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Composts *vs.* mineral fertilisers: sustainable options for agricultural fertilisation

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The misuse of mineral fertilisers in agriculture can have a negative effect on soil and water quality. In this sense, we question if there is any effective alternative to the use of mineral fertilisers. Uncontrolled application of mineral fertilisers can cause environmental problems such as eutrophication and nitrate contamination caused by nitrogen (N) and phosphorous (P) leaching to ground and surface waters, soil acidification and accumulation of toxic elements, as well as changes in soil microbiology and fertility. Organic fertilisers, such as composts, are products rich in nutrients and beneficial for plant growth that can be used in substitution of mineral fertilisers. The aim of this study was to assess the efficiency of two composts produced from pig slurry as soil fertilisers, in substitution of mineral fertilisation.

A pot trial was conducted in a greenhouse, using ryegrass as a test plant and five fertilising treatments: Compost A and Compost B (both made with the solid fraction of pig slurry (SF) and cotton gin residues (CGR) at two different SF:CGR proportions: 3:4 and 4:3 (v/v) for compost A and B, respectively) at two different doses (D1 (44.6-49.3 Mg ha^{-1}) and D2 (89.3-98.6 Mg ha^{-1})), and a 10:10:10 NPK fertiliser (F); a non-fertilised control soil was included (C). Both composts were mature and biochemically stable, and therefore of enough quality for agricultural purposes, presenting high concentration of humic substances and nutrients beneficial for plant growth. Application rates were based on the N requirement of the ryegrass; the first dose (D1) of composts was calculated to provide the same amount of total nitrogen (TN) as the F treatment, while D2 treatment doubled the amount of TN in F treatment. The composts were applied to the soil at the beginning of the experiment, while the inorganic fertiliser (F treatment) was applied in two phases. Ryegrass was harvested three times and after the first and second cut, a strong raining event was simulated and the leachates were recovered from the bottom of the pot. Both ryegrass and the leachates were analysed throughout the experiment and the soil and roots were analysed only at the end of the experiment.

Results showed higher biomass production (1.2-3.6 times higher) when compost was used, in comparison with the control treatment, especially in D2 (Figure 1). In the first harvest, compost-based treatments were as efficient as F treatment in supplying the nutrients needed for a correct plant growth, showing similar biomass production for D1 and F treatments and higher biomass production when the compost dose was doubled. However, after the first rain event, biomass production decreased to values bellow the ones found in F, but still higher than those in the control. Such decreases in production were related to limited available-N, which may be due to N-leaching, caused by the strong rain events and low organic-N mineralisation. The highest plant biomass in harvests 2 and 3 occurred in F, as fertiliser was applied twice during the experiment.

In conclusion, a compost-based fertiliser seems to be effective replacing the mineral fertilisation at the short-term, but a combination with mineral fertilisation during plant growth season may be needed to supply the required nutrients for an efficient crop production, since compost addition cannot be repeated during the growing season.

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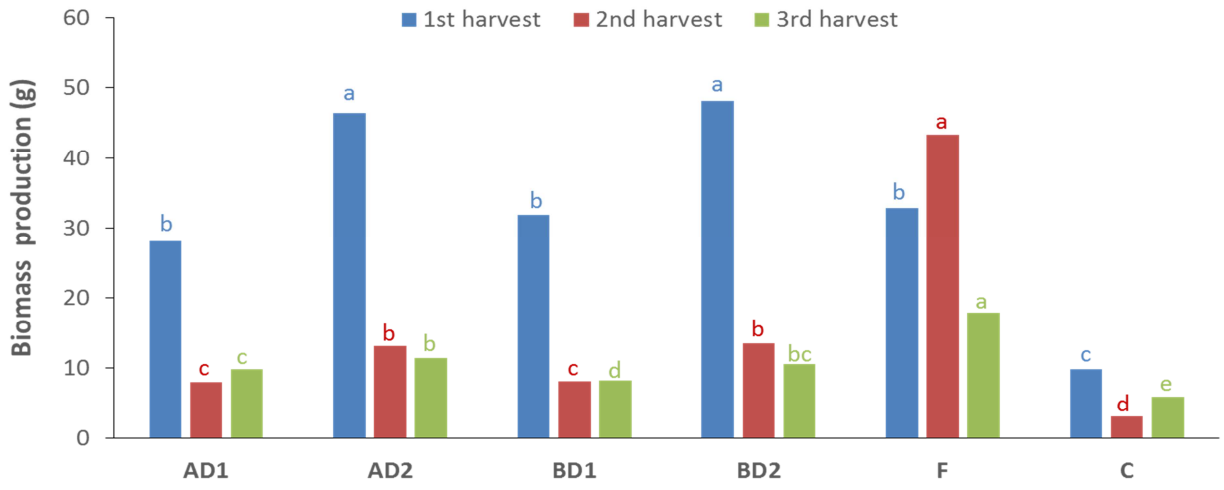

Figure 1 – Biomass production per pot (fresh weight) of ryegrass at the different harvests. Values followed by different letters in each harvest are significantly different at P<0.05.