RESEARCH ARTICLE

INFLUENCE OF ORGANIC AMENDMENT AND MYCORRHIZA ASSOCIATION ON COWPEA

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ABSTRACT

Organic amendment has a great potential to increasingly replace the use of mineral fertilizer and pesticide for sustainable crop production. A screen house experiment was conducted to evaluate the effects of organic amendments on the growth of two cowpea varieties with and without mycorrhiza inoculation. The experiment was a completely randomized design and a factorial combination of two cowpea varieties (IT99K-573-1-1 and Oloyn), two levels of inoculation with mycorrhiza (with and without) and five levels of organic amendments (formulated from palm kernel cake, oil palm empty fruit bunch cake, plantain peels and Tithonia). Each treatment combination had six replicates. Organic amendments were incorporated two weeks before planting of cowpea seeds and inoculation of mycorrhiza to the soil. Data were collected on cowpea growth attributes such as the number of leaves, number of branches, plant height, stem girth and leaf area. Data were subjected to analysis of variance using the GenStat Discovery Edition 4 and treatment means were separated using the Duncan’s Multiple Range Test at 0.05. Organic amendment 5 (control) was best in terms of mean values for number of leaves, number of branches and plant height. Cowpea plants inoculated with mycorrhiza were best for all growth attributes. In the residual experiment, Oloyn variety with organic amendment 3, previously inoculated with mycorrhiza and had the highest mean number of leaves and oloyn variety with organic amendment 4 not previously inoculated with mycorrhiza had the highest mean plant height. Therefore, we need to transform and use some of the agricultural waste that are rich in nutrient particularly in phosphorus as a source of organic fertilizer for cowpea cultivation.

KEYWORDS

mycorrhiza inoculation, organic amendments, cowpea

1. INTRODUCTION

Organic amendments increase soil fertility by supplying macro- and micro-nutrients for optimum yield, improve soil physical and chemical properties, and enhance soil microbial activities. This improves soil fertility (Gitari et al., 1998; Mugendi et al., 1999; Mwaura and Mathenge, 2014). The enhancement of soil microbial activities by organic amendments improves soil fertility by breaking down residues, fixing nitrogen in the soil, and sequestering carbon (Giller et al., 1997). Phosphorus is critical to cowpea yield because it is reported to stimulate growth, initiate nodule formation as well as influence the efficiency of the rhizobium legume symbiosis (Haruna and Aliyu, 2011). Magani and Kuchinda reported that for economic growth and yield, cowpea required 37.5 kg/ha of phosphorus in northern Guinea Savanna of Nigeria (Magani and Kuchinda, 2009).

A study reported phosphorus requirement of cowpea in southern and the extreme northern part of Nigeria, respectively (Kang and Osiname, 1979; Singh et al., 2011a). Increasing cowpea production by the smallholder farmers in the southern Guinea Savanna of Nigeria, calls for the search for organic fertilizers to improve cowpea cultivation. The rising call for more environmentally friendly and healthy agriculture is a strong incentive to find alternative strategies to replace the use of mineral fertilizer and pesticide. Among the initiatives towards improvement in low-input farming the utilization of soil biota, is one of the most promising strategies provided by key ecological services. Arbuscular mycorrhizal (AM) fungi, belonging to the phylum Glomeromycota, are a main component of soil microbiota and probably represent the most important terrestrial symbiosis (Jeffries et al., 2003; Fitter, 2005).

Mycorrhiza has been found to be useful in ecological restoration which enables the establishment of host plant on degraded soil through improved quality and health of the soil (Jeffries et al., 2003). In degraded soils, AM fungi help plants capture nutrients such as phosphorus and micronutrients. Inoculating soil with AM fungi improves the growth and yield of mycotrophic plants (Fagbola et al., 2005 and Osonubi et al., 1991). The AM symbiosis affects the community and diversity of other organism in the soil. In recent years, agrochemicals such as chemical pesticides and fertilizer are extensively applied to obtain high yield. Intensive application of agrochemicals leads to several agricultural problems and poor cropping systems. Some farmers use more chemical fertilizers than the recommended levels for many crops. This practice accelerates soil acidification but also risks of contaminating ground water and the atmosphere and weakens the roots of plants and making them susceptible to diseases (Chun-Li, 2014).

There has been a surging interest in ecofriendly and sustainable agricultural practices such as the use of microbial biopesticides and biofertilizers (Maluá et al., 2012). In addition to enhancing plant growth and productivity, such products provide other beneficial ecosystem services that sustain the environment. Microbial based formulations could thus be adopted by smallholder farmers to serve as a cheap and efficient way of enhancing soil fertility. Therefore, there is need to transform and use some of the agricultural waste (Oil palm empty fruit bunch ash, palm kernel cake, tithonia and plantain peels) that are rich in nutrient particularly in phosphorus as a source of organic fertilizer needed for cowpea cultivation. The use of agricultural waste helps produce both greater quantity and quality cowpea, such will be less harmful to human health when consumed and would satisfy the international standards for export.

2. MATERIALS AND METHODS

2.1 Experimental Site and Design

The experiment was conducted at the Department of Agronomy screen house, University of Ibadan, Ibadan, Nigeria. The 5×2×2 factorial experiment had six replications and was laid out in a completely randomized design. The treatments consisted of three factors: two cowpea varieties: IT99K-573-1-1 (V1) and Oloyin (V2), five levels of organic amendments (A) formulated from Palm kernel cake (PKC), Oil Palm Empty Fruit Bunch Ash (OPEFBA), Tithonia (TT) and Plantain peels (PP) and two levels of mycorrhizal application: with (M+) and without (M-). The three factors produced 20 treatment combinations.

2.2 Soil Collection and Preparation

Subsoil samples were collected at 15-30 cm depth. The bulked samples were air-dried, sieved through a 2 mm mesh before weighing 5 kg into each of 120 black polythene bags. Samples were taken from the bulked soil for routine analysis.

2.3 Description of the Experiments

The experiment was in two phases: Experiment 1: Growth of two varieties of cowpea fertilized by organic amendment and mycorrhiza inoculation; and Experiment 2: Residual effect of experiment 1

2.4 Mycorrhizal Inoculation

Glomus clarum (Arbuscular mycorrhiza-AM) inoculum of 20 g was obtained from Department of Agronomy and applied to ¾ depth of the soil in each (those with mycorrhiza, M+) of the 5 kg soil in the polythene bags before sowing the seeds same day. The AM were applied at two levels (with and without).

2.5 Organic Amendments

The organic amendments used were from materials such as Palm kernel cake (PKC), Oil Palm Empty Fruit Bunch Ash (OPEFBA), Tithonia (TT) and Plantain peels (PP). These materials were sourced locally. The different organic amendments were analyzed for their nutrient composition and applied at different rates and formulations. The treatment combinations were incorporated and allowed to mineralize for two weeks before planting cowpea.

2.6 Cowpea Varieties and Planting

Two varieties of cowpea (IT99K-573-1-1 and Oloyin) were obtained from International Institute of Tropical Agriculture (IITA) Ibadan and Bodija market, respectively. Three seeds of cowpea were sown per polythene bag same day after mycorrhizal inoculation and two weeks after adding organic amendments. The plants were later thinned to 2 plants per pot after emergence. Weeding was done often until harvesting.

2.7 Data Collection

2.7.1 Cowpea Growth Attributes

The measurement of growth attributes (number of leaves, number of branches, plant height, stem girth and leaf area) commenced two weeks after planting (WAP) and this was done at weekly interval (2, 3, 4, and 5 weeks). The plant height was measured from the base of the plant to the tip using a metre rule, the number of leaves and number of branches that emerged were counted and recorded, the stem diameter was measured using vernier calipers and multiplied by 2π to get stem girth and the leaf area was calculated using graphical method.

2.8 Experiment 2: Residual Effect of Experiment 1

The study location, same soil (with residual organic amendment and mycorrhiza), was used. Soil analysis, plant analysis, data collection on growth parameters and statistical analysis were done as in Experiment 1.

3. RESULT AND DISCUSSION

Generally, cowpea growth attributes (the number of leaves, number of branches, plant height, stem girth and leaf area) increased at successive weeks. This could be because of increased soil nutrients. Organic amendment 5 (control) did best in terms of mean highest mean number of leaves, mean number of branches and mean plant height. Oloyin variety did best in terms of highest mean number of leaves, mean number of branches and mean stem girth. Cowpea plants inoculated with mycorrhiza had the best in all growth attributes (Figure 1). The difference obtained in the growth attributes of cowpea varieties may be attributed to the different framework of the varieties as explained (Fall et al., 2003). Plant height has been reported as a function of yield for some crops (Abayomi, 1992). The IT99K-573-1-1 variety inoculated with mycorrhiza and organic amendment 5 had significantly highest plant height. This is in contrast to the work of who reported an increase in height and vegetative growth of cowpea lines with an increase in P application (Teneb et al., 1995). This also differs from the report of Ahmed that applying amendment increase in nutrient content of plant resulting in higher rate of synthesis and assimilation of photosynthates and finally higher number of leaves and branches (Ahmed, 1997).

In the residual experiment (Figure 2), Oloyin variety with organic amendment 3, previously inoculated with mycorrhiza and had the highest mean number of leaves and Oloyin variety with organic amendment 4 not previously inoculated with mycorrhiza and had the highest mean plant height. IT99K-573-1-1 variety with organic amendment 2, not previously inoculated with mycorrhiza had the highest mean number of branches and mean leaf area. IT99K-573-1-1 variety with organic amendment 1, not previously inoculated with mycorrhiza had the highest mean stem girth.

Figure 1: Mean Growth Parameters of Cowpea Across Weeks 2, 3, 4 and 5 After Planting as Affected by Organic Amendment and Mycorrhiza Inoculation.
In recent years, there has been intensive application of agrochemicals that leads to several agricultural problems and surging interest in eco-friendly and sustainable agricultural practices. AMF and agricultural waste prove to be good strategies to improve the growth and yield of cowpea. Organic amendments application and *Glomus clarum* inoculation as a source of organic nutrients may benefit cowpea growth in soils deficient of P.

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**References**


