

Effect of Tithonia Biomass and Mineral Fertilizer Application on Soybean Performance in Degraded Technosols from Tantalum Mining in Gatumba, Rwanda

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Abstract:

Large areas of the Gatumba Mining District (GMD) in Rwanda are covered by Technosols (pegmatite or pegmatite-soil mixtures) resulting from coltan mining activities. These substrates are poor in soil plant nutrient contents and are low in soil productivity. Due to agricultural land shortage in Rwanda, almost all the available land is farmed. The present study was conducted to evaluate the effect of tithonia and inorganic fertilizers on plant nutrient uptake and biomass production of soybean grown in Gatumba soils that are affected by the previous coltan mining activities. A greenhouse pot experiment and a field trial were conducted using pegmatite substrate alone and pegmatite-Lixisol Bt mixture in a completely randomized design (CRD). Another experiment was set on cambisol in a farmer's field to compare the treatments from the technosols (affected by mining). Tithonia biomass (T) was applied at 5 tonnes (t) dry matter (DM) ha⁻¹ alone and combined with triple superphosphate (TSP), Matongo rock phosphate (MtRP) (for the greenhouse), Minjingu rock phosphate (for the field trials) and ammonium sulphate (AS). Soybean biomass, grain yield as well as its total N, P and K were measured at harvest while soil total nitrogen (N), available phosphorus (P), potassium (K) and carbon (C) were analyzed before and after the trials. The results demonstrate that soybean DM, grain yield, N, P and K accumulation were higher on pegmatite than on the mixture. The combination of T, MtRP and TSP also gave higher grain yields on both pegmatite (2.1t ha⁻¹) and mixture (1.7 t ha⁻¹) in the greenhouse. In the field, T+MRP and AS treatments, compared to other treatments, gave highest grain yields (1.5 ha⁻¹) followed closely by T+MRP+TSP (1.49ha⁻¹) on pegmatite while on the mixture, T+MRP+AS gave highest grain yields (0.87 ha⁻¹) followed closely by T+MRP+TSP (0.7 ha⁻¹). At the end of the greenhouse experiment, all treatments on both pegmatite and the mixture showed a general increase in pH, total N, exchangeable K and total organic C with the exception of the available P in the mixture which had declined. The same increase in soil nutrients was observed also in the field trial with the exception of total N that declined in all soil types and treatments. The combination of tithonia green manure and different inorganic fertilizers significantly (<0.05) increased the N, P and K accumulation of soybean grain, shoot and root biomass over tithonia alone. The results indicate that soil plant nutrients generally increased in all treatments in both greenhouse and field trials which is a good indication that these technosols can be reclaimed for agricultural use.