International Journal of Agriculture Innovations and Research
Volume 4, Issue 1, ISSN (Online) 2319-1473

Effect of Arbuscularmycorrhizal Fungi and Poultry Manure on Growth and Nutrients Uptake by Maize under Field Condition

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Abstract **– Field experiment was conducted to study the effect of arbuscularmycorrhizal fungi (AMF) and poultry manure (PM) on the growth and nutrients uptake by maize. The experiment was laid out in a randomized complete block design with 6 levels of PM in tones ha^{-1} (0, 4, 6, 8, 10, & 12) and 2 levels of AMF; (inoculated , +AMF and un-inoculated, -AMF) + recommended dose of NPK (RD NPK) chemical fertilizer; making 13 treatment combinations replicated 3 times. Plant growth (height, leaf area, root volume, shoot, and root dry weight biomass), root colonization (RC %) and uptakes of N, P, & K were assessed after six weeks growing period of maize. Inoculated plants and RD NPK recorded higher values for plant growth biometrics and nutrients uptake compared to un-inoculated plants.Poultry manure application enhanced RC % and AMF spore density with maximum value (43.00±38.70 %, 17.33±1.202 g^{-1} soil) at 12 t PM ha^{-1}. Applying 12 t PM+AMF produced plants with the highest shoot and root biomass weights (199.00±3.055, 9.57±0.713 g) that were comparable to RD NPK (194.33±2.404, 9.27±0.376 g). Increase in shoot dry biomass due to AMF revealed, 19.3%, 20%, 12.2%, 7.2%, 7.9%, and 15.2% over 0, 4, 6, 8, 10 & 12 t PM ha^{-1} of un-inoculated plants. Applying 12 t PM+AMF recorded higher shoot dry biomass by 2.3% over RD NPK. RC % correlated positively with shoot biomass (R^2= 0.753). Maximum N, P, & K uptake were recorded at 12 t PM+AMF compared to all the treatments. It could be concluded that PM have potentially stimulated AMF symbiosis, enhanced maize growth and nutrients uptake under normal field condition compared to chemical fertilizer, thus could be considered for maize production.**

Keywords **– Nutrients Uptake, AMF, NPK Fertilizer, Poultry Manure, Plant Growth.**

I. INTRODUCTION

Low-input agricultural system is gaining grounds as substitute to conventional high-input crop production due to negative environmental impact, health related issues and high cost of fertilizing crops [23,62]. Contrary to chemical fertilizers, applications of organic amendments to agricultural ecosystems might enhance crop yield, improve soil quality and reduce environmental pollution [66, 16]. Organic amendments could improve soil fertility, increase water holding capacity, soil aggregate stability and stimulate microbial population and diversity [58, 67]. An important group of the soil microbial populations is arbuscularmycorrhizal fungi (AMF).

Arbuscularmycorrhizas (AM) are group of fungi that live symbiotically in association with great majority of higher plants [28]. From such association, plant host provide synthetic carbon to fungi while in exchange; the fungus provides nutritional needs of the plant. Plant roots once colonized by AMF benefit from enhanced nutrients and water uptake, protection from soil-borne pathogens improving plant health [59, 60], tolerance to heavy metals and resistance from environmental stress [24,49]. AM fungi are important components of sustainable agricultural system. Its applications in low-input farming systems have gained popularity in many developed countries due to positive effect on environment and their potential to increase efficiency use of externally added fertilizers [13, 45].

In low-input system of agriculture, compost and farmyard manure are commonly used as source of nutrients to maintain soil fertility and improve crop production. It is suggested that the fungi are most efficient in low to moderately fertilized soil thus may be crucial in sustainability of low-input farming [65, 31]. Several researchers have highlighted positive influence of organic amendmentsapplication on AM population, diversity and colonization [6, 20,40, 48,57]. However, negative impacts have also been documented [27, 51, 32]. Conflicting results could be attributed to the nature, type, application rates, concentration and availability of nutrients in the amendments [26, 21]. George [25] reported positive effects from high application rates of composted turkey litter on AMF population and diversity compared to high rate of un-composted broiler manure. Several AMF studies with organic amendments were conducted in sterilized soil under controlled conditions, revealing positive results [38, 70, 41, 56, 42]. Abdullahi et al. [1] reported enhanced plant biomass yield and nutrients accumulation in maize grown on sterilized loam and peat soil under greenhouse due to AMF inoculation in combination with composted poultry manure in the same study region. Conversely, benefits accrued from laboratory study mostly do not reflect under field condition [12]. Though, limited studies conducted under field condition by some researchers [69, 8, 44, 5] have revealed complementary results on AMF root colonization with improved plant growth and yield due to enhanced nutrients uptake. However, there is no documented data on performance of maize inoculated with indigenous AMF isolates under field condition in the study area. As such, the present study was conducted to test the efficacy of indigenous AMF isolates under normal field condition where native AMF coexist. The aim was to determine the effect of AMF in combination with poultry