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VETIVER GRASS PERFORMANCE UNDER COMPOST AND MYCORRHIZA TREATMENTS

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ABSTRACT

The influence of compost and *Glumus clarum* arbuscular mycorrhiza in sterilized and non – strerilized soils on the mycorrhiza infection rate (MIR) and biomass yield of vetiver grass was studied over twelve weeks. The treatment consisted of a factorial combination of two soil conditions (sterilized and non-sterilized), two levels of mycorrhiza inoculation (inoculated and non-inoculated) and four levels of compost amendment (0. 2.5, 5.0 and 7.5 tons/ha). The experiment was laid out in randomized complete block design with three replications. Analysis of variance showed that compost amendment significantly influenced MIR and dry biomass yield but not with the fresh biomass yield. The dry biomass yield of the vetiver grass responded differently to mycorrhiza treatment based on the different compost rates with best performance obtained from inoculated samples that received 5.0 tons/ha. The combined effect of mycorrhiza treatment and different soil conditions was only significant on dry and fresh root weights with inoculated samples performing better in sterilized soils.

Keyword: Mycorrhiza, sterilized soil, vetiver grass, inoculation.

INTRODUCTION

Vetiver grass Technology was first developed for soil and water conservation on farmlands which plays a vital role on agricultural land (Truog , 1999). It has great utility in stabilizing and reclaiming lands degraded by erosion, heavy metals (Truog, 1996, Truog and Baker, (1998)) for agricultural use. The unique morpholohical (Possession of deep penetrating finely structured deep root system that is capable of reaching 3-4 m in the first year of its establishment) and ecological (Tolerance to soil salinity, sodicity, acidity, Al and Mn toxicities and heavy metals such as Arsenic, Chromium, Nickel, Cadmium, Mercury, Zinc, Lead and Selenium) characteristics of vetiver grass has key role in its use in the areas of environmental protection.

Mycorrhizae - fungi which live in a mutualistic association with plants by growing on the plant roots and providing nutrients such as phosphorus, nitrogen and copper in return for carbohydrate for growth (Smith, 2009).They have been reported to coevolved with the emergence of vascular plants and are believed to have first appeared more than 400 million years ago (Remy et al., 1994).The growth of Vessicular Arbuscular mycorrhiza (VAM) fungi on plant is usually characterized by percentage infection of the root which is greatly influenced by environmental factors and other factors that affect root growth (Smith, 2009).

Hetrick and wilson (1989) observed lower plant growth and infection rate of VAM in soils low in fertility under unsterilized condition than when the soil was sterilized as a

result of microbial competition with other micro organism for available nutrient with a proposition of the need of external source of fertilizer and increasing inoculum dosage of VAM to bring about correction of this growth suppression.
There is therefore great need to develop systems that will improve the yield of vetiver grass. The present work is therefore aimed at investigating the influence of soil sterilization and mycorrhiza inoculation on the growth and yield of vetiver grass amended with compost.

MATERIALS AND METHODS

The experiment which lasted for twelve weeks was carried out at Teaching and research farm of Ladoke Akintola University of Technology (LAUTECH) Ogbomoso, Oyo state. Sub soil samples (15-30)cm were collected from land under fallow at the Teaching and research farm. The soil samples were air dried and made to pass through 2mm sieve after which it was subjected to routine analysis. Half of the whole soil samples were sterilized at a temperature of 80^{o}C for 24 hours to eliminate any indigenous micro-organism while the remaining half was left unsterilized .

The experiment was a factorial combination of four compost rates (0, 2.5, 5.0 and 7.5 t/ha), two soil conditions (sterilized and non-sterilized) and two mycorrhizal rates (inoculated and non-inoculated) with three replications to bring about 48 treatments with each treatment pot containing 6kg of appropriate sterilized and non-sterilized soils. The compost used was prepared from well cured maize stover and poultry manure. The mycorrhizal inoculum used consisted of a mixture of dried colonized roots, adhering soil and spores of *Glomus clarum*. The inoculums was applied at the rate of 30g per bag. Compost amendment was done 2 weeks before planting. Tillers of 10cm root length and 20cm shoot length of Vetiver grass were planted into each pot. Wetting and hand weeding were done appropriately.

The experiment was terminated twelve weeks after planting during which vetiver grass from each pot was carefully uprooted after the soil had been well moistened after which individual shoot was severed carefully from the root. The roots were thoroughly washed in water. The fresh shoot and root weights were then taken. Fine textured mycorrhizal hyphea were collected from each root for analysis on Mycorrhizal Infection Rate (MIR) using the Trypan blue staining and dissecting microscope method described by Giovanneti and Mosse (1980) in which the cleared roots were dispersed in a 9cm diameter Petri plate on which a grid is drawn using a dissecting microscope at x40 magnification. The eyes were casted along the lines in both horizontal and vertical directions. The intersection between the line and the root revealed the "infected" and "non-infected" roots. The percentage infection was then calculated accordingly.

RESULTS AND DISCUSSION

The physicochemical properties of the soil sample used for the study is presented in Table 1.

Table 1: Physiochemical property of the soil sample

Property	Value
Clay (g/kg)	170
Silt (g/kg)	110
Sand (g/kg)	720
pH (1:1)	6.3
Organic C (g/kg)	6.8
Total N(g/kg)	1.8
Avail P (mg/kg)	9.0
Ca (cmol/kg)	1.1
Mg (cmol/Kg)	0.6
k (cmol/Kg)	0.2
Na (cmol/Kg)	0.1
Base sat. %	76.5
Ex. Acidity	0.6
ECEC	2.8

The chemical property of the compost used is shown in Table 2.
Table 2: Chemical properties of the compost materials and matured compost

Property	Maize stover	Poultry manure	Matured compost
pH	5.8	5.4	7.5
Total N (g/kg)	10.2	19.2	24.1
Total P (g/kg)	8.2	18.4	14.0
Ex. K (g/kg)	12.7	23.0	20.9
Ex. Ca (g/kg)	11.6	94.6	18.5
Ex. Mg (g/kg)	2.2	4.2	4.0
Total Fe (mg/kg)	31	190	57.0
Total Cu(mg/kg)	2400	4200	4396
Total Pb (mg/kg)	< 1.0	<1.0	<1.0

Effect of compost amendment on yield parameters of vetiver grass is shown in Table 3. Compost significantly influenced fresh root, dry root and dry shoot weights. Compost rate of 2.5 t/ha initially reduced fresh and dry root weights but as the compost rates was increased up to 5.0 t/ha yield increased and later decreased at 7.5 t/ha. Dry shoot weight increased significantly with increasing compost rate with control having the least performance.

Table 3: Compost effect on yield parameters of vetiver grass

Compost t/ha	Fresh Shoot weight	Fresh Root weight	Dry root weight	Dry shoot weight	MIR %
	------------------------------------ g/pot ------------------------------				
0	46.6	72.6	42.0	22.3	23.2
2.5	52.1	61.0	36.2	26.8	24.2
5.0	65.0	95.1	56.2	30.0	12.5
7.5	61.8	90.9	55.5	31.1	12.5
LSD	19.94	15.08	19.82	7.13	9.13

Note: MIR = Mycorrhizal Infection Rate

Compost amendment sharply reduced mycorrhiza infection rate (MIR) by almost 50% and kept values constant at higher compost rate (Table 3). This is evident in the negative correlation (r = -0.872) of MIR with compost (figure 1). This reduced colonization rate might be due to the high phosphorus content of the compost used. Filho et al (2008) reported similar growth depression with increasing levels of P which impaired symbiosis with regards to the drain of carbohydrate from the host. This further corroborate the fact that mycorrhiza strive better in soils low in phosphorus. Compost however correlate positively with dry shoot weight (r = 0.967) and dry root weight (r =0.783) (figure 2 and 3) under the conditions of this study.

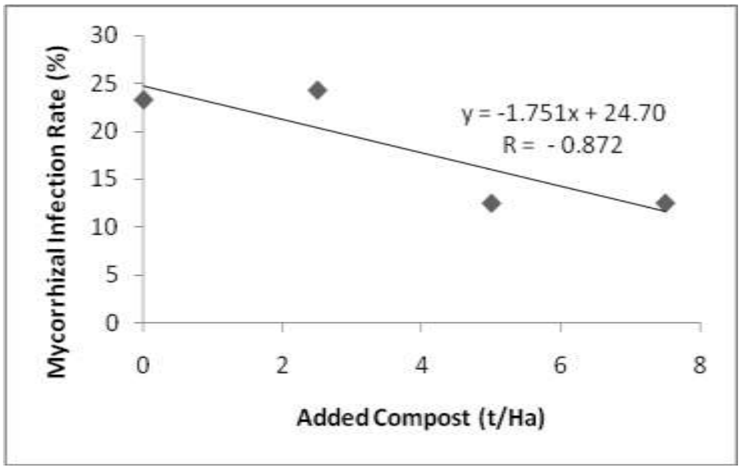

Figure 1: Impact of compost amendment on mycorrhizal infection rate

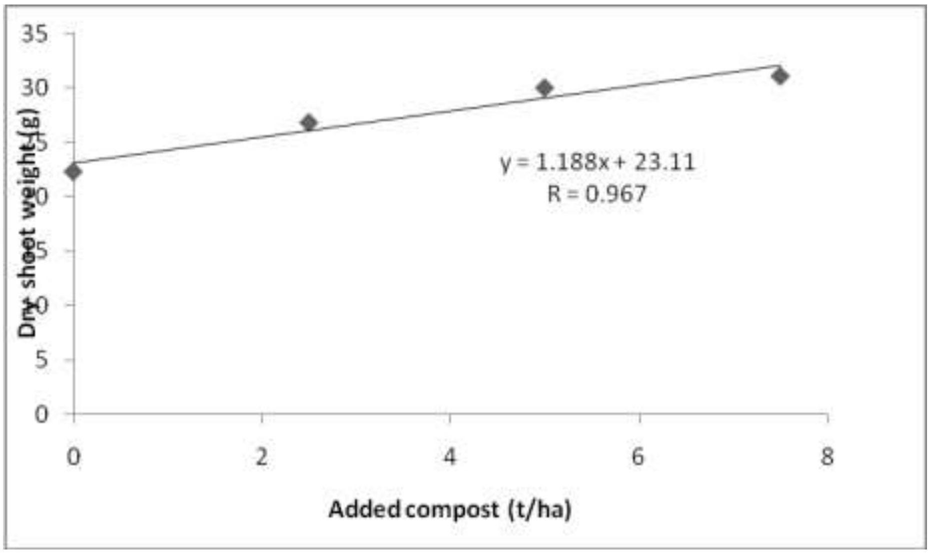

Figure 2: Impact of compost amendment on dry shoot weight

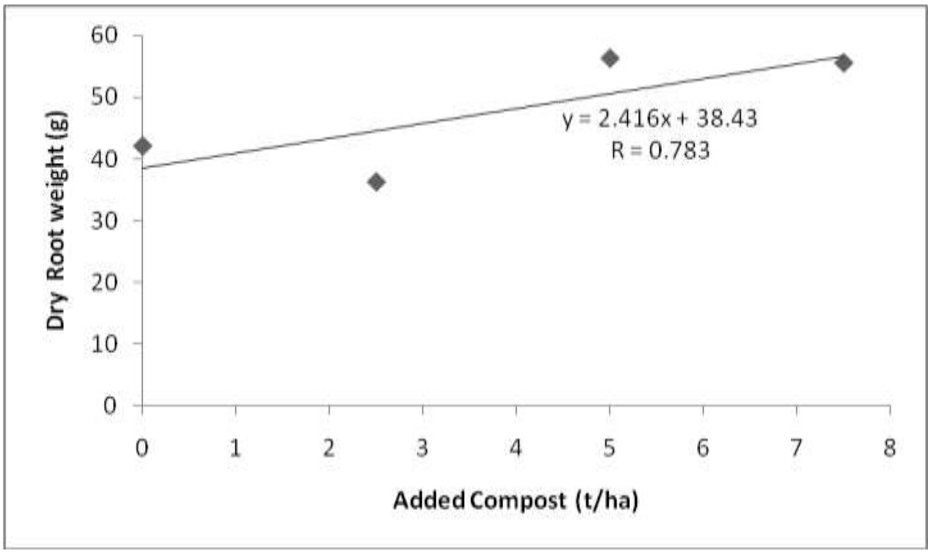

Figure 3: Impact of compost amendment on dry root weight

The interactive effect of compost and soil condition revealed that the performance of vetiver grass under different compost rates were not statistically different under sterile or non-sterile condition Table 4. Samples that received 5.0 t/ha whether sterilized or not gave the highest shoot length, root length and fresh shoot weight which were significantly different from control although no variation was seen across dry shoot weight. Fresh root and dry root weights on the other hand were favoured by 7.5 t/ha compost rate.

Table 4: Combined effect of compost and soil condition on Vetiver grass yield parameters

Compost t/ha	Soil Condition	Shoot Length	Root Length	Fresh Shoot Weight	Fresh Root Weight	Dry Shoot Weight	Dry Root Weight
		------------- cm -----------		--------------------------- g /pot ------------------------------			
0	S	91.8	28.8	45.2	77.6	23.4	41.9
	NS	70.5	25.6	48.0	67.6	21.2	42.2
2.5	S	87.1	32.6	54.2	68.9	28.5	42.1
	NS	87.8	32.1	50.0	53.1	25.2	30.3
5.0	S	99.4	33.8	66.9	92.4	31.2	56.7
	NS	103.5	47.1	63.0	97.9	28.9	55.8
7.5	S	87.5	28.8	60.9	100.8	31.3	62.2
	NS	99.7	34.0	62.8	81.1	30.9	48.8
	LSD	30.3	16.5	13.9	43.2	10.9	28.0

Note: S = Sterilized soil, NS = Non – sterilized soil

Table 5 showed the interactive effect of soil condition and AMF inoculation on yield performance of vetiver grass. This effect was significant on fresh root, dry root and dry shoot weights with sterilized inoculated samples having values significantly higher than non-sterilized inoculated samples. There was no variation across the mycorrhiza infection rate under the different soil and inoculation conditions with non-inoculated samples having higher value, there is possibility of competition among the AMF inoculated and other native micro-organism for air and nutrient.

Table 5: Combined effect of soil condition and AMF inoculation on Vetiver grass performance

Soil condition	AMF Inoculation	Fresh Shoot weight	Fresh Root weight	Dry root weight	Dry shoot weight	MIR
		------------------------------- g/pot ------------------------- ----------				%
S	I	57.2	92.8	55.7	29.4	17.9
	NI	56.4	77	45.8	27.8	22.4
NS	I	48.1	59.2	35.8	22.9	15.1
	NI	63.8	90.7	52.8	30.2	17.1
	LSD	19.43	29.7	19.5	7.1	10.0

CONCLUSION

The following are the findings made from this work

- Compost amendment of 5 t/ha supported optimal yield of vetiver grass under the conditions of this experiment
- Compost amendment on the other hand especially those with high phosphorus content negatively influence root infection rate of AMF
- Soil sterilization alone and AMF inoculation alone do not significantly affect vetiver grass performance.

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