



Max-Planck-Innovation

Technology Offer

Leaf metabolites as markers for mycorrhizal colonization of plant roots

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Background

All plants need the nutrient phosphorus (P) to grow and flourish, but the majority of P present in the soil is not suitable for plant uptake. The common solution is high P fertilization, however, natural phosphate resources suitable for fertilizers are not only limited but plants also take up only ca 10-25% of the supplied nutrient.

In regard of a sustainable agriculture, it will be necessary to develop crop varieties that are less dependent on high P input. A widespread plant strategy to cope with natural low P environments is symbiosis with specific soil fungi, called arbuscular mycorrhizal fungi (AMF). These fungi colonize the plant roots and provide P and other nutrients in return for sugars and various carbon metabolites. Moreover, the fungus may provide increased resistance to stresses like drought, salinity or pathogens.

Conventional agriculture has ignored the importance of AMF and generated elite breeding lines that produce extraordinary yields in regimes that disfavour AMF colonization such as tillage, monocropping and high rates of fertilizers. As a result, modern domesticated varieties show a decreased ability to establish AMF symbiosis (Fig. 1). To reverse this trend and generate high performance breeding lines able to cope in P-limited environments, AMF colonization status should be monitored routinely. However, state-of-the-art methods are not only laborious and time-consuming but also destructive to the plant root.

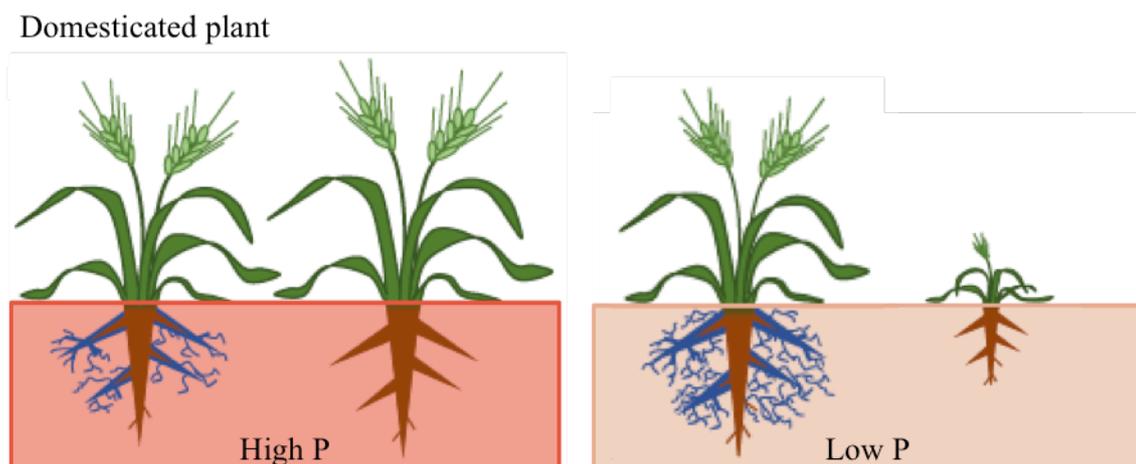


Figure 1: Domesticated plants grow well on P-rich soils whether or not AMF symbiosis is established. However, plants having established AMF symbiosis have a clear growth advantage at limited P environments. Selecting and optimizing these variants should be beneficial for a sustainable agriculture. Figure with modifications from (1)



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Researchers from the Max-Planck-Institute for Chemical Ecology in Jena discovered that a group of metabolites called blumenols accumulate not only in roots but surprisingly also in the leaves of plants having successfully established AMF colonization (2). Analyses of leaves from tobacco-, wheat-, barley-, tomato- and potato- plants suggest that blumenols can serve as robust indicators for plant-AMF symbiosis. Measuring the level of specific blumenols in the leaves is quick and easily applicable to a large number of plants. This technology may enable plant breeders to screen for crops performing well in AMF symbiosis, a trait that could not be selected for so far.

Highlights

- **Leaf marker for mycorrhizal symbiosis**
- **Marker-assisted breeding**
- **Useful for High-throughput analysis**

Patent Information

European priority application has been filed in February 2018.

Licensing Information:

The technology is available for licensing on a co-exclusive basis for a defined set of crops.

Literature

(1) Martin-Robles, N. et al., *New Phytologist* (2018) 218: 322–334 doi: 10.1111/nph.14962

(2) Wang, M. et al., *eLife* 2018;7:e37093 doi: 10.7554/eLife.37093