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Phytotoxicity and Nitrogen Mineralisation of Composted and Vermicomposted Cotton Residues

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Abstract

Arable lands in Sudan have been adversely affected by soil fertility decline; this degradation could be maintained with external nutrient inputs. Due to the high cost and availability of the inorganic fertilisers, it is necessary to find alternative sources. Cotton residues are available after harvest and considered as waste materials. Application of decomposed residues maintains soil properties to sustain crop production. Decomposition rate depends on the residue quality, environmental conditions and the decomposer organisms present. Earthworms are widely used because they directly and indirectly modify decomposition.

An experiment was carried out to evaluate the toxicity of cotton residues by biological testing that of a vital importance for screening its suitability for land application. The toxicity of the composted and vermicomposted materials was investigated using seed germination bioassays using cress (*Lepidium sativum* L.). Materials were mixed with water at concentrations of 0 gL⁻¹ (only water); 8 gL⁻¹ (0.24 g of material plus 30 ml of water); 16 gL⁻¹ (0.48 g of material plus 30 ml of water). The extract concentrations did not exert any significant adverse effect ($p > 0.05$) on the measured parameters namely, relative seed germination (RSG), germination index (GI) and root elongation. At all concentrations the percentages of seed germination were greater than 90%. Treatments resulted in a linear increase in root elongation and quadratic increase of germination index of more than 100 for all extracts.

An aerobic incubation experiments was also conducted in the same materials under controlled conditions (35°C) for 35 weeks to quantify the nitrogen (N) mineralised. The applied materials were equivalent to 4 g N and 8 g N (Urea). Application of the materials affected the mineralised N concentration ($p < 0.0001$). The treatments contained more mineral nitrogen compared to the control during the whole incubation period. The pronounced mineralisation was observed after 21 and 28 weeks of incubation while no significance was found regarding the other dates. The less mineralised nitrogen was observed after 1 week.

The study objectives were (1) to experimentally investigate the net N mineralisation and (2) to evaluate the toxicity and suitability of the materials used before their application as plant medium.

Keywords: Compost, cotton residues, phytotoxicity, N mineralisation, vermicompost