Combined application of arbuscular and ericoid mycorrhizal fungi together with compost and biochar products originating from bio-waste

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Introduction: The high amounts of bio-waste produced in the EU have an enormous beneficial potential if the material could be led back into agri- or horticulture. The "end of waste" (EoW) concept opens the possibility that waste, after a recovery treatment, can cease to be waste, if it fulfils certain criteria. These criteria ensure that the quality of the material is such that its use is not detrimental to human health or to the environment.
The significance of treated bio-waste for agri- and horticulture lies in its nutrient content but as well in the possibility of products combining recycled biological material and inocula of mycorrhizal fungi or bio-control organisms.

The REFERTIL project (Oct 2011 – Sept 2015) has the mission to contribute to the transformation of bio-waste into new resources. This includes standardization of bio-waste treatments and nutrient recovery processes. The output products will be safe, economical and standardized compost and biochar (BC) products containing phosphorous and nitrogen that can be beneficially used by farmers. The REFERTIL consortium consists of 13 partners from 9 EU member states (research institutions, SME, public authorities).

Materials: Composts are commonly known. However, its quality and beneficial potential depend on the input material used for compostation.
Biochar originates from different types of plant and/or animal waste biomass carboniferous materials. Biochar is produced under low temperature carbonization conditions at an average 500°C in the absence of oxygen. Properly produced biochar from bone material contains high amounts of P and Ca, whereas the contamination with heavy metals and organic pollutants is minimal. The P-fraction in the BC is not easy available to plant roots. This makes BC interesting as a P-fertilizer for organic vegetable production or low input agriculture.

Objectives of the work shown here:

- Selection of AMF and ERMF isolates suitable for combination with biochar and compost products.
- Evaluation of biochar and compost products for their technical suitability to be used in a combined product together with mycorrhizal fungi.
- Investigation of the role of mycorrhizal fungi in nutrient transfer from biochar and compost to plants.
- Research on the risks and advantages of a biochar-compost application for mycorrhizal formation and functioning.

First results: AMF and ERMF combined with bio-waste products
1. Possible negative effects on mycorrhizal development were tested with different AMF and ERMF isolates by mixing 10% biochar (from bone particles) or compost ("green compost" made 100% from plant material) into the substrate. Regarding compost 10% is a realistic mix, regarding biochar 10% is about 10 times overdose. Fig. 1 and Fig. 2 show that these amendments do not hinder a good mycorrhizal development. However, other types of compost and biochar as well as other symbionts are still to be tested. Additionally we will test the impact on the development of small model populations of mycorrhizal fungi.
2. Mycorrhizal functioning was up to now investigated regarding P-transfer from biochar to the host plant (Tagetes) via AMF. Fig. 3 shows the growth of the plants, without AMF they have no access to the P bound in the biochar particles (row B). In Fig. 4 the red columns represent row B and C in Fig. 3: without AMF there is only minimum P-flux to the plants at the level of 2% biochar in the substrate.

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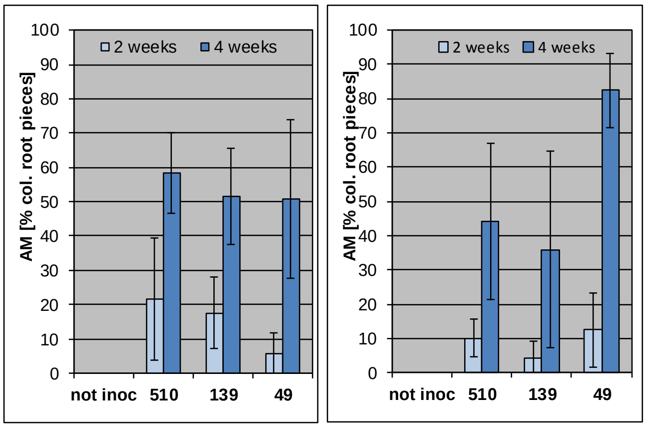

Fig. 1: AM colonization (± SD) of *Tagetes erecta* cv. Luna Lemon grown in quartz sand, inoculated with *G. intraradices* (510; 49) or *G. etunicatum* (139). All plants fertilized without P.
left = substrate + 10% BC; right = substrate + 10% compost.

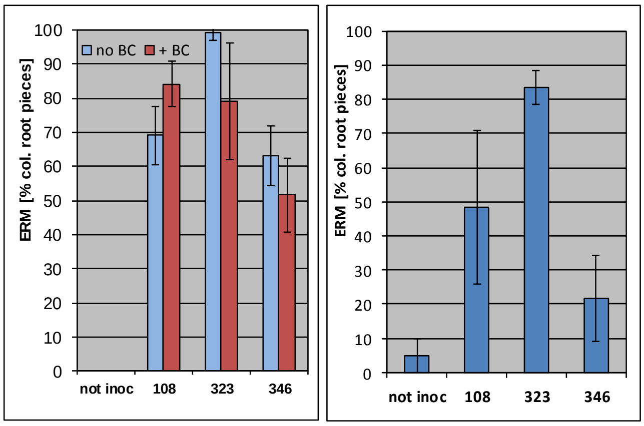

Fig. 2: ERM colonization (± SD) of Rhododendron cv. Cunningham´s White grown in rhodo-substrate, inoculated with ERMF isolates 108 (not identified), 323 (*Rhizoscyphus ericae*) or 346 (*Oidiodendron maius*).
left = substrate + 10% BC; right = substrate + 10% compost.

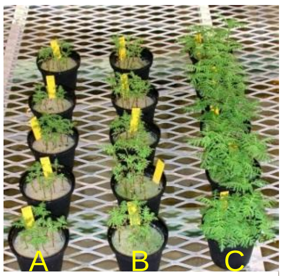

Fig. 3 (up): *Tagetes erecta* cv. Luna Lemon grown in quartz sand, 34 days after sowing. All plants fertilized without P. A = inoculated with AMF; B = with 2% (v/v) BC; C = AMF + 2% (v/v) BC.

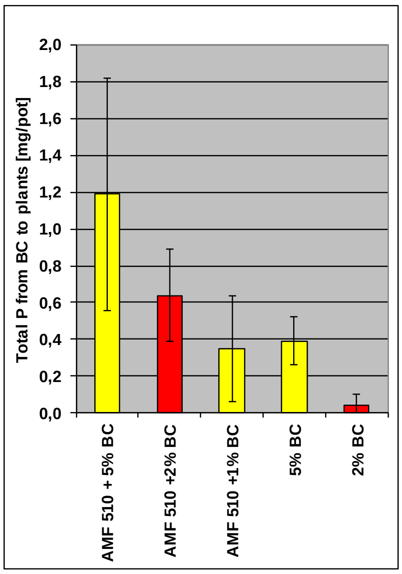

Fig. 4 (right): Total P-transfer (± SD) into tagetes (cv. Luna Lemon) plants after 52 days of growth in quartz sand. All pots were fertilized with P-free Hewitt-solution. Biochar (BC) added in varied amounts (v/v); n = 5.