REFERTIL NEWSLETTER

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Issue: March 2015 - Compost and Biochar

Agronomical Evaluation Tests 2014

In This Issue

REFERTIL PARTNERS

REFERTIL IN BRIEF

The REFERTIL project is providing advanced solutions to the added value transformation of the organic bio-waste streams from Europe's agriculture and food industries. In this context, the REFERTIL project is improving the current compost systems and developing new generation zero emission industrial scale biochar technology for safe, economical and ecological nutrient recovery process, most importantly Phosphorous, for conservation agriculture. The targeted high quality output products aiming to reduce the use of mineral fertilizers and intensive chemicals in agriculture; enhancing the environmental, ecological and economical sustainability of food crop production. Furthermore reducing the negative footprint of the cities and overall contributing to climate change mitigation, while creating new bio-economy. Moreover, the REFERTIL project provides strong policy support to the European Commission for the revision of the Fertiliser Regulation, that will standardize and law harmonize the safe biochar and compost products use as organic P-fertilisers and/or soil improver and/or growing media products.

'ABC' - Animal Bone bioChar

EVALUATION OF COMPOST AND BIOCHAR QUALITY IN THE REFERTIL PROJECT

Compost and biochar evaluation trials were started in 2014 by REFERTIL in several European Countries, under different soil and climatic conditions:

- The Netherlands: strawberry and tomato in greenhouse;
- Italy: tomato, pepper, zucchini, lettuce, cucumber in nursery, greenhouse and open field;
- Slovenia: strawberry in open field;
- Ireland: cereal crops in open field;
- Denmark: barley and other cereal crops;
- Hungary: vegetables and cereal crops in open field.

The aim of the trials is to validate the developed transformation and recycling technologies, the compost and biochar potential for reduction of the mineral fertiliser use, the effects for crop productivity, enhanced soil health, improved nutrients availability to plants and suppression of soil-borne plant pathogens.

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Summary results of the REFERTIL field trials

- Animal bone char (ABC) can be used as organic fertilizer (100-400 kg/ha) and mixed in growing media (0.1-5% v/v).
- High quality compost can be used as soil improver (5-30 t/ha) and mixed in growing media (1-20% v/v).
- Nutrients present in compost and biochar products are taken up by tomato plants: organic by-products are successfully recycled and replaces the use of mineral P and K fertilizers in agricultural crop production.
- Green waste compost with a relatively low nutrient content can be used as organic amendment to substitute peat in potting soil and showed the capacity to enhance *Pythium* suppressiveness of the substrate.
- Mycorrhiza and nutrient solubilising bacteria can be combined with the application of biochar and compost products in agriculture and horticulture.

Strawberry field in Slovenia

Greenhouse trials in Italy

Greenhouse trials in Italy

Sweet pepper produced in a farm using compost and biochar in Italy

Greenhouse and field trials in Italy

Within the **REFERTIL** project, different tests were carried out by **Agroinnova – University of Torino** to test the agronomical performance of 12 **composts** and 4 **biochar**:

- potting trials on vegetable crops (zucchini, lettuce) to evaluate the use compost and biochar as soil improvers, organic fertilizers or growing media;
- suppressiveness trials on cucumber, to evaluate the capacity of compost and biochar to control plant pathogens;
- field trials on tomato, pepper and lettuce, to validate the use of compost and biochar in farms located in Italy.

Composts deriving from animal manure and municipal biowaste reduced seeds germination and plant growth when used as growing media, and they are not recommended to be mixed at dosages higher than 5-10%. However they have a good fertilization effect when applied to soil, and increased yields when applied at 10-30 t/ha. Green waste composts can be used as growing media, and 50% of them suppressed soil-borne plant pathogens. Animal Bone bioChar ABC showed a good fertilization effect on crops, while plant based biochar had few effects on yields and results vary according to soil type.

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Field trials on strawberry

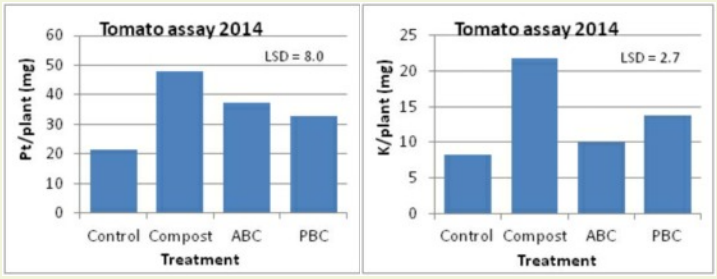
In trials carried out by Lea Lavric (KOTO, Slovenia), compost and ABC biochar have been applied in field trials and compared to one mineral fertilizer. During the first year of the trial, the application of 130 kg/ha of animal bone char (ABC) and of 10 t/ha of green composts produced in Hungary and Spain provided **yields similar to the application** of 800 kg/ha **of mineral fertilizers**.

The achieved results indicate the possibility to use selected compost and biochar for substituting chemical fertilizers.

Strawberry field test Lukovica, Slovenia

Tomato nutrient uptake with the use of compost and biochar

In trials carried out by Joeke Postma & Els Nijhuis (DLO, Wageningen UR), young tomato plants were grown in potting soil with different organic amendments: a green waste compost, plant based biochar (PBC) and animal based biochar (ABC). Total biomass and nitrogen uptake of the plants differed not significantly, but the uptake of potassium (K) and phosphate (P) was clearly enhanced by the presence of the different organic amendments.



Uptake of phosphate (P) and potassium (K) by young tomato plants grown in potting soil.

Suppression of tomato disease with compost

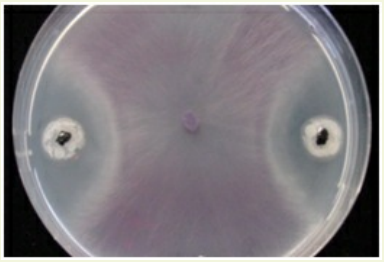
In trials carried out by Joeke Postma & Els Nijhuis (DLO, Wageningen UR), young tomato plants were grown in potting soil artificially infested with the soil-borne plant pathogen *Pythium aphanidermatum*.

Bioassay with young tomato plants to test disease suppressive properties.

More healthy plants were present when compost was added to the potting soil compared to the potting soil without compost. A green waste compost from a Dutch producer was tested in 2012, 2013 and 2014, resulting in, respectively, 46, 98 and 26% more healthy plants compared to the un-amended potting soil. Also compost from other sources enhanced disease suppressiveness when 10 % was added to potting soil. Four different composts from Spain and Hungary increased the number of healthy plants with 22 up to 41 %.

Beneficial effect of bacterial inoculants

In trials carried out by Joeke Postma & Els Nijhuis (DLO, Wageningen UR), a bacterial strain, *Pseudomonas chlororaphis* 4.4.1, was introduced into the potting soil directly, or indirectly via compost or biochar. This bacterial strain has the capacity to inhibit growth of plant pathogenic fungi and to make phosphorus available for plant growth. The *Pseudomonas* strain protected the tomato seedlings against infection by *Pythium aphanidermatum*, resulting, on average, in 48% more healthy plants. It also promoted the uptake of phosphorus (P) by the tomato seedlings when non-soluble P was present in the form of animal bone char (ABC).



Pseudomonas chlororaphis inhibiting growth of fungal plant pathogens.

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THE USE OF MYCORRHIZA FOR INCREASING COMPOST AND BIOCHAR QUALITY

Joeke Postma, Els Nijhuis & Marieke Förch from Wageningen UR tested the use of mychorriza on strawberry in 2014.

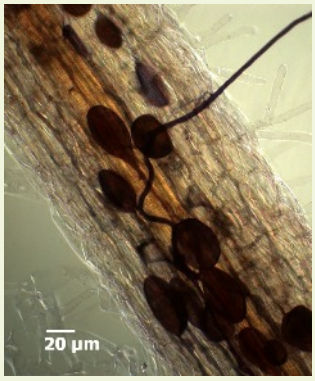
Phytophthora cactorum is an important disease in strawberry cultivation, both in plant propagation and fruit production. Potting mixes and other substrates used for strawberry cultivation are free of mycorrhiza. Therefore the inoculation of mycorrhiza in such growing media can have beneficial effects.

In tests carried out by Wageningen UR, composts, animal bone char, chitin and antagonistic micro-organisms (*Trichoderma*, *Pseudomonas*) were ineffective to reduce the disease. However, the mycorrhiza *Rhizophagus irregularis* delivered by Dr. H. von Alten from the University of Hannover was able to reduce infection with *P. cactorum* by around 50% when compared with the control plants without mycorrhiza.

Production of strawberries in substrate, Dutch system under glass

What is a mycorrhiza?

Nearly all plants on earth live in symbiosis together with fungi. Their roots are in contact with the symbionts, the mycorrhizal fungi, which supply the plants with nutrients deriving from regions of soil not accessible to roots or root hairs.



Mycorrhiza colonizing roots under magnification of light microscope

Mycorrhiza inoculum produced by Dr. H. von Alten, University of Hannover

Mycorrhiza species have a number of beneficial properties, such as making phosphorus available to the plant or reducing pathogen infection by means of competition.

Why shall biochar and compost be combined with mycorrhizal fungi?

Compost and biochar contain nutrients that are important for plant growth and development. These nutrients are released in soil only slowly and is not easily available to plant roots.

Bioassay with marigold plants to test biochar, compost and mycorrhizal effects

Mycorrhizal fungi have much better tools for extraction of bound nutrients compared to plant roots, and allow much better plant growth if mycorrhizal fungi are applied together with biochar and compost (right group of plants in the picture, left = ABC alone).

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