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Significant plant growth stimulation by composted as opposed to untreated Biochar

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The application of production-fresh, untreated biochar does not always result in yield improvements, in particular in temperate or boreal soils. Therefore the use of biochar for soil C sequestration, although desirable from a global change mitigation point of view, may never be implemented without proven and economically feasible pathways for biochar effects in agriculture. To investigate earlier reports of the beneficial effects of composting biochar (e.g. Fischer & Glaser, 2012) we conducted a fully replicated (n=3, +/- biochar) large-scale composting study at the Delinat Institute in Arbaz, Switzerland. The materials were manures (bovine, horse and chicken), straw, stone meal and composting was performed with our without +20 vol.% of a woody biochar (German Charcoal GmbH). Interestingly, the rotting temperature was significantly higher in the biochar-compost while C and N were retained to a certain extent.

To investigate the effect of composting ("ageing") on biochar effects, a completely randomized full-factorial pot study was carried out in the greenhouse using the pseudo-cereal Chenopodium quinoa. The three factors used in the study were (I) type of biochar addition ("aged", "fresh", or zero BC), (II) addition of compost and (III) low and high application rates of a full NPK-fertilizer (equivalent to 28 and 140 kg N ha-1, NPK + micronutrients) in several doses. The growth medium was a poor loamy sand. Biochars and compost were all added at a rate of 2% (w/w) to the soil.

From the start there was a considerable difference between the growth of Quinoa with the fresh compared to the aged biochar. The fresh biochar produced the well-known reduction in plant growth compared to the unamended control. This reduction was alleviated to a certain extent by the addition of either compost and/or increased fertilization. In contrast the co-composted biochar always resulted in a highly significant stimulation of the Quinoa yield (roots, shoots, inflorescences). This stimulation was most pronounced when the growth conditions were the most unfavorable (no compost addition + low fertilization: aged BC 305% versus fresh BC 61% of zero-BC). The stimulation was least pronounced in the treatment where the growth conditions were most favorable (compost addition + high fertilization). However, despite the higher fertility and higher nitrate values the mixtures with the composted biochar did not show higher N2O emissions. Reasons for the strong significant change in plant growth promotion, i.e. changes on the biochar surfaces that occur during the composting, will be discussed.

Fischer D, Glaser B (2012) Synergisms between compost and biochar for sustainable soil amelioration. In: Management of Organic Waste. (eds Sunil K, Bharti A), ISBN 978-953-307-925-7, Chapter 10, pp. 167-198.