Effect of Artificially Aged Biochar (BMC) on the mycorrhizal colonisation, plant growth, nutrient uptake and soil quality improvement

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Keywords: BMC, mycorrhizal colonization, nutrient uptake, yield

Introduction

Biochar mineral complex (BMC) is a Terra Preta (black earth) like particle composed of biochar (approx. 30% by weight) made from woody waste mixed with manure and other sludges (approx. 30%), clay and minerals such as calcium carbonate, rock phosphate, dolomite, crushed granite, and biomass ash. This mixture is heated at approximately 220°C for 2 hours to form a stable organo-mineral biochar micro-aggregate. Previous unpublished trials with BMC have shown increased plant growth, microbial growth and nutrient uptake at low application rates (<300kg/ha). However, the effect of BMC on mycorrhizal colonization and soil quality changes need to be investigated.

The aim of this experiment is to clarify several questions such as: (i) Can BMC stimulate mycorrhizal fungi? (ii) Can BMC increase wheat growth and nutrient P uptake? (iii) what is the effect of using different biochars different clays and different manures?

Results and Discussion

The plant growth (total dry weight and shoot dry weight) was significantly increased after application of 100 kg/ha of BMC5 and 6 (made from low temperature biochar) and at 200kg/ha of BMC7 and 8 (fig. 1). Shoot dry weight of plants grown with 200kg/ha of BMC5 decreased. Mycorrhizal colonization significantly increased for all BMCs although BMC6 applied at 200kg/ha was not great (fig. 2). The effects of BMC on microbial biomass, activity, and on other soil quality improvement will be presented. P uptake in shoots and available P in soil was significantly higher for all BMC’s although the greatest plant uptake was measured in BMC5 at 100kg/ha and BMC6 and 8 at 200kg/ha.

Conclusion

The present formulation of BMC is effective in enhancing growth of wheat at low application rates (less than 100kg/ha of biochar). The increase in yields appears due to an increase in P uptake in the plants which could be partly attributed to increase in AMF colonisation. Crop yields are similar to those achieved by addition of the same application rate of chemical fertilizers.

Acknowledgements

Financial support has been provided by VenEarth Llc and from the Australian Research Council

After 6 weeks of growth, parameters are measured include total microbial biomass (microbial biomass C, N, P); % of root colonized by mycorrhizal fungi, roots dry weight/total root length, shoots dry weight, plant N and P concentration and uptake.
**Fig. 1** Effect of BMC application on plant shoot, root and total plant growth 6 weeks after sowing.

**Fig. 2** Effect of BMC on arbuscular mycorrhizal colonisation in wheat roots.

**Fig. 3** Effect of BMC application on available P in soil and plant shoot P uptake.