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GROWTH, HERBAGE YIELD AND NUTRIENT UPTAKES OF INDIGENOUS JUTE MALLOW (*CORCHORUS OLITORIUS*) AS INFLUENCED BY DIFFERENT FERTILIZER SOURCES UNDER DRY SEASON ALFISOLS CONDITIONS

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ABSTRACT

Although soil moisture is a major limiting factor to sustainable crop production in the tropics, particularly during dry season, artificial moisture application if properly supported by application of suitable fertilizer materials, a desirable fertilizer use efficiency and enhanced crop performance, may be achieved. Field experiment was carried out during the late or dry season of the year 2014, at the Arable Crop Experimental Unit of Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso, to evaluate the response of Corchorus olitorius to different fertilizer types (of dissimilar origins or sources). Five (5) fertilizer treatments (N. P. K. 15-15-15, Urea, Poultry manure, Organo-mineral, Composted Tithonia biomass), and the Control (which received no fertilizer application), were investigated. All fertilizers were applied at the recommended N-rate of 60 kg Nha^{-1}. The treatments were laid out in Randomized Complete Block Design (RCBD), replicated three times. Data collected on growth and yield parameters were analyzed following the procedures of analysis of variance (ANOVA) and means were separated using Duncan's Multiple Range Test (DMRT) at 5% probability level. Application of different fertilizers of dissimilar origins significantly improved Corchorus olitorius performance, compared to the control, as the growth, herbage production and nutrient *uptakes of Corchorus olitorius significantly increased with improved soil nutrition via the applied organic and inorganic fertilizers. The organic-based and organo-mineral fertilizers effectively competed with the N-rich chemical fertilizers (NPK and Urea) tested. Hence, application of either organic fertilizer or organo-mineral fertilizer may be more suitable than any of the chemical fertilizers tested. This will reduce chemical inputs and their residual effects on soil and considerably encourage maximum and lasting utilization of soil nutrients by crop-plants.*

Keywords: Fertilizer sources, Indigenous Jute mallow, Alfisols, Dry Season, Herbage Yield and Nutrient uptakes.

I. INTRODUCTION

Jute mallow (*Corchorus olitorius), which is also* known as wild / bush okro or Egyptian spinach, is a flowering annual leaf vegetable, which belongs to the family Malvaceae and the genus *corchorus*. Although the plant is now grown all over the World, South China is believed to be its centre of origin, from where it was introduced to India and Pakistan. Farmers often grow it in association with other vegetables or food crops such as okra, tomato, watermelon, groundnut or yam (Nwangburuka *et al.*, 2012). It grows more easily in rural subsistence farming system, when compared to exotic vegetables like *Brassica oleraceae* and *Spinacea oleraceas*. *Corchorus* is a versatile indigenous vegetable known for its acceptability in human diet, health treatments and industrial uses (Akoroda, 1985). It nourishes the body with minerals, vitamins, hormone precursors, in addition to proteins and energy (Schipper, 2000). It is cooked in a thick viscous soup added to stews and eaten with starchy staples like fufu, eba, amala and pounded yam. The leaf is a rich source of iron, proteins, calcium, thiamin, riboflavin, niacin and dietary fibre (Nwangburuka *et al.,* 2012). *Corchorus* comprises 40 - 100 species, amongst which are wild (non-edible) and cultivars or cultivated (domesticated) species. The most common of the jute mallow family members are the *Corchorus capsularis and Corchorus olitorius* (Tindall, 1986). Within the group of *C. olitorius*, are many local cultivars e.g. early and late flowering and with varying growing habits and leaf shapes (Schippers, 2000). In Nigeria, the most popular local or indigenous variety is Amugbadu, which has finely serrated or lobed margin and elliptical (ovate) leaves. It is well known for being relatively well adapted to many soil types and conditions, in addition to being tolerant to direct sowing, transplanting and repeated harvesting by continuous cutting (Akoroda, 1985). Generally, *Corchorus* thrives relatively well on mildly acid, neutral and basic (alkaline) soils. It prefers sandy loam soils which is very rich in organic matter. Jute mallow is susceptible to drought at different stages of growth, even during the flowering period (Nwangburuka *et al.*, 2012). It is usually propagated by seed, which may be broadcast or drilled. Seeds of *C. olitorius* undergo dormant period which makes germination to be considerably poor. It can be overcome by pre-planting soaking of seeds in hot water (parboiling). The seeds could be tied in a piece of cotton cloth and immersed in almost-boiling water, for five seconds (Akoroda, 1985; Tindall, 1986).

Achieving a sustainable crop production, particularly under tropical climate conditions (where human activities such as bush burning, continuous cropping, overgrazing, mining, bulldozing and numerous climatic attributes are aggravating nutrient imbalances and soil depletion), requires special consideration of both the general soil moisture conditions and soil nutrient contents (Akanbi, 2002; Babajide, 2010). However, as shifting cultivation and bush fallowing are now becoming impracticable, due to urbanization and increasing demands for various land utilization types, the choice of suitable fertilizer for improving soil nutrition and crop productivity has become a serious problem. Amongst the major concerns regarding fertilizer usage is that, the use of chemical / mineral fertilizers is usually associated with toxicity and undesirable residual effects, apart from being highly priced, commonly hoarded and scarce. Also, the organic manures commonly applied by farmers as dependable alternatives, are known to be relatively slow in the release of nutrients, besides, there are problems in relation to competitions and sourcing for the materials required for making the manures (Ojeniyi and Akanni, 2008). Moreso, apart from the reported notable defects of both chemical and organic fertilizers, farmers aggravate the poor soil conditions by neglecting the importance of maintaining organic matter in the soil system and abusive application of fertilizers, regardless of any scientific fertilizer recommendations (Sobulo, 2000; Seran *et al.*, 20l0). Amongst other nutrients, Nitrogen enhances the vegetative growth of plants, and therefore inevitable and mostly suitable for leaf vegetable production. Among the chemical fertilizers, Urea and NPK are mostly used to fertilize vegetable farms, in the southwestern Nigeria, while application of poultry manures and burying of decomposing plant residues or compost are popularly adopted for arable crop production. Hence, there is need to assess the effectiveness of these commonly used fertilizer materials via the performance of *Corchorus olitorius* in the study area, so as to recommend the most suitable fertilizer, for improved soil quality and fertility, and optimum vegetable crop performance, under environment friendly soil conditions.

2.0. MATERIALS AND METHODS

2.1. *Experimental Location and Description*

Field experiment was carried out during the dry season (January and March) of the year 2015, at the Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso. Ladoke Akintola University of Technology (LAUTECH), Ogbomoso falls between latitude 8^0 10' N and longitude 4^0 10' E, which also falls under southern guinea savanna vegetation zone of Nigeria, located in the south-western region. This experimental location is distinctively characterized by bimodal rainfall distribution, with the annual mean rainfall of between 1150 mm and 1250 mm**.** The early rains start in late March /early April and end in late July / early August, which is usually followed by a short dry spell in August. Also, the late rainy season spans between August and November.

2.2. *Land Clearing, Soil Sampling and Analysis*

Land clearing and preparation were carried out manually, following farmers' conventional practice, using hoe, cutlass, mattock, rake etc. Each plot size was 2.0 x 2.0 m^2. During land preparation, soil samples were collected from the soil depths of between 0-15 cm, for pre-cropping physico-chemical analyses, according to IITA, (1982). The soil samples were Alfisols, belonging to Olorunda soil series (Smyth and Montgomery, 1962).

2.3. *Treatments and Experimental Design*

Five (5) fertilizer treatments (N. P. K. 15-15-15, Urea, Poultry manure, Organo-mineral, Composted Tithonia biomass), and the Control (which received no fertilizer application), were tested. All fertilizers were applied at the recommended N-rate of 60 kg Nha^{-1}. The treatments were laid out in Randomized Complete Block Design (RCBD), replicated three times.

2.4. *Propagation and Agronomic Practices*

After proper seed parboiling and air-drying, five (5) *Corchorus* seeds (of a very common indigenous variety named Ogbomoso Local), were sown per hole, at a Spacing of 50 x 20 cm^2. Pre-sowing applications of poultry manure, Tithonia-compost and organo-mineral were done by incorporating the fertilizer materials into the soil at two (2) weeks before sowing, while post-sowing application of urea and NPK were done by ring method of application, at two weeks after sowing. The compost used was prepared from *Tithonia diversifolia* (Hemsl.) *A. Gray* plant materials and well-cured poultry manure (According to the compost making procedures of Babajide, 2010). Aleshinloye organomineral produced by Waste management Establishment at Aleshinloye, Ibadan, Nigeria was used, while the poultry manure applied was collected from the

Poultry unit of Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso. All fertilizers were applied at the recommended N-rate of 60 kg N ha^{-1} (Akanbi, 2002). A water tank (400 litres capacity) regularly filled up from a drilled bore-hole available in the Faculty of Agriculture, was the perennial water source used throughout the experiment. The watering was maintained regularly twice on daily basis (early in the morning and late in the evening) with the aid of watering can filled with water from the opened tap when ever required. Thinning was done at two weeks after sowing (2WAS). Weeding was manually done using hoe on weekly basis.

2.5. *Data Collection, Plant Sampling and Statistical Analysis*

Data collection on growth parameters (number of leaves, plant height, number of branches and stem girth) commenced at three weeks after sowing. Plant height was determined by using measuring tape placed at the base of the main stem of the plant to the tip. Harvesting was done at 6 WAS. Plant samples were oven dried at 80°C for 48 hours (AOAC, 2005). Electronic weighing balance model citizen Mp600H was used to determine the fresh and dry weights of the shoot and root, followed by determination of nutrient concentrations in plant samples and nutrient uptakes (Ombo, 1994: Gungula, 1999**).** All data collected were subjected to analysis of variance (ANOVA). The means were separated using Duncan's Multiple Range Test (DMRT) at 5% probability level (SAS, 2013).

3.0. RESULTS AND DISCUSSION

3.1. Soil physicochemical properties

The results of soil physico-chemical analyses revealed that; the soil used for this experiment was mildly-acidic (pH 6.2) and texturally sandy-loam: (Sand; 85.4%, Silt; 11.4% and Clay; 3.2%). Also, the soil was grossly low in essential nutrients: (Total N; 0.04%, Available P; 4.78 mg kg-1 and exchangeable bases (in cmol kg^{-1}), K; 0.62, Ca; 1.31 and Mg; 0.38), and organic Carbon; 1.78%. These results agreed with Olabode *et al.* (2007) and Babajide *et al.* (2012), who reported that the soils at the study area was slightly acidic in nature and generally low in essential nutrient concentrations, hence, marginally supportive for vegetative and reproductive stages of the commonly grown arable crops.

3.2 Growth and herbage production of *Corchorus olitorius* as influenced by Fertilizer types

Application of fertilizers significantly improved growth parameters of *Corchorus olitorius* since all the fertilizer treatments introduced were significantly higher than the control

(Table 1). Application of organomineral significantly improved plant height of *Corchorus olitorius* but the value was not significantly different from those obtained from applications of poultry manure (T3) and Tithonia compost (T5). Poultry manure significantly increased stem girth size but the value was not statistically different from all other fertilizer treatments applied while the control had the least value (Table1). Application of organic and inorganic fertilizers significantly improved number of branches and number of leaves of *Corchorus olitorius* while the control had least values (Table 1). All these results agreed with the findings of Akanbi, (2002); Olabode *et al.*, (2007) and Babajide and Oyeleke, (2014), who reported significant growth parameters of arable crops as resulted from improved soil nutrition via organic and inorganic fertilizer applications. Application of organic fertilizers (T3, T4, and T5), significantly enhanced fresh shoot weight of *Corchorus olitorius* (Table 2). Application of inorganic fertilizers (T1, and T2) produced significantly lower fresh shoot weights but significantly higher than the control (Table 2). Applications of fertilizer significantly improve shoot dry weight compared to the control (Table 2). Fresh root and dry root weights were significantly enhanced by application of fertilizers (Table 2). Poultry manure application significantly improved fresh and dry root weights of *Corchorus olitorius*, while the control had the least values (Table 2).

All these results corroborated with the findings of Ojeniyi and Akanni, (2005); Seran *et al.*, (2010) and Babajide and Olayiwola, (2014), who reported significant yield parameters of arable crops as resulted from organic and (or) inorganic fertilizer applications.

TABLE 1: Fertilizers application on growth parameters of *Corchorus olitorius*

Treatments	Plant height (cm)	Stem girth (cm)	No of leaves	No of Branches
To	7.4c	0.4c	14.2b	2.7b
T1	17.2b	0.8ab	37.3a	6.5a
T2	15.2b	0.9ab	37.2a	8.4a
T3	23.4a	1.2ab	43.1a	8.3a
T4	27.2a	1.3a	61.4a	9.0a
T5	24.3a	1.0ab	35.5a	7.6a

Means followed by the same letter are not significantly different using Duncan multiple Range test (DMRT). To = Zero application of fertilizer, T1=NPK fertilizer,T2=Urea,T3=poultry manure,T4 organo mineral, T5 Tithonia compost.

TABLE 2: Fertilizers application on yield parameters of *Corchorus olitorius*

Treatments	Fresh Shoot Weight (g/ plant)	Dry Shoot Weight (g/ plant)	Fresh Root Weight (g/ plant)	Dry Root Weight (g/ plant)
To	0.6c	0.2b	0.3d	0.1b
T1	6.1b	2.5a	2.1b	0.5a
T2	3.8b	2.0a	1.2c	0.4a
T3	11.7a	3.3a	4.4a	0.7a
T4	9.3a	2.6a	4.0a	0.7a
T5	9.2a	1.8a	1.7c	0.4a

Means followed by the same letter are not significantly different using Duncan multiple Range test (DMRT). To = Zero application of fertilizer, T1=NPK fertilizer,T2=Urea,T3=poultry manure,T4 Organo mineral, T5 Tithonia compost.

Application of fertilizer on nutrient uptake of *Corchorus olitorius*

The significantly highest values of nutrient uptake for N, P, K, Ca, Mg, and Fe were obtained through application of organomineral. Aleshinloye organomineral application significantly enhanced uptake of nutrient T4 (Table 3). Although not significantly different from P uptake of T1 they were statistically similar (Table 3). The control had the significantly lowest values for all nutrient uptake. These results agreed with the findings of Akanbi, (2002) and Babajide, (2010), who reported improved crop performance and (or) soil quality as resulted from either sole application of manure or integrated of different nutrient sources. The significantly highest values of Cu, Mn and Zn were observed in the T1 (NPK) the inorganic fertilizer applied. But compare to control, all the treatment were higher than T0. T5 (Tithonia compost had significantly highest value of Mg, Ca, Na in terms of nutrient uptake. There were significantly different since all the control. The result corroborated the findings of Chukwuaka and Omotayo (2009) and Babajide *et* *al* (2012), who reported Tithonia biomass as a dependable fertilizer material which could supply adequate nutrients for improved crop yield and nutrient uptakes of crop plant whenever incorporated into the soil.

Table 3: Organic and inorganic Fertilizers application on nutrient uptake of *Corchorus olitorius*

TREATMENTS	N	P	K	Ca	Mg	Na	Fe	Cu	Mn	Zn
	→	gkg^{-1}	←		→		$Mgkg^{-1}$	←		
T0	7.6a	0.7c	0.5d	0.5e	0.5e	0.6bc	91.7d	1.3c	64.2b	14.2b
T1	64.3c	13.3a	13.8c	2.3d	0.8d	0.6b	106.9c	4.5a	72.9a	23.3a
T2	96.4a	10.9a	16.2b	5.0b	1.8c	0.7a	124.2b	3.5b	35.1c	12.5b
T3	64.1c	11.8b	16.9b	4.1c	1.9c	0.5bc	126.9b	3.7b	33.0c	13.6b
T4	98.0a	14.5a	19.3a	8.5a	2.2b	0.4c	136.6a	3.7b	26.5d	11.9b
T5	69.1b	11.3b	19.3a	8.1a	2.7a	0.5bc	155.8a	3.4b	27.7d	12.7b

Means followed by the same letter are not significantly different using Duncan multiple Range test (DMRT). To = Zero application of fertilizer, T1=NPK fertilizer,T2=Urea,T3=poultry manure,T4=organomineral, T5=Tithonia compost.

4.0. CONCLUSION

Application of fertilizers (irrespective of the sources), significantly improved the growth and yield parameters measured, compared to the control. Although, application of organic fertilizers and organomineral had significantly higher values of most of the parameters measured, the values were not significantly different from those obtained from the tested inorganic fertilizers (i,e urea and NPK). The organic-based and organo-mineral fertilizers effectively competed with the N-rich chemical fertilizers (NPK and Urea) tested. Hence, application of either organic fertilizer or organo-mineral fertilizer may be more suitable than any of the chemical fertilizers tested. This will reduce chemical inputs and their residual effects on soil and health-threats. Adoption of such low-input technology may favour maximum and lasting utilization of soil nutrients by crop-plants. Also, use of organomineral fertilizers may promote environment friendliness, particularly both in the areas of reducing chemical fertilizer load on soils and conscious efforts towards turning of harmful phyto-residues, as well as industrial and domestic wastes into effective fertilizer materials under tropical environment when most farmlands could be regarded as marginal.

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