江西省水利科学院
Jiangxi Academy of Water Science and Engineering

EGU General Assembly 2022

Arbuscular mycorrhiza promotes the clean production of subtropical orchards

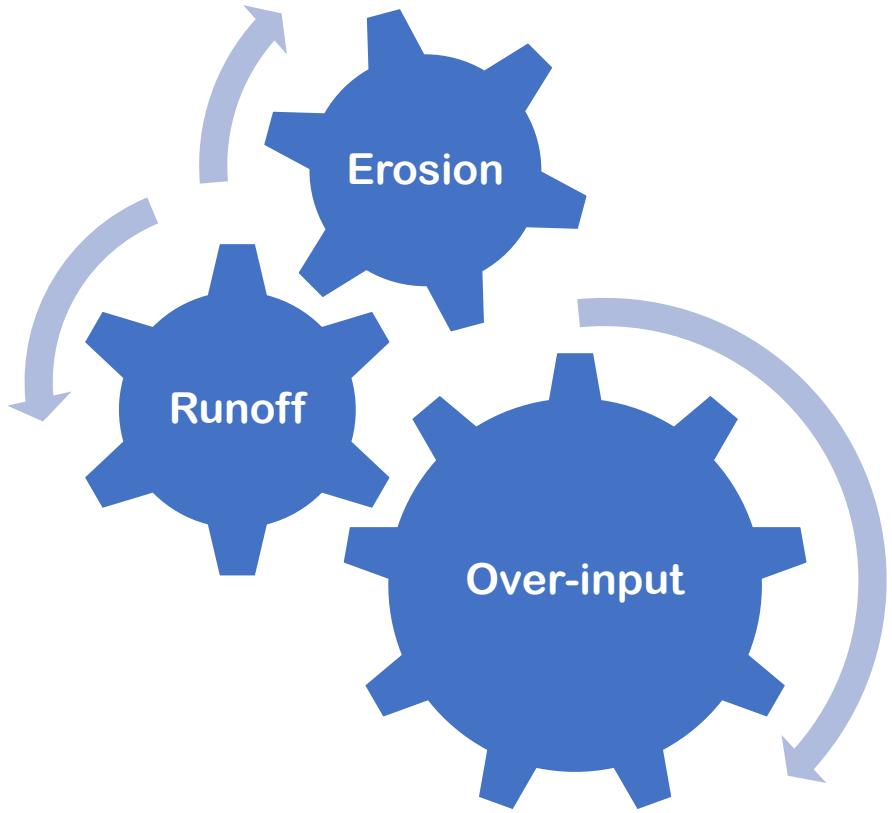
Hongguang Liu

Jiangxi Academy of Water Science and Engineering
China

Subtropical orchards develop rapidly

Catena 206 (2021) 105558

Nonpoint source pollution of subtropical orchard



NPS

On-site

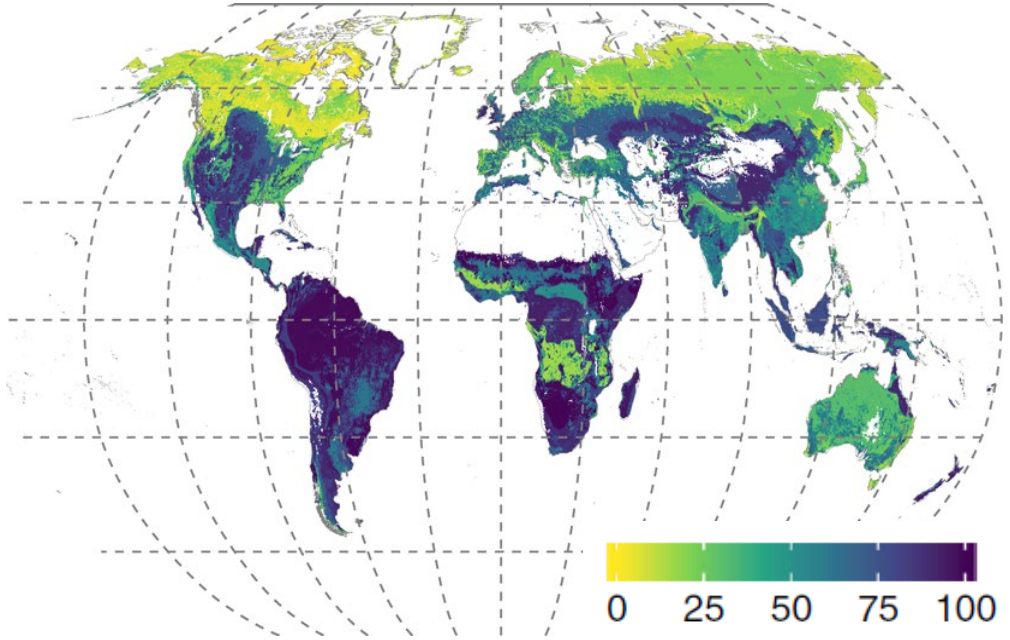
Soil fertility decline
Soil structure degradation
Low productivity
Nutrient imbalance

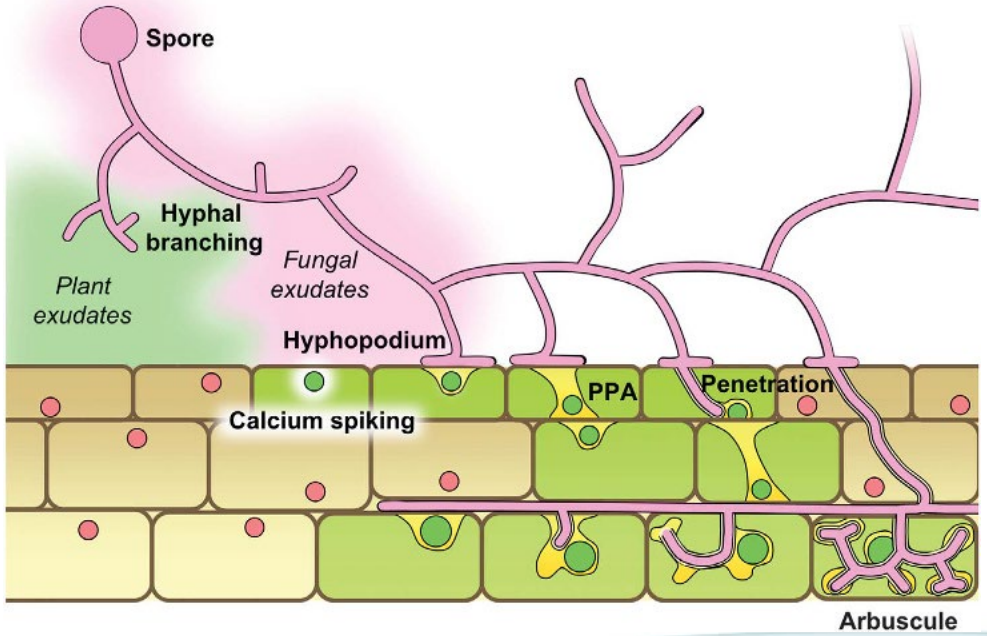
Off-site

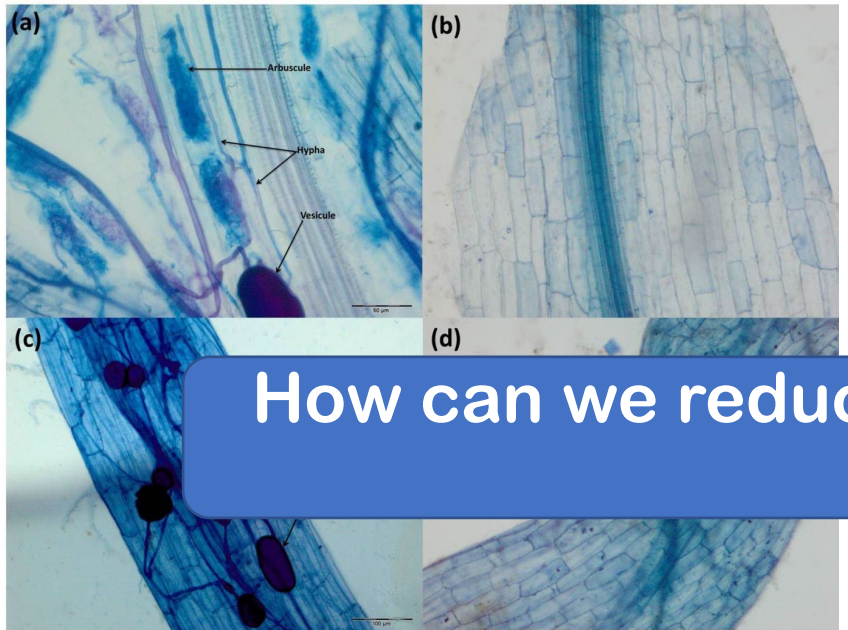
Eutrophication
Environmental safety

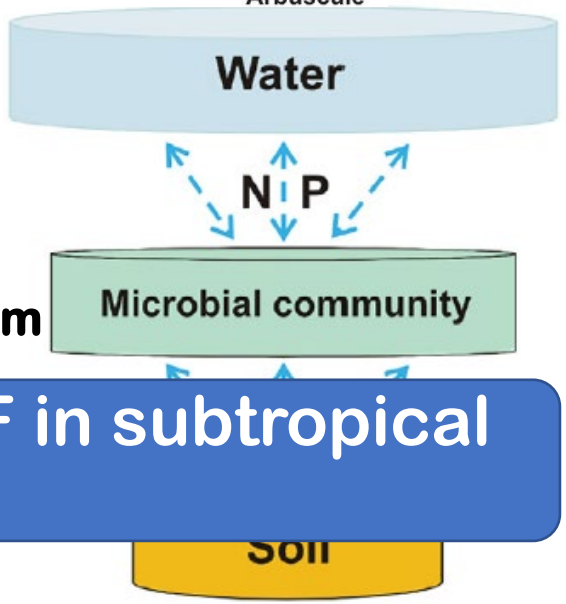
Techniques are needed to promote the clean production of orchard

AMF and NPS in subtropical orchard







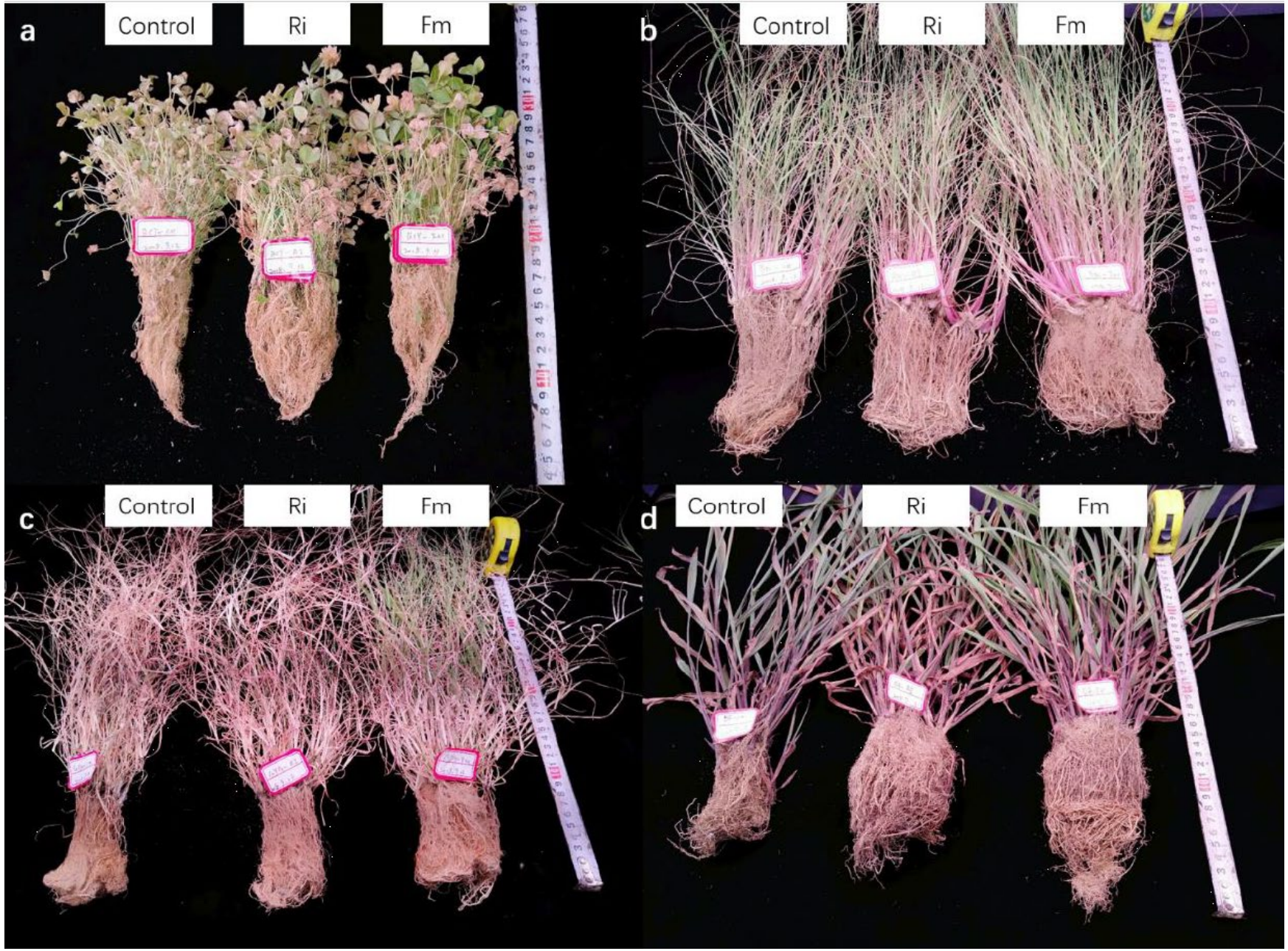


Immune system

How can we reduce NPS via modulating AMF in subtropical orchards?

Nat. Commun. (2019) 10:5077; (2010) 1:48; STE. 607–608 (2017) 1376–1380

AMF enhance soil aggregation



The root systems of grasses commonly used for erosion control were significantly enhanced by AMF inoculation.

AMF enhance soil aggregation

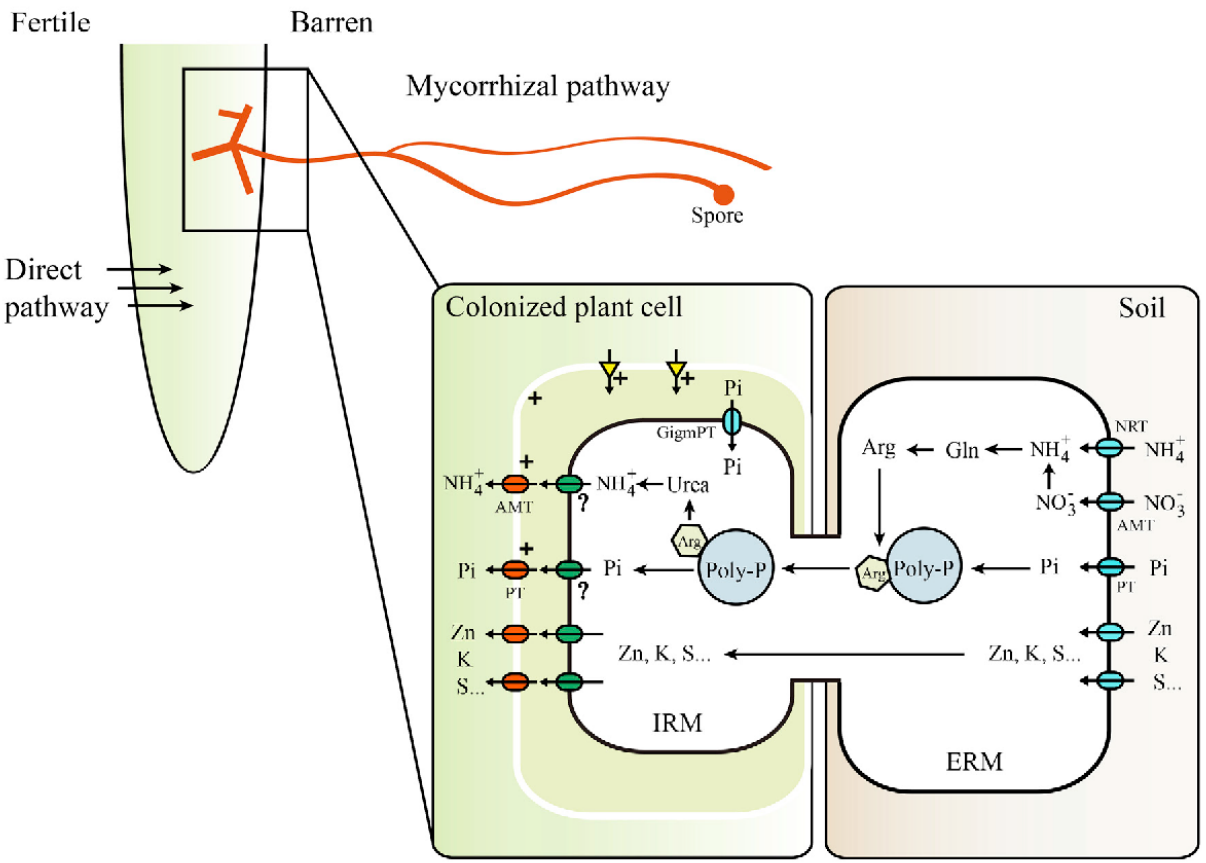
WSA (%)	*Trifolium repens*	*Paspalum notatum*	*Cynodon dactylon*	*Paspalum thunbergii*
Control	65.88 (12.09) b	76.77 (4.95) a	67.69 (16.11) a	70.50 (5.82) a
FM	72.84 (10.41) ab	79.20 (4.35) a	73.15 (8.94) a	75.33 (4.21) a
RI	82.65 (6.70) a	78.09 (2.44) a	71.42 (1.90) a	72.78 (5.04) a
F	**3.558**	0.45	0.282	1.138
P	**0.061**	0.648	0.760	0.353

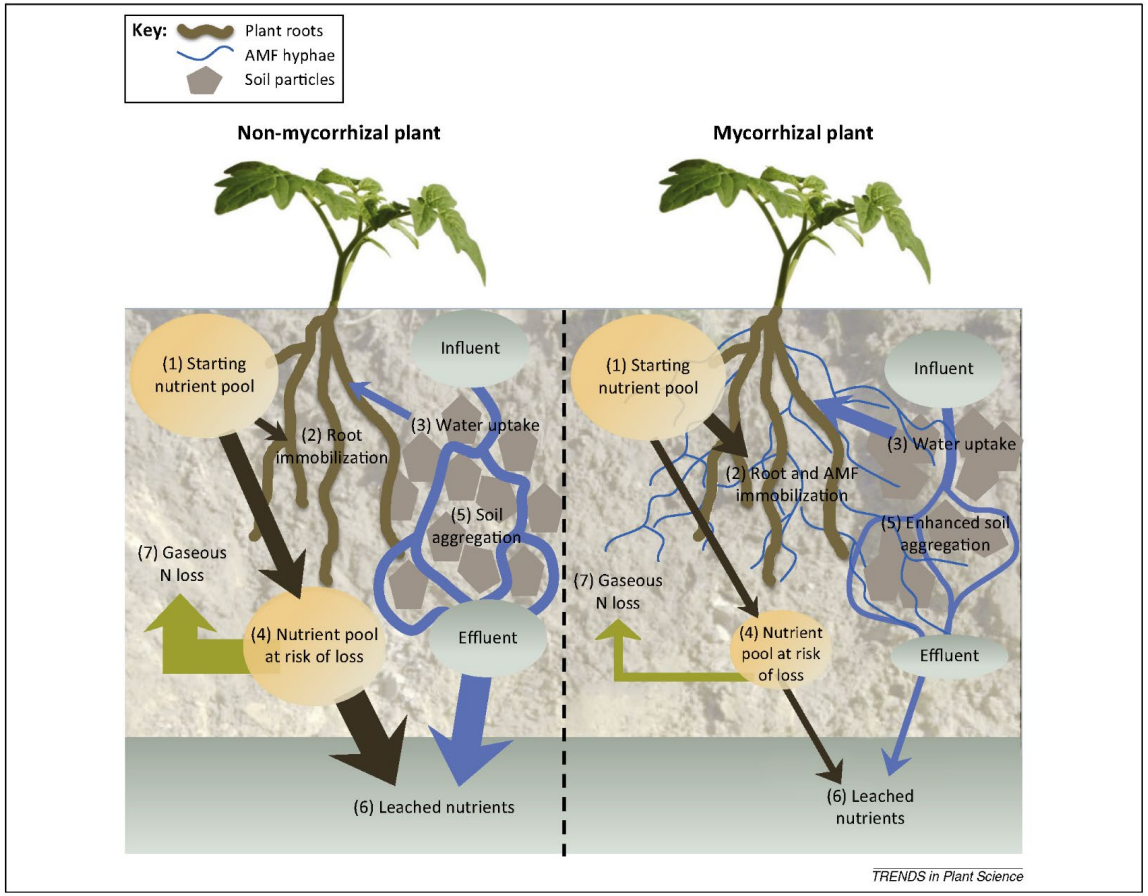
FM and RI increased WSA of *T. repens* by 11% and 25% than control

AMF significantly promoted the root structure and architecture of grasses, especially for the legume, which indirectly increased the soil water stability.

Unpublished data

AMF roles in nutrient use & loss



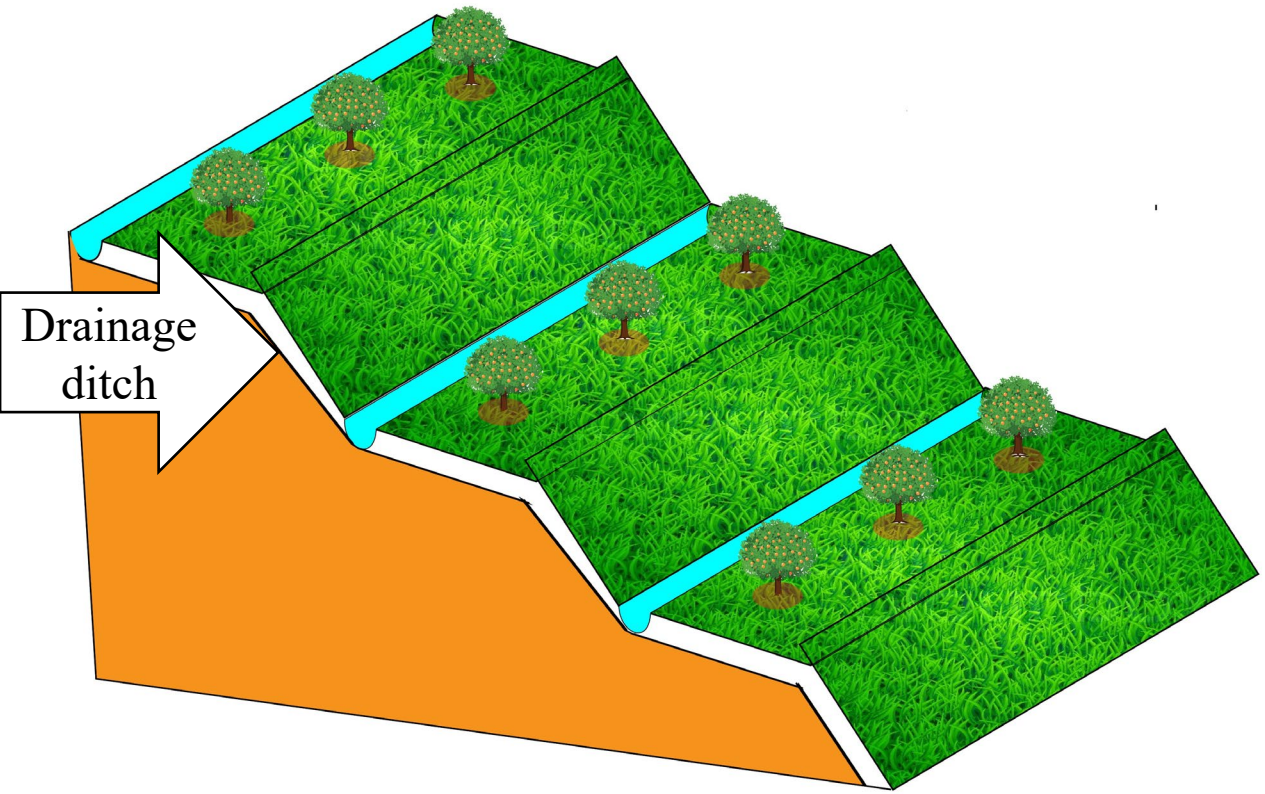


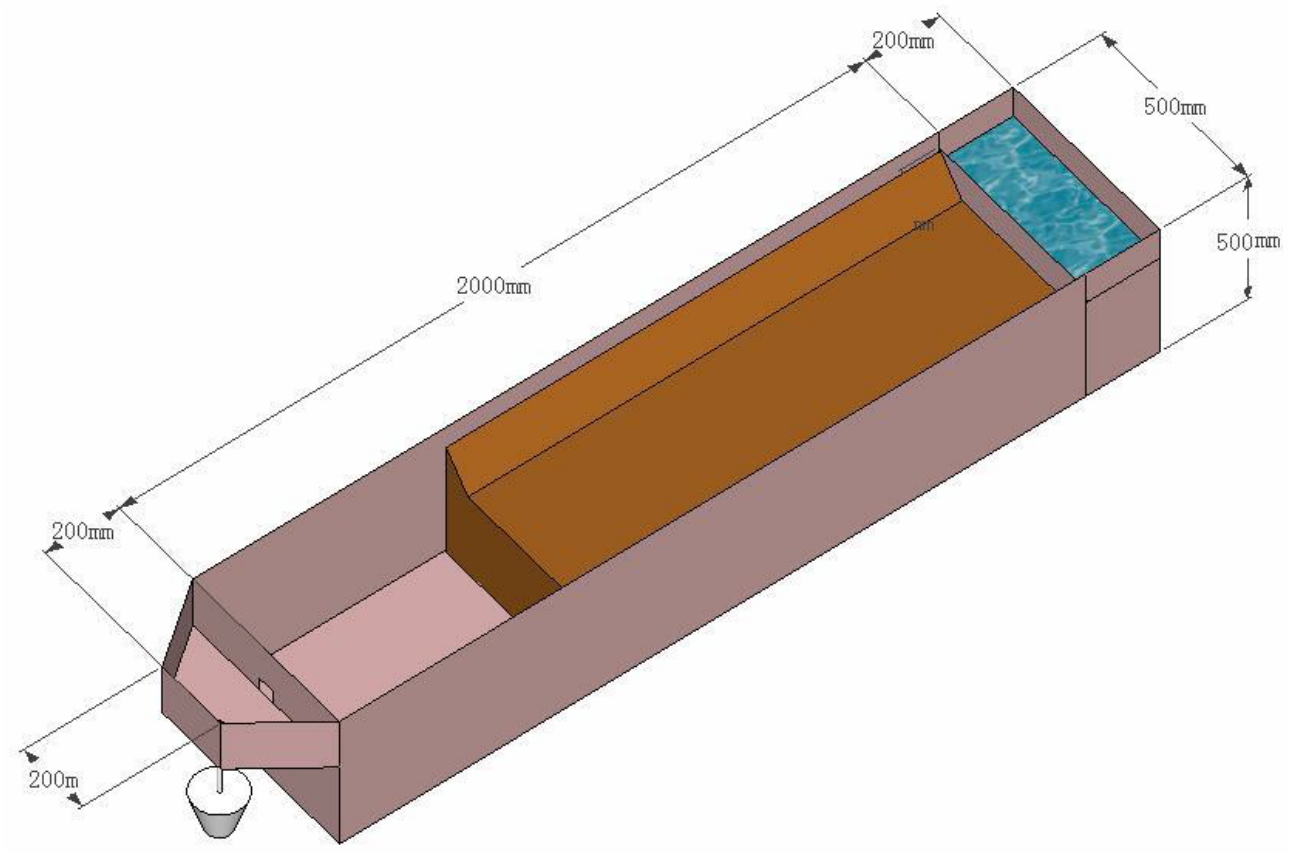
Promoting nutrient uptake: P, N, Zn, K, S……

Curbing nutrient loss: leaching and aerial pathway

Mol. Plant (2017) 10:1147-1158; TIPS (2015) 20: 283-290

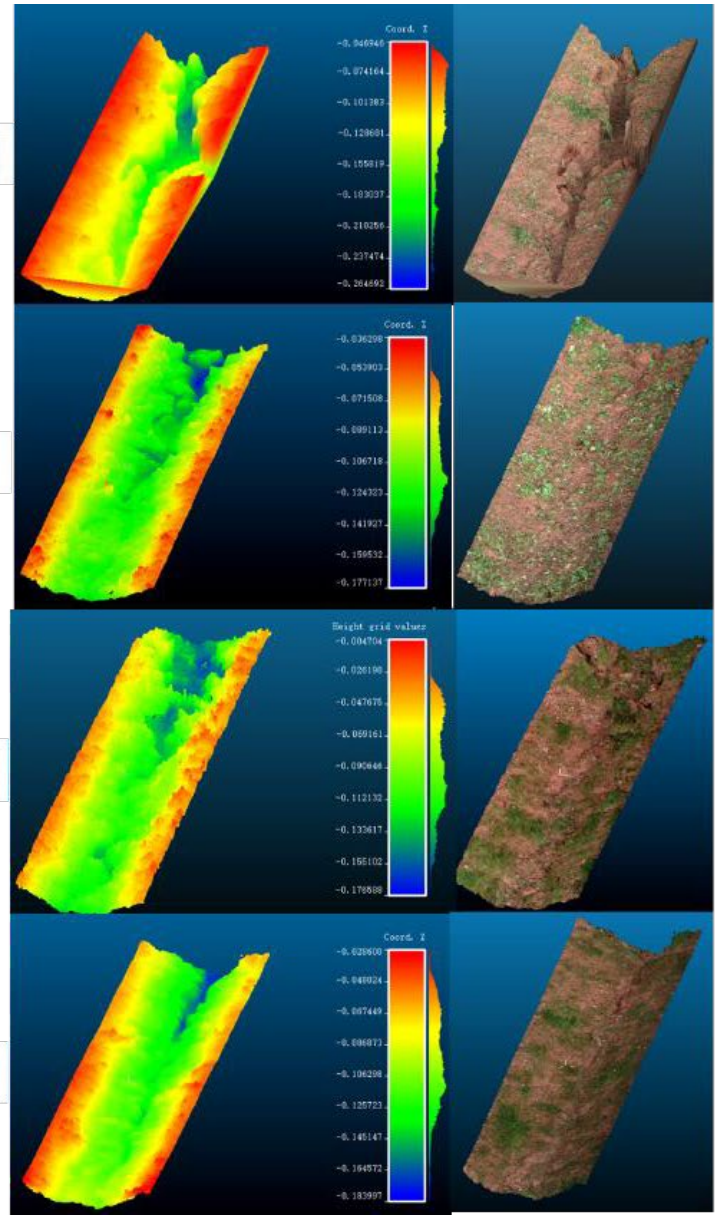
AMF contribute to P retention of grass ditch

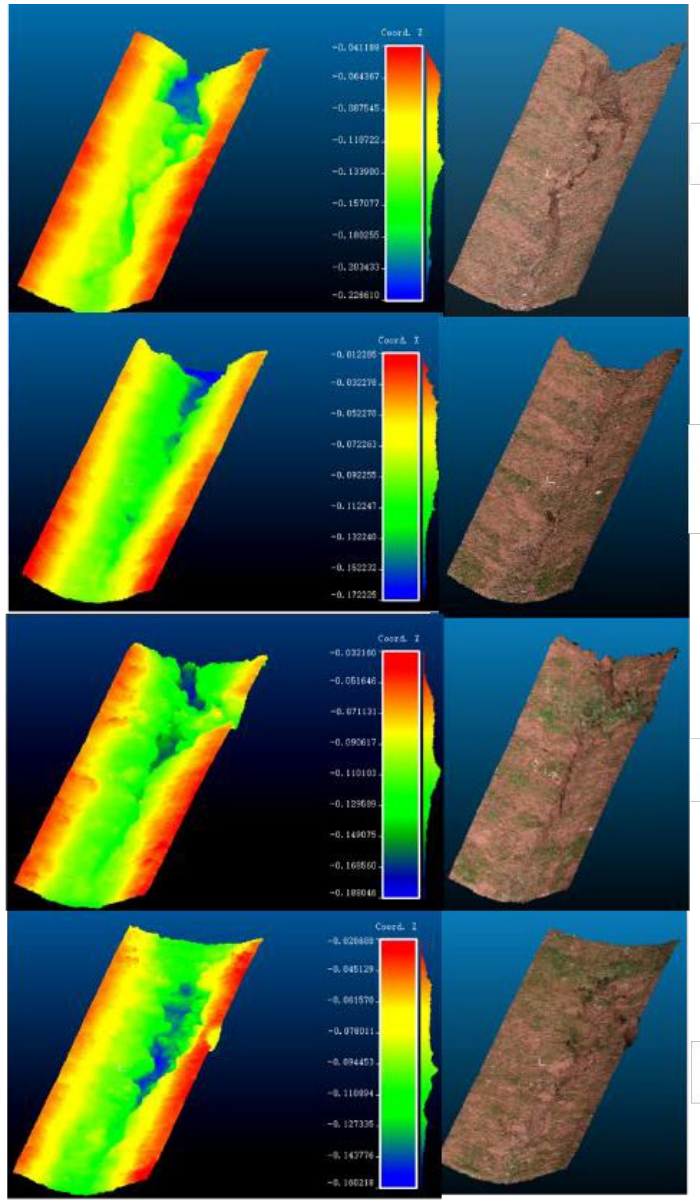




Quantify the AMF contribution in P retention in grass ditch via simulated water flow.

AMF contribute to P retention of grass ditch

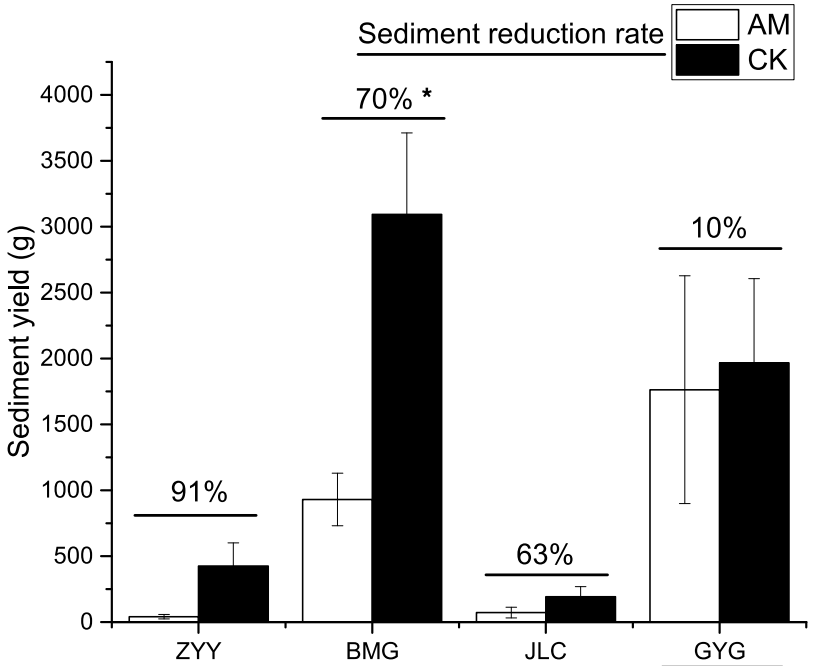


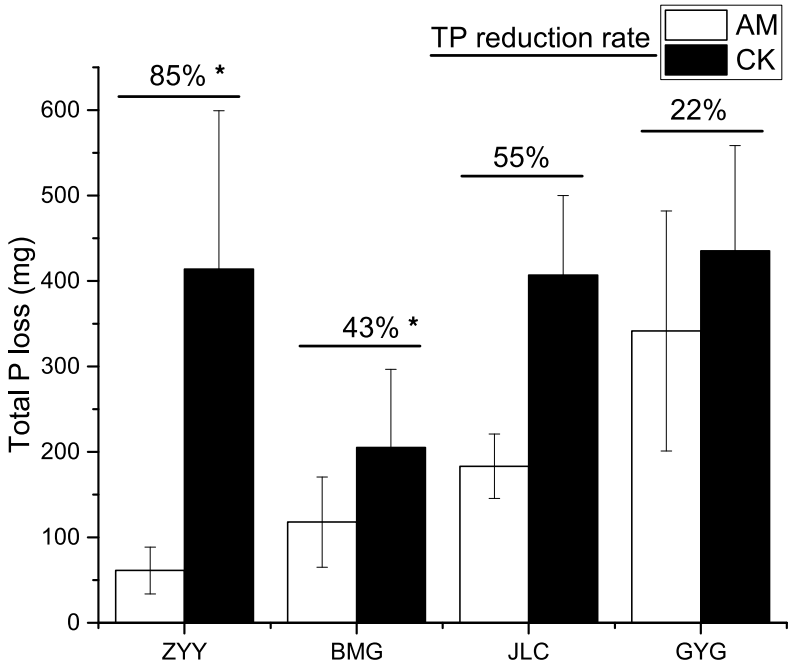


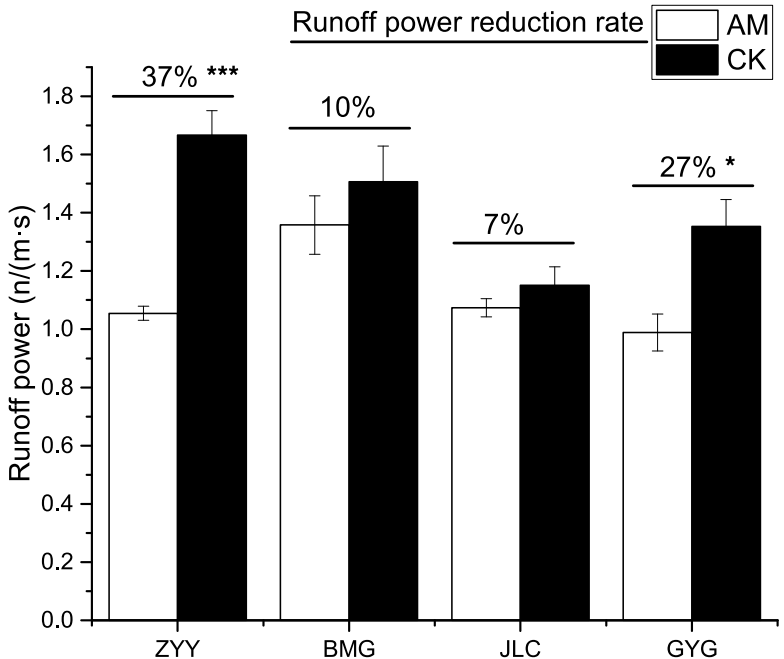
The existence of AMF greatly decreased the erosion degree of the grass drainge ditches.

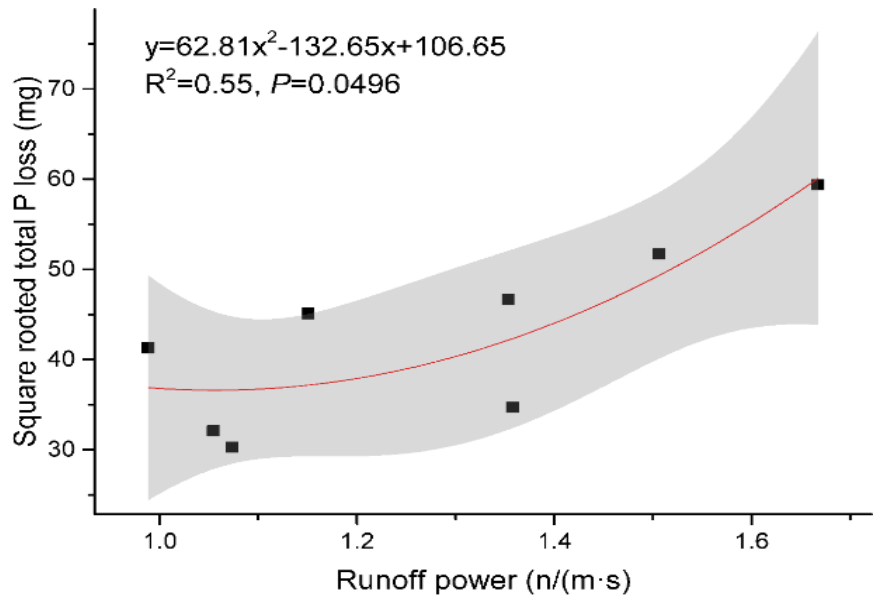
ZYY-*Astragalus sinicus*; BMG-*Lotus corniculatus*; JLC-*Zoysia japonica*; GYG-*Cynodon dactylon*.

AMF contribute to P retention of grass ditch









The runoff power is significantly correlated with P loss. AMF contribution of in curbing P loss is due to reduced runoff power.

Unpublished data

AMF trigger defense system of fruit trees

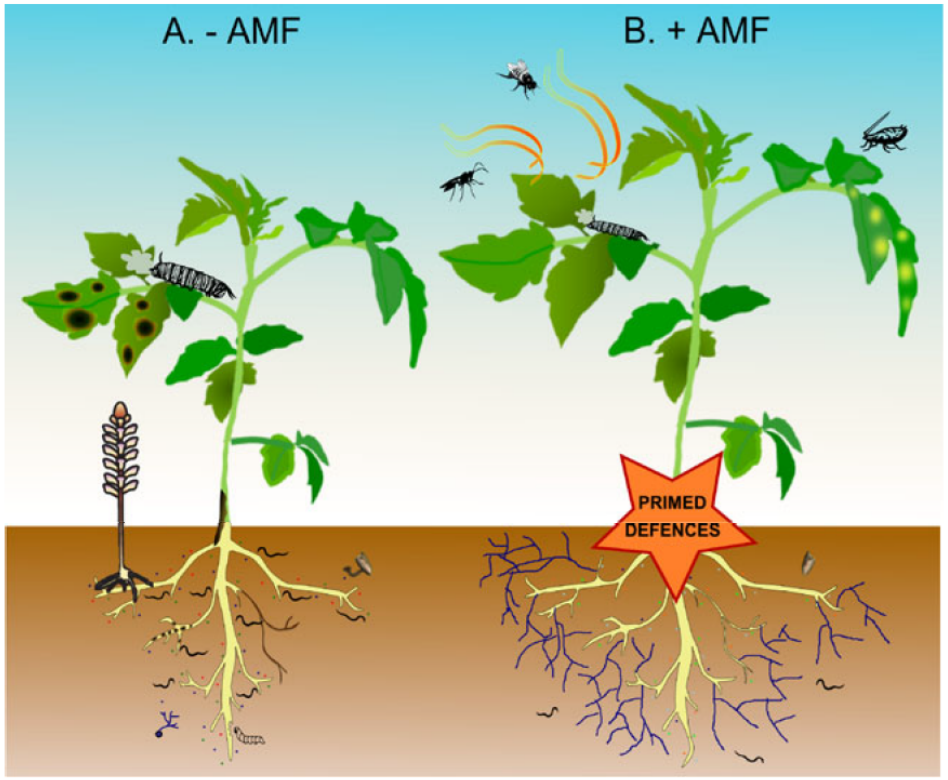


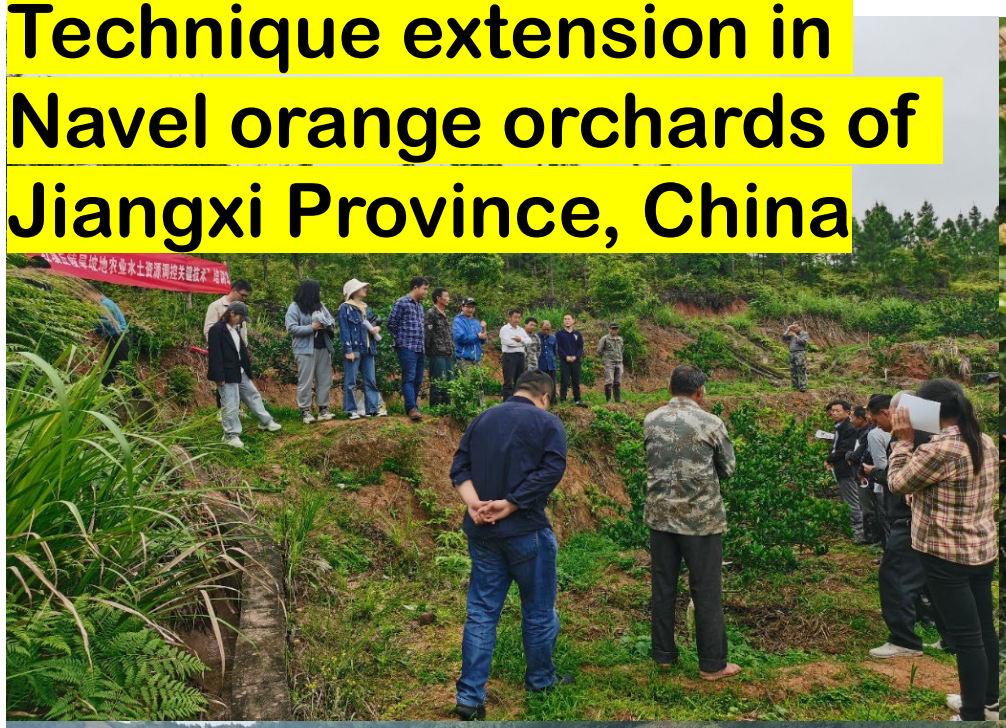
Fig. 1 a Non-mycorrhizal plant (− AMF). Absence of root colonization by AMF leads to stronger development of symptoms in response to necrotrophic pathogens and more damage upon feeding by chewing insects in roots and shoots when compared to mycorrhizal plants. Release of strigolactones (SLs) as part of the root exudates induces branching of AMF hyphae to promote mycorrhization but also induces germination of *Orobanchaceae* seeds which then parasitize the host plants' root system. **b Mycorrhizal plant (+AMF).** Growth promotion is often observed due to improved acquisition of mineral nutrients through the AM fungal hyphal network (represented in blue). Changes in the root exudate patterns repel nematodes and induce changes in the soil microbial community, possibly attracting antagonists of pathogens and a reduced release of SLs minimizes the risk of infection by root parasitic plants. Priming of plant defenses leads to a general reduction of the incidence and/ or damage caused by soil-borne pathogens, nematodes and chewing insects. In above-ground plant parts, viral and fungal biotrophs, as well as phloem-feeding insects, perform better on mycorrhizal plants. In contrast, the primed jasmonate-regulated plant defense mechanisms restrict the development of necrotrophic pathogens and the performance of phytophagous insects. Indirect defenses, such as the release of volatiles, are boosted and parasitoids are efficiently attracted

The primed defenses via common network of AMF mycelia potentially leads to decline in using farm chemicals.

How to foster a healthy AMF community in subtropical orchard?

- Sod culture
- Inoculation with AMF
- Optimize fertilization plan
- Proper usage of fungicide

Technique extension in Navel orange orchards of Jiangxi Province, China



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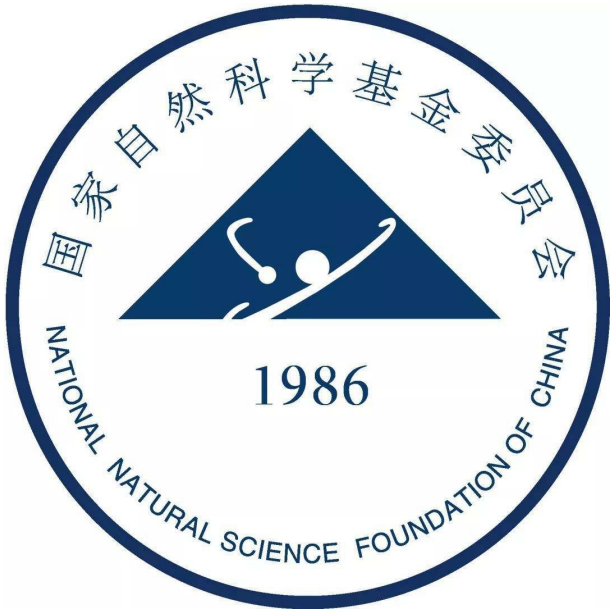
Thanks for your attention



Dr. Hongguang Liu
Email: hongguangliu0791@hotmail.com