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"Resilience of agricultural systems against crises"

Organic Amendment, Composting, Soil Fertility Improvement and Climbing Bean Yield in Degraded Soil of Rwanda

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Abstract

The soils in the Gatumba sector of Rwanda are highly degraded due to increased land use pressure, mining activities and low inputs use. A study was undertaken at a degraded tantalum mined site to (1) identify different sources of organic materials usable as amendments, (2) evaluate the effects of improved *versus* traditional composting on physical and chemical properties of soils, and (3) assess the impacts of nutrients recycled under the two systems on climbing beans growth and yield. A survey using 50 households (HH) in Gatumba area, and 200 HH from Muhanga, Huye, Nyamagabe and Nyanza Districts was also conducted. These districts have been selected for being the biggest producer of solid wastes around Gatumba sector. Materials collected for the study were: (i) farm yard manure (FYM), solid wastes (SW) and tithonia biomass (TB) from and around Gatumba and (ii) SW from Muhanga. Composting was done under plastic roofing (improved, IR) and tree leaves shade (local system). The treatments under plastic roofing were: (i) SW, (ii) FYM, (iii) SW plus Minjingu phosphate rock (MPR, 13-15 % P, with neutral ammonium citrate solubility of 4.4%), (iv) FYM plus MPR , (v) FYM plus SW, (vi) FYM plus SW plus MPR , (vii) TB plus FYM plus SW. Treatments under tree leaves shades included: (viii) SW, (ix) FYM and (x) SW plus FYM. MPR was added at the rate of 50 g kg^{-1} dry matter (DM) FYM/SW. The quality of organic materials collected from rural and urban areas was very poor with 0.30 % total N, and 0.064 % total P for rural and 0.73 % total N and 0.133 % total P from urban SW. Similarly, traditional composting yielded poor quality material (0.23 – 0.30 % total N and 0.060-0.072% total P), while plastic roofing increased total N from 0.96 to 1.65 %, and total P from 0.13 to 0.30 %). The effects of improved compost on growth and yield of climbing beans were assessed using replicated experiments (four trials in un-mined and four in degraded sites). We measured plant height, number of pods, biomass, and grain yield. Improved compost (5 t DM ha^{-1}) improved total DM yield from 1.99 – 3.54 t ha^{-1} grain compared to traditional compost (0.76 – 0.90 t ha^{-1}) at the same rate of compost application. For the growth parameters, improved compost promoted the plant vegetative growth, which could be arranged in descending order of treatmsnts as follows: TB-enriched compost – MRP-enriched compost – FYM – SW. The highest climbing beans biomass and grain yield was 20.06 t ha^{-1} and 15.55 t ha^{-1}, and 3.06 and 3.54 t ha^{-1} (on a dry matter basis) for FYM+SW+MPR IR and TB+FYM+SW IR, respectively. Improved compost can contribute to the legumes development in small-scale low-input farming system of Rwanda.

Keywords: Climbing beans, compost, degraded, mined, rock phosphate, soil

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