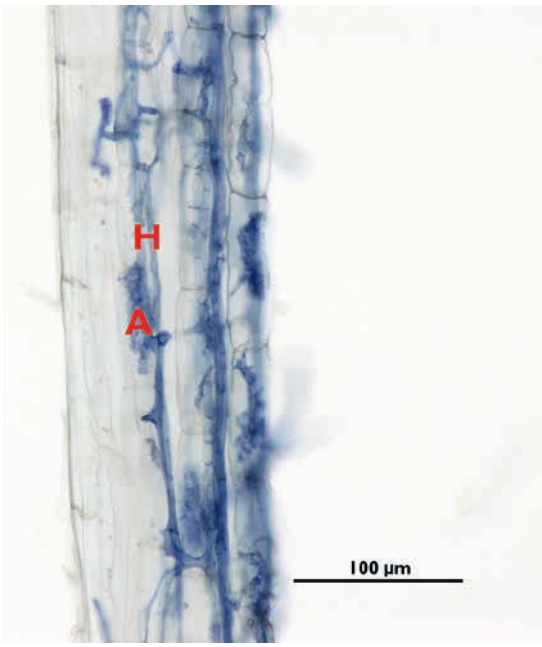
Keeping plants healthy

Optimizing agroecosystem productivity through effective mycorrhizal performance management

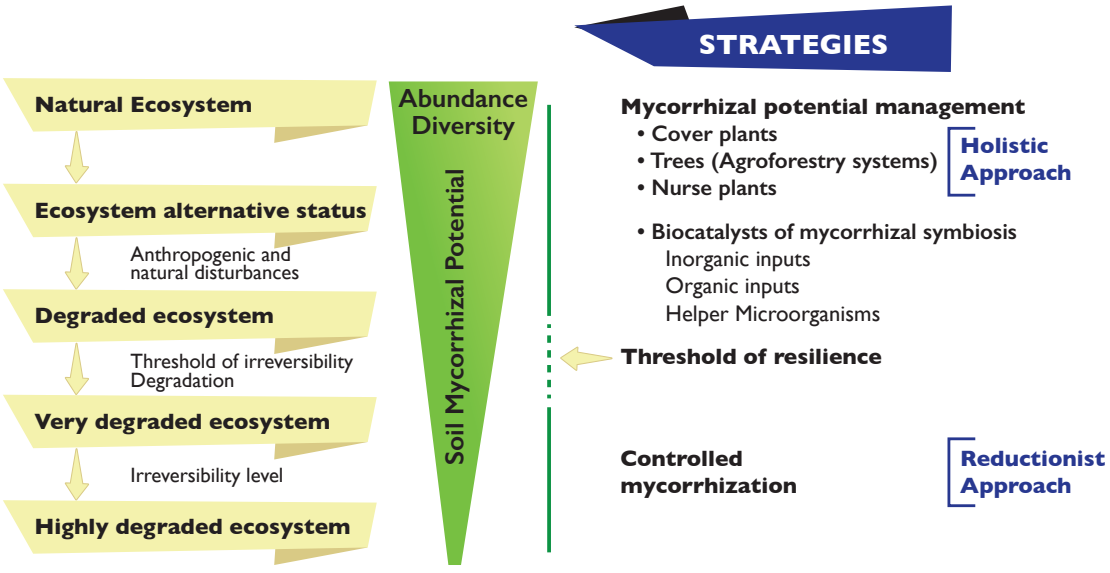
Mycorrhizal symbiosis is a reciprocally beneficial relationship between certain types of fungi and plant roots (Photo). It is a major microbial constituent of biological mechanisms governing soil fertility and the spatiotemporal dynamics of terrestrial plant communities (diversity, productivity, resilience). Many scientific studies have shown that this biological process facilitates plant growth in environments under abiotic (mineral deficiency, heavy metal pollution, water scarcity) and/or biotic (high parasitic pressure of phytopathogenic agents) stress(1). The extent to which this symbiosis will benefit plant growth is dependent on the composition of the soil mycorrhizal fungal community (spore abundance and diversity), i.e. the mycorrhizal infection potential (MIP) of the agroecosystem. The degree of soil degradation is closely correlated with this MIP (Figure). Based on scientific findings concerning this symbiotic process, different soil MIP management strategies may be developed according to the extent of degradation of the system targeted for remediation:

1. If the MIP value is considered high enough to be revived, a 'holistic' approach is implemented by installing plant cover that hosts a variety of highly mycotrophic plants (e.g. legumes).
2. If the MIP value is low, a 'reductionist' approach is favored via the mass reintroduction of mycorrhizal spores. Soil inoculations of one or more fungal strains preselected under controlled conditions for a given parameter (e.g. effect of the strain on growth of a target plant) are then carried out.

Many research results highlight the importance of soil mycorrhizal fungal communities in promoting sustainable agriculture. They also show **the potential advantages of mainstreaming these microorganisms in the design of innovative agroecological cropping sequences, with emphasis on beneficial plant/microorganism interactions.**



▲ *Spores and hyphae of arbuscular mycorrhizal fungi. A: arbuscules, H: hyphae*



▲ *Strategies for managing the mycorrhizal infection potential (MIP) according to the extent of degradation (resilience threshold) of the environment to be remediated.*
Holistic approach: increased MIP via biological vectors (cover plants, nursery plants, etc.).
Reductionist approach: mass introduction of mycorrhizal spores into the environment to be remediated (controlled mycorrhization technique).

Contacts

Robin Duponnois (LSTM, IRD, France), robin.duponnois@ird.fr

Yves Prin (LSTM, CIRAD, France), prin@cirad.fr

For further information

(1) Ramirez-Flores M.R., Perez-Limon S., *et al.*, 2020. The genetic architecture of host response reveals the importance of arbuscular mycorrhizae to maize cultivation. *eLife*, 9: e61701. https://doi.org/10.7554/eLife.61701

(2) Wahbi S., Sanguin H., Baudoin E., Tournier E., Maghraoui T., Prin Y., Hafidi M., Duponnois R., 2016. Managing the soil mycorrhizal infectivity to improve the agronomic efficiency of key processes from natural ecosystems integrated in agricultural management systems. *In*: Hakeem K. *et al.* (eds) *Plant, soil and microbes. Volume 1. Implications in crop science. Springer,* Cham: 17-27. http://dx.doi.org/10.1007/978-3-319-27455-3_2