Influence of Quality Compost on Plant Growth and Mycorrhizal Colonisation in Corn

Getinet Desalegn, Erwin Binner, Andreas Lössl, Horst Vierheilig, Peter Liebhard, Peter Lechner

Universität für Bodenkultur Wien
Department für Angewandte Pflanzenwissenschaften und Pflanzenbiotechnologie
Department Wasser-Atmosphäre-Umwelt (WAU)

Introduction

The declining of organic matter is one of the most critical threats of soil functions in most agricultural lands worldwide. Among the different farm practices, compost application can be employed to build organic carbon stocks in the soil. In the composting literature, the composting process and the composition of organic sources play significant roles in the production of high quality stabilized final compost.

The poster elaborates the effects of quality compost application on: (1) yield structures of corn (*Zea mays* L.); (2) plant nutrients uptake and (3) infectivity potential of indigenous arbuscular mycorrhizal fungus (*Glomus mosseae*).

Research methodologies

Phase I: Production of quality compost

The two tested composts were produced from biowaste alone (B) and a mixture of biowaste and horse manure (BHM) in 200 L reactor (Fig. 1).

Compost quality was controlled and monitored as adapted in Getinet et al. (2008).

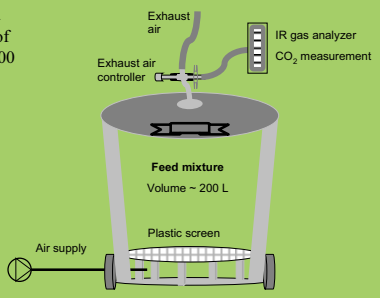

Figure 1: Schematic diagram of composting reactor used under room temperature conditions for preparing the two composts

Phase II: Assessment of quality compost

Finally, a positive effect of quality compost application on soil fertility and plant growth was evaluated.

The experiment was designed in a Randomized Complete Block Design with six replicates.

Treatments were the two composts B and BHM and two additional treatments (chemically fertilized and unfertilized/control).

Experimental setup and plant growth

Results and discussion

In this study, the final compost obtained from the two-combined substrates was less mature and less stable due to the presence of higher bedding materials (wood chips and straw) in the horse manure. after 140 days of composting. On the other hand, the humic acids content was higher of about 50% in pure biowaste than its mixture with horse manure (data not shown). The amount and the quality of humic acids in compost considered as important indicator of their biological maturity, chemical stability, warranty for safe impact and successful performance in soil (Senesi et al., 2007).

Compost application to soils increased plant height (PH), leaf area index (LAI) and biomass dry matter yield (DMY) of corn significantly ($p<0.001$) as compared to the control (soil-only) treatment (Fig. 2). Green et al. (1995) reported that yield responses are reflected from the influence on the quantity and quality of organic matter added to the soil and mineralization rate.

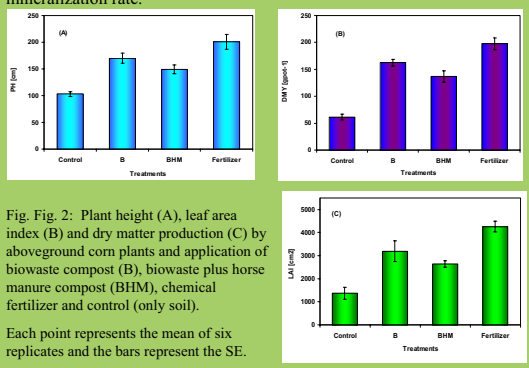

Fig. Fig. 2: Plant height (A), leaf area index (B) and dry matter production (C) by aboveground corn plants and application of biowaste compost (B), biowaste plus horse manure compost (BHM), chemical fertilizer and control (only soil).

Each point represents the mean of six replicates and the bars represent the SE.

Largely, compost amendments affected the nutrient concentration in the corn positively. Hence, chemical digests of the extracts from leaves and stems of plants revealed that the N_2, P, K^+, Ca^{++} and Mg^{++} concentration in the pure biowaste compost treated pot was significantly greater ($P<0.001$) than the mixture and control treatments (Fig. 3A, B, C, D and E). The addition of organic matter to soil in the form of stabilized and mature compost, rich in humic acids increases mineralization of nitrogen and micronutrients has already been reported elsewhere. Thus, in terms of nutrient release and composition, compost obtained from pure biowaste was better as compared to its mixture with horse manure.

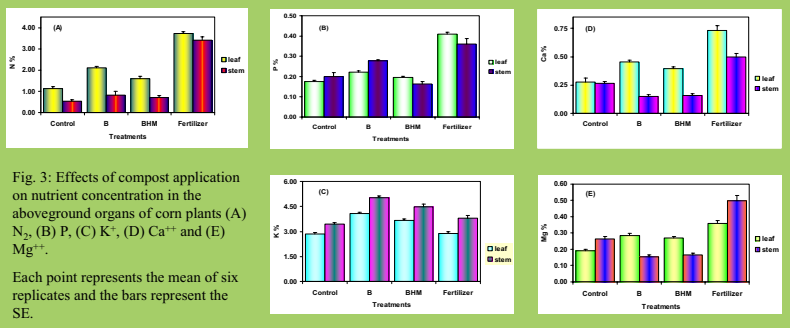

Fig. 3: Effects of compost application on nutrient concentration in the aboveground organs of corn plants (A) N_2, (B) P, (C) K^+, (D) Ca^{++} and (E) Mg^{++}.

Each point represents the mean of six replicates and the bars represent the SE.

The highest indigenous mycorrhizal colonization of 52% was recorded in the control treatment, while compost amendment negatively affected them (data not presented here). That might be associated with higher bioavailability of plant nutrients, particularly phosphorus in the compost treated pots than in control treatment. Gavito and Miller (1998) suggested that fertilization of naturally infertile soils reduces *G.mosseae*.root colonization, while fertilization of naturally fertile soils has little or no effect. Overall, it seems that the initial soil fertility mediates arbuscular mycorrhizal fungi response. Of course, many processes are indeed involved in the efficiency of P acquisition of a plant.

Conclusions and recommendations

It is plausible to conclude that the highest bioavailability of plant nutrients and the highest functional groups of soil organic matter are noted after quality compost addition. Such noted changes play an important role in the soil functions to improve plant productivity. A similar long-term experiment is essential for a better understanding of the changes in soil functions as well as to better follow organic matter development.

References

GAVITO, M.E., MILLER, M.H. (1998): Early phosphorus nutrition, mycorrhizae development, dry matter partitioning and yield of maize. PLANT SOIL 199, 177-186.
GETINET DESALEGN, BINNER ,E., LECHNER, P. (2008): Humification and degradability evaluation during composting of horse manure and biowaste. COMPOST SCI UTIL 16 (2), 90-98.
GREEN, C.J., BLACKMER, A.M. (1995): Residue decomposition effects on nitrogen availability to corn following corn or soybean. SOIL SCI SOC AM J 59, 1065-1070.
SENESI, N., PLAZA, C., BRUNETTI, G., POLO, A. (2007): A comparative surveys of recent results on humic-like fractions in organic amendment and effect on native soil humic substances. SOIL BIOL BIOCHEM 39, 1244–1262.

Tropentag, October 5-7, 2011, Bonn
Contact: Getinet Desalegn, getinet.desalegn@boku.ac.at

universität des lebens