EFFECT OF NPK AND ORGANO-MINERAL FERTILIZER ON THE GROWTH AND YIELD OF JUTE MALLOW (*Corchorus olitorius*) IN ILORIN NORTH CENTRAL NIGERIA

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Abstract
The Southern Guinea Savannah zone of Nigeria comprises thousands of hectares of arable land which are used for the cultivation of crops such as maize, cassava, guinea corn, vegetable crops etc and the people in the zone are predominantly peasant farmers who rely on low inputs for the growing of their crops. Nevertheless, the environment is subjected to constant bush fire, which degrades the vegetative cover, predisposes the soil to direct sunlight, and depletes the organic matter content of the soil with the resultant soil erosion and subsequent low soil fertility. A study was conducted at the Teaching and Research Farm of the University of Ilorin, Ilorin a Southern Guinea Savannah zone of Nigeria during the dry and wet seasons of 2012 to evaluate the effect of NPK fertilizer and organo-mineral fertilizer on the growth and yield of jute mallow (*Corchorus olitorius)* a local delicacy. The treatments imposed were three levels of NPK 15:15:15 at 0, 100 and 200kgha^{-1} and five levels of organo-mineral fertilizer at 0, 1, 2, 3 and 4t/ha in a 3 x 5 factorial scheme fitted into a randomized complete block design (RCBD) replicated thrice. Data were collected on growth parameters –plant height, number of branches, number of leaves, fresh weightper plantand per hectare. Analysis of variance (ANOVA) for all measurements was performed using Genstat version 12 software package. The results showed that application of organo-mineral and inorganic fertilizer and their combination significantly ($P<0.05$) influenced the growth and yield of jute over the control.

Keywords: Organo-mineral, NPK, growth, yield and *Corchorus olitorius*

Introduction
Jute mallow *(Corchorus olitorius*), a member of the Tiliaceae family is used as a traditional vegetable in West Africa,cultivated for fibre in Asia but not a valuable fibre crop in Africa. However the fibre is used domestically (Grubben and Denton, 2004).In the Southern Guinea Savannah zone of Nigeria, the crop is cultivated in poor soils, which often results in low yield but fertile soils will produce better crop thatis cherished by consumers and hence provide higher income for farmers. (Eifediyi *et al.* 2013 and Opole *et al*. 1991) had observed that jute mallow is particularly suitable for resource poor farmers as it is easy to cultivate and require minimal external inputs, unlike exotic vegetables, thereby providing an avenue for resource poor farmers, especially women to earn a decent living. Vegetable plays a key role in human nutrition, especially in rural areas where animal protein is expensiveand beyond the reach of peasant farmers, as it a good source of minerals and vitamins. The crop has the ability to adapt to diverse growing conditions such as low nutrient soils, in both dry and semi- arid regions and in the humid areas of Africa (Schillers, 2000). This has made it a popular vegetable crop among peasant farmers in these regions. During the dry periods, farmers often move to swampy areas and practice intensive cultivation because of its high value. The soil in sub-Saharan Africa is inherently infertile, low in organic matter content due to rapid decomposition of plants and animal remains and therefore cannot support intensive cultivation of crops such as vegetables. One of the ways of soil nutrient

replenishment is by the use of fertilizer but Nigerian farmers access to fertilizer for vegetable growing is limited by fund (Agbede and Kalu, 1995); its scarcity and hoarding have negative impact in the distribution chain which hampers the use of the input by resource poor farmers, especially women. It becomes expedient to source for materials which are environmentally friendly, cheap and readily available.

In Nigeria, where there is a spiral increase in populationand pressure on land for other purposes such as road construction, buildings and other infrastructural development, fallow period which is the traditional method of soil fertility replenishment has been further reduced.The use of inorganic and organo-mineral fertilizers will however, boost crop growth and development resulting in increased food production. Inorganic fertilizer (NPK) serves as an easy source of nutrient release to crops (Agboola, 1986), increases the ability of plants to resist fungal and bacterial attack (Vanlauwe *et al.,* 2002); plays a catalytic part in protein synthesis, chlorophyll formation, carbon assimilation and acceleration of enzymatic action (Hedge, 2001). Organo-mineral fertilizer on the other hand has two major components; mineral component which is readily available to plants and the organic component which is slowly released for plant`s utilization (Osumah and Tijani, 2010). The organic component of the organo-mineral fertilizer improves soil physical, biological and chemical properties while providing plant nutrients at the same time and ensures the sustainable use of the soil. Studies have shown that when crops are fertilized with organic manures, they are more nourished, store longer and do not show susceptibility to rapid mould and decomposition unlike mineral fertilizers (Makinde *et al.*, 2011). There is also better crop establishment and improved efficiency of the utilization of applied materials (Odu and Mba,1991).

Schippers (2002) stated that selections in jute mallow are made for rapid early growth, deep green, glossy colour sand late flowering. The use of organo-mineral and inorganic fertilizers will confer these attributes on jute mallow.In recent times, the combined application of organicand inorganic fertilizers has been suggested to be more sustainable than separate application (Aliyu and Olanrewaju, 2000; Giller, 2002). Law- Ogbomo *et a*l. (2011) also asserted that the use of organic and inorganic fertilizer has been found to be a sound fertility management procedure.Ano and Agwu (2005) recommended the combined use of organic and inorganic manures as soil amendment for increasing crop productivity in the Southern Guinea Savannah zone. Integrated use of organic wastes and mineral fertilizeris reported to reduce the cost and amount of fertilizer required by crops (IAEA, 2003; Krupnik *et al.*,2004; Dobermann and Cassmann 2004). Bair (1990) also reported that proper soil fertility management and sustainable agriculture can be achieved with the use of both mineral fertilizer and organic manure. Paul and Mannan (2006) suggested that integrated nutrient management through combined use of organic wastes and chemical fertilizers could be an effective approach to combat nutrient depletion and promote sustainable crop productivity

In Nigeria the cultivation of vegetables is constrained by poor soil nutrient contents, which is a general feature of soils in Southern Guinea Savannah due to constant bush burning and erosion. There is a need for the use of external inputs in the form of organo-mineral and inorganic fertilizer to optimize production. This work was therefore carried out to investigate the effect of organo-mineral and inorganic fertilizer on the growth and yield of jute mallow.

Materials and Methods

The study was conducted at the Teaching and Research Farm of the University of Ilorin, Ilorin, Nigeria (8^o 48' N, 4^o 58’ E and 307m above sea level) ina Southern Guinea Savannah zone of Nigeria. The area is characterized by an annual rainfall of 1186mm, mean annual temperature of 29ºC while the average

annual relative humidity is about 85%. The soil is well drained and the soil order is Alfisols belonging to the Tanke series (Ogunwale *et al.*, 2002). The site was a two-year fallow land that had been cropped to maize and cassava for two years prior to the establishment of the experiment. Soil samples were collected from 0-30 cm depth from twenty locations prior to planting and application of organo-mineral fertilizer within the experimental plots before and after the experiment and a composite was taken for physico-chemical characterization. Soil pH was measured (soil: water ratio, 1:2) using a glass electrode, total N content was determined by micro- Kjeldahl method (Bremner, 1965), available phosphorus was determined following Bray No 1 (1 N NH4F + 0.5N) using HCl extractant by vanadomolybdophosphoric acid method (Kuo, 1996), organic carbon was determined using the modified Walkley-Black method (Nelson and Sommers,1996)and exchangeable bases extraction done using 1N ammonium acetate, exchangeable K and Na were determined using flame photometry while Ca and Mg were analysed by Atomic Absorption spectrophotometry.

Experiment 1 (Pot Experiment)

Experiment 1(pot experiment) commenced on the 25th of February 2012 with the planting of a local variety of jute mallow (ewedu) in the nursery by drilling method. The seedlings were later transplanted into pots containing 10 kg of soil four weeks after planting. Two pots represented a treatment (two plants per pot). The treatments imposed were three levels of NPK 15:15:15 at 0, 100 and 200kgha^{-1} and five levels of organo-mineral fertilizer at 0, 1, 2, 3 and 4t/ha in a 3 x 5 factorial scheme fitted into a randomised complete block design (RCBD) replicated thrice. The organo-mineral fertilizer was mixed evenly with the soil samples before the pots were filled with soil two weeks before transplanting. The organo-mineral fertilizer was a commercial fertilizer from Pacesetter Grade A.Data were collected fortnightly beginning at 4 weeks after transplanting (WAT) from the two plants in each pot for the following parameters; plant height, number of branches, number of leaves and data on fresh weight per plant and per hectare were collected at 8 WAT. Plant height was assessed by using a measuring tape from the base to the terminal point of the plant, number of leaves and the number of branches were visually counted. At harvest, the plants were uprooted and weighed using a sensitive weighing balance. Analysis of Variance (ANOVA) for all measurements was performed using Genstat software version 17 statistical package for completely randomised design (CRD) and mean separation was done based on the work of Steele and Torrie (1980).

Experiment 2 (Field Experiment)

This experiment commenced on 25 July, 2012 with planting of a local variety of jute mallow in a nursery by drilling. The soil was ploughed, harrowed and beds measuring 6metres by 1metre were made with 0.50 metres avenue between the beds. The treatments imposed were three levels of NPK 15:15:15 at 0, 100 and 200kgha^{-1} and five levels of organo-mineral fertilizer at 0, 1, 2, 3 and 4t/ha in a 3 x 5 factorial scheme fitted into a randomised complete block design (RCBD) replicated thrice. The organo-mineral fertilizer was properly mixed in the beds by using a hoe and a rake two weeks before transplanting was carried out. The seedlings were transplanted at a spacing of 20 x 20 cm and manual weeding was carried out at 3 weeks after transplanting. Data taken were the same as in Experiment 1.

Results and Discussion

Soil Properties

The chemical properties of the soil and organo-mineral fertilizer before and after cropping are presented in Table 1. The results of the soil test indicated that it was slightly acidic and the nutrient composition was below the critical range for profitable crop production. The data indicated that after cropping, the soil was slightly acidic in nature, the organic matter content of the soil decreased slightly and there was a slight increase in nitrogen content of the soil. In addition, the magnesium and

exchangeable K increased after the experiment. The nutrient status of the soil recorded an appreciable increase after cropping. This increase could be attributed to the residual effects of OMF, which is an organic and inorganic form of manure. This is in agreement with the findings of Grinting *et al*. (2003) who reported that nutrients contained in the organic fractions were released more slowly and stored for longer time in the soil thereby ensuring a long time effect and hence, support better crop development and yield.

Table1: Chemical composition of the soil and organo-mineral fertilizer

Soil Properties	**Soil Sample before cropping**	**Soil sample after cropping**	**Composition of organo- mineral fertilizer**
Ph (in 2:1 water)	6.20	6.5	6.10
Organic .matter	0.67	0.50	2.32
Organic carbon(%)	0.39	0.29	1.34
Nitrogen (g/kg)	0.80	1.59	4.42
Calcium (mg/kg)	1.10	0.90	2.80
Mg(cmol/kg)	0.90	3.21	3.87
Available P(mg/kg)	3.43	2.28	7.04
Exch. K(cmo/kg).	0.12	0.21	0.35

The plant height of jute in Experiment 1 and 2 is presented in Table 2.In Experiment 1, the data indicated that at the three sampling periods, as the rate of OMF increased, there was a significant ($P<0.05$) increase in the plant height of jute. Also the use of fertilizer significantly ($P<0.05$) increased the plant height. There was a significant ($P<0.05$) interaction effects. In Experiment 2, a similar trend of what was observed in experiment 1 was recorded across the three sampling periods. These results are similar to the findings of Olaniyi *et al*. (2010) who reported that the growth of okra plant was markedly influenced by the combined application of organo-mineral and inorganic fertilizer. The responses of the treatments to the applied nutrients arealso in agreement with the reports of Akanbi *et al.* (2005) on okra and maize; The low response of jute to inorganic fertilizer alone compared to combined application of the fertilizers is in agreement with the response patterns reported by Akanbi *et al*. (2005) on okra and maize. Makinde *et al.* (2010) observed similar increase in growth parameters of *Amaranthus cruentus* when combined applications of OMF and inorganic fertilizer were used.

The number of branches increased with increase in the rate of application of inorganic fertilizer and OMF application. Using NPK fertilizer in combination with organo-mineral fertilizer increased the number of branches of jute mallow and this is in agreement with the findings of Schillers (2000) who stated that using organic and inorganic fertilizer increased number of branches of jute mallow which will in turn produce more leaves. The combined application rates of 75kg NPK and 3 tha^{-1}organo-mineral fertilizers gave the best okra performance compared to other treatments (Olaniyi *et al*., 2010). John*et al.* (2004) had advocated for an integrated use of organic manure and inorganic fertilizers for the supply of adequate quantities of nutrients to improve crop productivity while minimizing environmental impact from fertilizer use

Data on the number of leaves in Experiment 1 and 2 are presented in Table 4. In Experiment 1, the data on the number of leaves indicated that there was a trend, as the rate of application of OMF increased, the number of leaves increased significantly ($P<0.05$) and there was a significant OMF and fertilizer interaction ($P<0.05$) across the three sampling periods of 4, 6 and 8 WAT.A similar trend of what happened in Experiment 1 was repeated in Experiment 2.

Complimentary use of organic manure and inorganic fertilizer has proven tobe a sound soil fertility management strategy in many countries of the world (Lombin *et al.*, 1991). The nutrient composition of NPK fertilizer was available for plant utilization, which therefore influenced the number of leaves. Ayeni *et al.* (2012) opined that combination of organic manures and NPK had better effect on the nutrient uptake, growth and yield of maize. Aliyu and Olarewaju (2000) reported that the use of combined organo-mineral and NPK fertilizers produced the highest fruit yield of pepper.

Data on the yield components of jute mallow in Experiments 1 and 2 is presented in Table 5.The data on the fresh weight per plant showed that using OMF at 4t/ha produced the highest weight per plant which was significantly different ($P<0.05$) from the other treatments. The yield obtained in this study is in conformity with the findings of Ipinmoroti and Adeoye(2002) that quick releaseof inorganic components and slow nutrient release of the organic constituents of the organic components of OMF must have sustained the performance of *Amanranthus cruentus.* Makinde *et al.* (2010) observed similar increase in growth parameters of *Amanranthus cruentus* when both organo-mineral and inorganic fertilizer were applied.The increase in growth parameters and yield attributes is in agreement with other research investigations (Denton and Adeniran, 1990; Olaniyi, 2006).

The decrease in yield after the optimum rates adduced to luxury consumption by the plant. The present investigation revealed that the application of the NPK at $100kgha^{-1}$ increased plant height, number of leaves, number of branches and fresh weight of fruit. In Cameroun, the average yield from an experiment is 38t/ha in a well-fertilized farm but farmer's yield is usually 5 – 15t/ha. In Nigeria, there is an average yield of 20 – 25kg per $10m^2$(Grubben and Denton, 2004). There was an appreciable increase in the nutrient status of the soil after cropping due to the organic component of the fertilizer. This is in agreement with the findings of Kang and Balasubramanian (1990) who reported that crop yield could be obtained with balanced use of NPK and organic amendments.

Conclusion

The study revealed that the combined application of OMF and inorganic fertilizer increased the growth attributes of jute mallow (plant height, number of leaves and number of branches) It can be concluded from the result of the study that using a combination of NPK fertilizer and organo-mineral fertilizer improved the growth attributes of jute and hence the characters which are desired by consumers.

Table 2: Effect of organo-mineral fertilizer and NPK fertilizer on the plant height (cm) per plant of jute mallow at 4, 6 and 8 Weeks after transplanting (WAT) in Expt 1 and 2

		4 Weeks after Planting NPK Fertilizer (kg/ha)				6 Weeks After Planting NPK Fertilizer (kg/ha)				8 Weeks After Planting NPK Fertilizer (kg/ha)			
	OMF t/ha	**0**	**100**	**200**	**Mean**	**0**	**100**	**200**	**Mean**	**0**	**100**	**200**	**Mean**
Expt	0	10.29	10.69	11.35	10.77	41.56	42.53	50.2	44.76	70.40	73.80	101.10	81.77
1	1	10.68	11.48	11.79	11.32	50.92	53.06	58.1	54.03	62.23	84.27	99.77	82.09
	2	11.68	12.44	13.22	12.45	55.64	58.9	61.42	58.66	79.43	87.87	88.90	85.40
	3	12.87	13.30	13.45	13.21	62.04	68.52	70.08	66.88	69.83	91.17	101.00	87.33
	4	12.93	13.56	13.56	13.35	68.7	69.93	70.43	69.69	80.74	88.00	100.77	89.44
	Mean	11.69	12.29	12.67		55.77	58.59	62.05		72.53	88.02	98.31	
	LSD	Fertilizer	0.192			1.717				0.590			
	(0.05)	OMF	0.149			1.330				0.547			
		Interaction	0.333			2.975				1.022			
	0	9.01	9.51	9.80	9.44	46.3	47.75	50.84	48.30	75.03	90.80	102.07	89.30
	1	9.47	10.36	10.79	10.21	55.05	61.83	64.13	60.34	82.37	85.27	103.63	90.43
Expt	2	10.46	11.06	11.34	10.95	61.73	66.30	77.20	68.41	85.73	106.33	94.67	93.58
2	3	11.31	11.53	11.77	11.54	75.27	77.93	80.07	77.76	86.20	101.80	101.93	96.64
	4	11.46	11.78	11.77	11.67	75.10	76.27	75.33	75.57	88.90	92.37	103.03	94.77
	Mean	10.34	10.85	11.10		62.69	66.02	69.51		83.65	94.11	103.03	
	LSD	Fertilizer	0.146			1.582				1.732			
		OMF	0.113			1.226				1.342			
		Interaction	0.252			2.740				3.000			

Table 3: Effect of organo-mineral fertilizer and NPK fertilizer on the number of branches per plant of jute mallow at 4, 6 and 8 Weeks after transplanting (WAT) in Expt 1 and 2

		4 Weeks after Planting NPK Fertilizer (kg/ha)				6 Weeks After Planting NPK Fertilizer (kg/ha)				8 Weeks After Planting NPK Fertilizer (kg/ha)			
	OMF t/ha	**0**	**100**	**200**	**Mean**	**0**	**100**	**200**	**Mean**	**0**	**100**	**200**	**Mean**
Expt	0	1.29	1.67	2.16	1.71	2.35	2.83	3.53	2.91	6.57	6.63	10.50	7.90
1	1	1.94	2.68	3.16	2.59	3.22	3.72	3.97	3.64	5.53	9.13	10.23	8.30
	2	2.09	2.96	3.03	2.69	3.34	4.43	4.69	4.15	8.43	9.17	8.94	8.85
	3	2.50	3.19	3.29	2.99	4.35	4.86	5.48	4.90	6.47	10.50	10.43	9.13
	4	2.51	3.25	3.26	3.01	4.33	5.39	5.27	4.99	7.47	9.00	10.40	8.96
	Mean	2.06	2.75	2.98		3.52	4.25	4.59		6.89	8.89	10.10	
	LSD	NPK	0.102			0.158				0.528			
		OMF	0.079			0.122				0.409			
		Interaction	0.177			0.274				0.914			
	0	1.65	1.87	2.33	1.95	4.03	4.24	4.33	19.01	6.76	10.10	10.96	9.28
	1	2.34	2.94	3.07	2.78	4.32	4.5	4.8	19.59	7.90	8.63	11.23	9.26
Expt	2	2.65	3.15	3.32	3.04	4.68	4.88	7.55	20.15	8.40	10.13	11.03	9.86
2	3	2.97	3.44	3.48	3.30	6.92	7.8	7.55	20.88	7.86	10.30	11.06	9.74
	4	2.99	3.44	3.44	3.29	7.68	7.67	7.73	21.14	9.90	10.80	11.56	10.76
	Mean	2.52	2.97	3.13		5.53	5.82	6.48		8.17	9.99	11.17	
	LSD	Fertilizer	0.315			0.288				0.505			
		OMF	0.244			0.223				0.391			
		Interaction	0.546			0.521				0.875			

Table 4: Effect of organomineral fertilizer and NPK fertilizer on the number of leaves per plant of jute mallow at 4, 6 and 8 Weeks after transplanting (WAT) in Expt 1 and 2

		4 Weeks after Planting NPK Fertilizer (kg/ha)				**6 Weeks After Planting NPK Fertilizer (kg/ha)**				**8 Weeks After Planting NPK Fertilizer (kg/ha)**			
	OMF t/ha	0	100	200	Mean	0	100	200	Mean	0	100	200	Mean
Expt	0	10.29	10.69	11.35	10.77	19.80	32.13	40.43	30.79	41.56	42.53	50.2	44.76
1	1	10.68	11.48	11.79	11.32	20.63	26.67	46.40	31.23	50.92	53.06	58.1	54.03
	2	11.68	12.44	13.22	12.45	28.20	34.83	34.13	32.39	55.64	58.9	61.42	58.66
	3	12.87	13.3	13.45	13.21	24.13	36.90	48.20	36.41	62.04	68.52	70.08	66.88
	4	12.93	13.56	13.56	13.35	29.23	32.90	47.77	36.63	68.70	69.93	70.43	69.69
	Mean	11.69	12.29	12.67		24.40	32.69	43.39		55.77	58.59	62.05	
	LSD	Fertilizer	0.192			0.759					1.717		
		OMF	0.149			0.588					1.330		
		Interaction	0.333			1.244					2.975		
	0	9.01	9.51	9.80	9.44	46.3	47.75	50.84	48.30	59.67	97.83	101.90	86.47
	1	9.47	10.36	10.79	10.21	55.05	61.83	64.13	60.34	85.03	90.40	104.77	93.40
Expt	2	10.46	11.06	11.34	10.95	61.73	66.3	77.20	68.41	90.20	100.07	96.07	95.44
2	3	11.31	11.53	11.77	11.54	75.27	77.93	80.07	77.76	87.20	102.17	106.10	98.49
	4	11.46	11.78	11.77	11.67	75.10	76.27	75.33	75.57	91.93	95.60	106.03	97.86
	Mean	10.34	10.85	11.10		62.69	66.02	69.51		82.81	97.21	102.97	
	LSD	Fertilizer	0..146				1.582			1.461			
		OMF	0.113				1.226			1.132			
		Interaction	0.252				2.740			2.530			

Table 5: Effect of organo-mineral fertilizer and NPK fertilizer on the fresh weight per plant (g) and fresh weight per hectare (kg) in Experiment 1 and Experiment 2

	Fresh weight per plant (g) Expt 1				**Fresh weight per hectare (g) Expt 1**				**Fresh weight per plant (g) Expt 2**				**Fresh weight per hectare Expt 2**			
	NPK Fertilizer (kg/ha)				**NPK Fertilizer (kg/ha)**				**NPK Fertilizer (kg/ha)**				**NPK Fertilizer (kg/ha)**			
OMF t/ha	0	100	200	Mean	0	100	200	Mean	0	100	200	Mean	0	100	200	Mean
0	41.50	60.70	64.87	55.92	10375	15175	16217	13922	60.10	67.33	103.93	77.12	15025	16834	25983	19281
1	51.33	50.67	66.93	56.31	12833	12667	16733	14078	46.77	83.50	102.17	77.48	11691	20875	25542	19369
2	53.10	62.57	57.27	57.64	13275	15642	14314	14410	63.37	88.60	90.63	80.87	15842	22150	22654	20215
3	46.33	63.83	67.33	59.17	11587	15958	16833	14793	59.13	99.70	102.50	87.11	14787	25025	25625	21812
4	56.80	58.17	67.43	60.80	14142	14539	16875	15185	67.17	91.20	102.77	87.04	16792	22797	25692	21760
Mean	46.81	59.19	64.77		12442	14796	16194		59.31	86.07	100.40		14827	21536	25099	
LSD	NPK	0.437			107.7				1.258				328.0			
	OMF	0.338			83.4				0.975				254.1			
	Interaction	0.756			186.5				2.179				568.2			

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