REFERTIL – COMPOST AND BIOCHAR TESTING

The REFERTIL compost and biochar evaluation trials started in 2013 in several European countries (the Netherlands, Italy, Slovenia, Ireland, Denmark, and Hungary) under different soil and climatic conditions. 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, and improved nutrients availability to plants with suppression of soil-borne plant pathogens.

Agroinnova – University of Torino carried out different test for evaluation of the agronomical performance of 12 composts and 4 biochar samples. They have conducted (i) potting trials on vegetable crops (zucchini, lettuce) to evaluate the use of compost and biochar as soil improvers, organic fertilizers or growing media; (ii) trials on cucumber, to evaluate the capacity of compost and biochar to control plant pathogens and (iii) field trials on tomato, pepper and lettuce, to validate the use of compost and biochar in farms located in Italy.

Figure 1. Refertil compost and biochar test in greenhouse (photo source: AGROINNOVA).

The results indicated that composts derived from animal manure and municipal biowaste reduced seed germination and plant growth when used as growing media, and they are not recommended to be mixed at dosages higher than 5%. 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.

In trials carried out by KOTO in Slovenia, compost and 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 bioChar (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 fertilizer.

In a greenhouse trial carried out by DLO, Wageningen UR, young tomato plants were grown in potting soil with different organic amendments. Green waste compost, plant based biochar (PBC) and Animal Bone bioChar (ABC) were added to the potting soil. Plants were harvested 4 weeks after sowing to assess dry weight and mineral content per plant. Total biomass and nitrogen uptake of the plants differed not significantly, but the uptake of potassium (K) and phosphate (P) was clearly influenced by the presence of the different organic amendments. P

and K levels were highest when 10% of compost was added to the potting soil; levels of P as well as K increased more than 100% compared to the un-amended potting soil. Levels of P were also elevated when 1% ABC or 1% PBC were applied with an increase of respectively 73 and 52%. K levels were elevated with respectively 20 and 66 when 1 % ABC or 1% PBC were applied.

The results with young tomato plants grown in potting soil clearly showed that the P and K present in compost and biochar products were taken up by the crop. Thus, organic waste is successfully recycled and replaces the use of mineral P and K fertilizers in agricultural crop production.

In trials also carried out by 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 bioChar.

Figure 2. Refertil strawberry field test in Slovenia (photo source: KOTO d.o.o. Lea Lavric).

Compost and biochar contain nutrients that are important for plant growth and development. These nutrients are released in soil only slowly and are not easily available to plant roots. When bio-char is produced from animal bones (ABC) it contains very high amounts of Phosphorous which is delivered to soil and plant only slowly. Plants do not live alone! Together with the soil they are the habitat of a multitude of bacteria and fungi. With some out of these groups plants can form a symbiosis that means living together with advantages for both partners. Within fungi there are the mycorrhizal fungi forming symbioses with plant roots. Mycorrhiza species have a number of beneficial properties, such as making phosphorus available to the plant or reducing pathogen infection by means of competition.

In a bioassay with marigold plants conducted by the University of Hannover it was confirmed that mycorrhizal fungi have much better tools for extraction of bound nutrients compared to plant roots, and thus much better plant growth can be expected if mycorrhizal fungi are applied together with ABC biochar and compost.

In another test carried out by Wageningen UR the mycorrhiza Rhizophagus irregularis delivered by Dr. Henning von Alten from the University of Hannover was able to reduce

infection with Phytopthora cactorum by around 50% when compared with the control plants without mycorrhiza.

To summarize the results of the REFERTIL field trials we present current conclusions:

- Animal Bone bioChar (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, in combination with a Pseudomonas bacterial strain, 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.

Authors

Edward Someus[1], Massimo Pugliese[2], Joeke Postma[3], Henning von Alten[4], Lea Lavric[5]

[1] Terra Humana Ltd.
[2] AGROINNOVA, Centre of Competence for Innovation in the Agro-Environmental Sector, Università degli Studi di Torino
[3] DLO, Wageningen UR
[4] Leibniz University of Hannover
[5] KOTO d.o.o.

Contact

Contact email: Edward Someus – biochar@3ragrocarbon.com , skype: edwardsomeus

URL: www.refertil.info

Acknowledgements

The REFERTIL project is co-funded by the European Union, Seventh Framework Programme under Grant Agreement number 289785.