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Effects of short-term application of arbuscular mycorrhizal fungi and poultry manure on improvement of soil quality

Rakiya Abdullahi[1], Samuel Lihan[1] and Rebicca Edward[2]

[1]*Department of Molecular Biology, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia*
[2]*Department of Plant Science and Environmental Ecology, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia*

ABSTRACT

A field study was conducted to investigate the short-term effect of arbuscular mycorrhizal fungi (AMF) and poultry manure (PM) application on improvements of some selected soil properties compared to NPK chemical fertilizer cropped to maize. PM was applied in tones (t) ha^{-1} (0, 4, 6, 8, 10 & 12) inoculated with AMF (+AMF) and without AMF (-AMF).Soil samples (0-15 cm) were collected from field according to treatments after maize growth to determine; physical (bulk density, water-stable aggregate [WSA]), chemical (pH, NO_3-N, K, organic carbon[OC]& P) and biological properties (dehydrogenase, urease, phosphatase, AMF spore counts and root colonization [RC]). Results revealed significant improvement in soil properties due to application of poultry manure with and without AMF compared to control and chemical fertilizer. Integration of PM and AMF at 12 t PM ha^{-1} significantly increased soil pH, NO_3-N, OC, available P, K, % WSA, dehydrogenase, urease and phosphatase activities with reduced bulk density compared to all the treatments. Residual soil NO_3-N, available P & K content at 12 t PM+AMF indicated increment by 11.4% N, 5.8% P, 15.2% K, 25.9% OC, and 21.4% WSA over RD NPK. Spore counts and RC % increased with addition of poultry, the highest recorded at 12 t PM+AMF (17.33±1.202 g^{-1} soil, 43.00±38.70 %). There was strong positive correlations between RC% and dehydrogenase (R^2= 0.854), phosphatases (R^2= 0.894), urease (R^2= 0.935) activities and WSA (R^2= 0.958). Results suggested that application of poultry manure and AMF inoculation could improve soil physical, chemical and biological properties thus could be regarded as a reliable option for maintenance of soil quality and sustainability of crop production.

Key words: Mycorrhiza, chemical fertilizer, enzyme activities, soil quality, poultry manure

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INTRODUCTION

Fertilizers are basically added to soil to increase nutrients availability for optimum crop production. Chemical fertilizer has undoubtedly played a major role in food security over the past four decades. Consequently, long-term and any how application has degraded the physical, chemical and biological properties of soil thus, reducing its productive capacity [1]. Yield has become low or stagnant in some regions even with the application of chemical fertilizer which could be related to low soil organic carbon [40,7], poor soil structure [41], and low microbial biomass [12]. Good agronomic practice that would restore and maintain soil quality is crucial to sustainability of agriculture. It is concluded that degraded soil has low nutrients content and soil organic carbon (SOC), poor soil structure and aggregate stability [3], with less microbial biomass [11] especially AMF [28]. Addition of organic C