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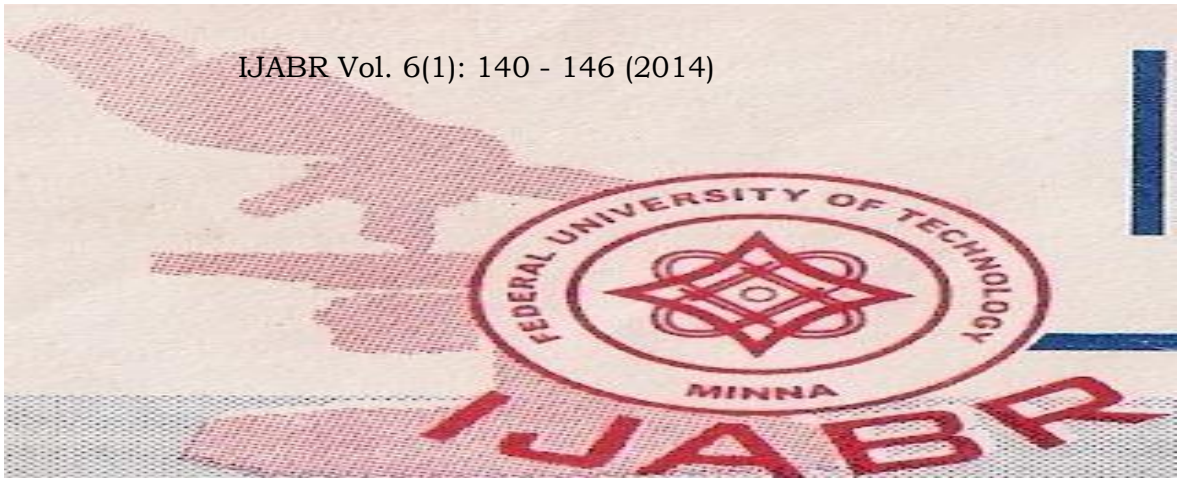

Original Article

Biofertilizer Properties of *Glomus clarum* and *G. deserticula* in Cowpea (*Vigna unguiculata*) Cultivars

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ABSTRACT

The potentiality of Arbuscular Mycorrhizal Fungi (AMF) as bio-fertilizer was assessed using *Glomus clarum* and *G. deserticula*. The sterilized soil was inoculated with varying concentration of the two species (0, 10, 20 and 30g/pot). Four cowpea seeds (Var. IAR-1074) were planted per pot for proliferation of the AMF. Eight weeks after planting (WAP) the soil samples were taken from each treatment and analyzed. From the results, the two species show no significant impact ($P>0.05$) on the various soil parameters, except the pH, organic carbon, organic matter, Mg and Fe concentration which were significantly different. The *G. clarum* showed a significantly higher pH value ($P<0.05$) at 20g/pot (7.450 ± 0.32) and 30g/pot (7.073 ± 0.112) respectively. In addition, increase in concentration of *G. clarum* tends to lead to increasing soil pH, from slightly acidic (6.888) to neutral (7.450). Similarly, in organic carbon, organic matter, Mg and Fe at various concentrations, *G. clarum* was significantly higher ($P<0.05$) than the *G. deserticula*. It can thus be concluded that *G. clarum* has a better bio-fertilizer properties than *G. deserticula*. The AMF used in this study have the potential to improve soil fertility although the impact varies with species of Arbuscular Micorrhizal Fungi.

Key words: AMF, Bio-fertilizer, IAR-1074, Soil parameters

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INTRODUCTION

Vesicular Arbuscular Mycorrhiza (VAM) which is also known as Arbuscular Mycorrhizae (AM) belongs to the endomycorrhizal fungal group. The AM fungi belong to Phylum Glomeromycota, Order Glomoles with nine genera of which genus *Glomus* is the most important with 110 described species (Dalpe *et al*., 2005). The classification of *Glomus* is based mostly on the structure of the soil–borne resting spores as whole as the developmental process and biochemical properties (Morton, 1993).

Arbuscular Mycorrhizal fungi are important rhizospheric micro-orgasnism that plays a major role among microbes in the soil. The association is a mutually beneficial event, with the fungal symbiont obtaining shelter and carbon from the host plants photosynthates for their growth and metabolism (Annapurna and Tilak, 1997). Although, AM fungi generally lack host specificity, they are soil type specific, with pH being the main factor. However, soil texture and organic matter may influence soil suitability for a particular fungus. On the other hand, the host plant may be selective in partnering with the available mix soil fungi (Jakobsen *et al*., 1992). The symbiosis establishment between roots and AM fungi commences with fungal spore germination that is enhanced under the effect of host root exudates (Tamasloukht *et al.,* 2003).

In recent years, biofertilizers have emerged as a promising component of integrating nutrient supply system in agriculture. Thus, biofertilizers are organic products containing specific microorganisms in concentrated forms, derived from the soil root zone (rhizosphere) (Mishra and Dadhich, 2010). Arbuscular Mycorrhizal Fungi (AMF) are obligatory symbionts that colonize the roots of approximately 80% of terrestrial plants, improving their nutrition, growth and disease tolerance (Smith and Read, 2008; Elsen *et al*., 2008).

Cowpea is of major importance to the livelihoods of millions of relatively poor people in less developed countries of the tropics (FAO, 2002). Islam *et al*. (2006) emphasized that all parts of the plant used as food are nutritious providing protein and

vitamins, immature pods and peas are used as vegetables while several snacks and main dishes are prepared from the grains. Egho (2009) reported that Nigeria is the 2nd greatest consumer of cowpea in the whole world. Among the legumes, cowpea is the most extensively grown, distributed and traded food crop consumed, more than 50% (Ogbo, 2009; Agbogidi, 2010).

Though Application of chemical fertilizers have being in use for a long time and have contributed to profer solution to soil infertility, such practices have posed many problems to many ecosystems especially the aquatic. Thus attentions are diverting towards the use of bio-fertilizer which are biodegradable and environmental friendly. Base on the foregoing, the present study was designed to investigate impact of two species of Arbuscular Mycorrhizal Fungi on the physico-chemical properties of the soil.

MATERIAL AND METHODS

The study was conducted in the Experimental garden, Department of Biological Sciences, Ahmadu Bello University, Samaru-Zaria, in the Northern Guinea Savanna ecological zone of Nigeria (11^{o} 11' N, 7^{o} 39'E, and 686m above Sea level).

The experiment was conducted in the Screen house situated in the garden. The sides of the screen house were covered with wire mesh to prevent pests and for good ventilation. The floor was cemented, disinfected and then covered with disinfected polythene sheets to minimize probable contamination. The research took place during the raining season (June to September) of 2007.

Collection of Experimental Materials

The mycorrhizal fungi: *Glomus clarum* and *G. deserticula* culture was obtained from IITA, Ibadan and Department of Agronomy, University of Ibadan, Ibadan. Top soil was collected from farmlands within Botanical garden, A.B.U. Zaria, while the sand was collected from river side. IAR-1074 was obtained from the Department of Plant Science, Institute of Agricultural Research (IAR), Zaria.

Soil Preparation and Fungi Inoculum Preparation

The top soil was mixed with the sand at 1:1 (V/V) ratio. This was then sieved

and sterilized partially at 120^0C for two hours. The methods of Heckman and Angle(1987)were used to prepare AM Inoculum as follows; Sterilized planting bags were filled with 6kg of sterilized sandy loam soil per bag. 50g of AM culture was mixed with the top 6cm of the soil in the planting bag and 20 grams of surface sterilized *Sorghum* seeds were planted per bag and then watered regularly.

These planting bags were kept in the screen house and watered every two days. At the end of two weeks after planting (WAP), the seedlings were thinned to 15 seedlings per bag. Watering continued, and then stopped at the end of 12 WAP. This was left for another ten days without watering. Then the shoots of the *Sorghum* plants in each bag were removed and the soil together with the root system in each bag was mashed together and mixed thoroughly to homogenize the soil and the colonized root parts to give the AM inoculum stock.

Preparation of the planting Bags and Inoculating the Soil

Perforated (at the bottom) planting bags of 15cm width was sterilized using 1% sodium hydrochlorite (NaOCl) for 5 minutes then rinsed several times with distilled water. Each sterilized bag was then filled up with 2Kg of the sterilized soil.

Inoculation of the Soil and planting of the seeds

A hole of about 6cm deep was dug in the soil contained in each planting bag. The AM inoculum was applied in 4 rates (0g, 10g, 20g and 30g/bag). The inoculum was poured into the hole.

Four Cowpea seeds were planted per bag after the inoculation. The seedlings were later thinned to two plants per bag at 2 WAP.

Data collection and analysis

Data were collected at 8 WAP, the soil samples were taken from each treatment combination and their physio-chemical parameters were taken. The data collected were pulled for analysis, Analysis of variance (ANOVA) was used to test the significance among the different concentration of AMF and Duncan Multiple Range Test (DMRT) was used to separate the means.

RESULTS AND DISCUSSION

The two species show no significant impact on the various soil parameters except for pH, organic carbon, organic matter, Mg and Fe. The highest pH values for *G. clarum* and *G. deserticula* were observed at 20g/pot (7.450) and 30g/pot (7.073) respectively (Table 1). However, the *G. clarum* performed better in improving the soil pH from slightly acidic (6.888) to a neutral (7.450) pH(Table 1). Similarly, *G. clarum* show significantly higer values in organic carbon, organic matter, Mg and Fe at the various concentration (Table 1).

The gradual decrease in carbon content displayed by *G. deserticula* might be due to the fact that the AM fungi utilize the carbon from the host plant which would have been part of the soil. This can be supported by Annapurna and Tilak, 1997 who reported that the association between the AM Fungi is a mutually beneficial event, with the fungal symbiont obtaining shelter and carbon from the host plants photosynthates for their growth and metabolism.

The relatively poor performance by *G. deserticula* may be associated to soil suitability for a particular fungus as reported by Jakobsen *et al.*, 1992. The improvement of soil pH, and organic matter support the biofertilizer ability of the two species of AM Fungi as reported by Galvez *et al.*, 2001, and IFOAM, 1998. In conclusion AMF fungi have the potential to improve some soil physiochemical properties; however, the impact varies with species of Arbuscular Micorrhizal Fungi. This experiment will be continued and effective AM fungi will be used as biofertilizer for crop production in Nigeria.

Table 1: Effects of *G. clarum* and *G. deserticula* on Physico-chemical Properties of Soil used in Growing Cowpea at 8 weeks after planting.

Soil parameter	0 (g/pot)		10 (g/pot)		20 (g/pot)		30 (g/pot)	
	Gc	Gd	Gc	Gd	Gc	Gd	Gc	Gd
pH	6.89a	6.89a	6.86a	6.93b	7.45d	6.98bc	7.22c	7.07bc
N	0.12c	0.08b	0.95e	0.09a	0.12a	0.08a	0.10c	0.24d
P	28.31a	33.50a	34.50ab	32.75a	36.88ab	28.68a	38.25a	31.80a
Org. C	0.97a	0.97a	1.53b	0.55a	1.58b	0.53a	1.22b	0.51a
Org. Mat	1.73a	1.73a	2.63b	0.945a	2.70b	0.90a	2.10b	0.87a
Mg	1.79a	1.79a	2.32b	1.08a	1.42a	1.27a	2.46b	1.23a
Fe	0.47a	0.47a	0.29a	0.48ab	0.43a	0.60ab	0.34a	0.70b
Cu	1.40a	1.40a	0.55a	2.00a	0.38a	1.88a	1.03a	2.40a
Zn	2.84a	2.84a	2.54a	2.59a	3.44a	2.42a	2.66a	2.57a
K	0.15a	0.15a	0.18a	0.10a	0.16a	0.12a	0.17a	0.12a
Ca	11.80a	11.80a	13.18a	9.91a	13.30a	10.01a	12.72a	9.70a
Na	0.27a	0.27a	0.33a	0.235a	0.39a	0.208a	0.393a	0.22a
EA	0.19a	0.185a	0.203a	0.153a	0.21a	0.188a	0.128a	0.21a
CEC	14.18a	14.17a	16.07a	11.61a	15.47a	12.20a	15.87a	11.79a

Means followed by the same letter (s) in each row, are not significantly different ($P>0.05$) tested by DMRT.
Note: Gc = *G. clarum* and Gd = *G. deserticula* Org = Organic, Mat = Matter

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