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Response of Jute Mallow (*Corchorus Olitorus*) to Varying Levels of Cow Dung and NPK Application

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Abstract- The experiment was conducted in the raining seasons of 2016 and 2017 at the Kogi State University Teaching and Research farm to evaluate the effect of cow dung and mineral NPK (15:15:15) on the growth and yield performance of Corchorusolitorius The experiment, a 2*4 Factorial Experiment with four replications consisted of two nutrient sources (Organic and inorganic) as well as four levels of cow dung (0 ton/ha, 2 ton/ha, 4 ton/ha and 6 ton/ha) and four levels of mineral fertilizers NPK 15-15-15 (0 kg/ha, 50 kg/ha, 100 kg/ha, and150 kg/ha). The seeds were immersed in hot water at 97 oC for 10 seconds and then allowed to dry overnight before direct seeding on flat top ridges. Generally results obtained showed significant ($P \leq 0.05$) response of Corchorusolitorius to increasing rates of either cow dung or NPK 15:15:15 for plant height, leaf number, stem girth, number of branches, number of pods, pod weight per plant and total leaf harvest, compared to the control.

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I. Introduction

In Nigeria the use of inorganic or organic fertilizer is still a must since land productivity is limited and the demand for higher production is pressing, considering the increasing population. Though nutrient elements have specific functions in crop growth and development and yield, however no single element can produce any meaningful changes in plant growth [1, 2].

Plant requirements for different elements supplied in fertilizers which are needed for growth, development and yield differ thus there is the need to investigate the effect of the different levels of these nutrients on farmer's intended goal(s). It should be noted that farmers have different objectives for raising specific crops, and these objectives may change with demands. Thus soil fertility and plant nutrition are important aspect of cropping systems and these include adequate supply of essential nutrients for soil productivity, plant nutrition and qualitative crop yield [2, 3, 4, 5, 6 and 7].

Generally, indigenous leafy vegetables are important in human diets [8] either as valuable sources human nutrients or as traditional medicine in many developing countries. Indigenous leafy vegetables (Jute mallow, Amaranthus, Fluted pumpkin, Waterleaf and Tomatoes) play critical roles in the livelihoods of rural communities especially during times of famine because they are the only alternative sources of medicine, nutrition and cash income [9]. Any operation that will positively affect the growth of these crops will impact positively on the living conditions of these rural communities.

Corchorusolitorius called Jews mallow or Jute mallow is an annual herb with slender stem and an important green leafy vegetable in many countries including Egypt, Sudan, India, Bangladesh, Malaysia, Japan, the Caribbean, Western Nigeria and as well as Cyprus [10].It is consumed as a health vegetable because it contains abundant carotene and other carotenoids, vitamins B1, B2, C, E and minerals with varying proportions of dietary fibre and protein [11, 12].

In West African countries including Ghana, Nigeria and Sierra Leone, the vegetable is cultivated for the stem bark which is used in the production of fibre (Jute) and for its mucilaginous leaves which are also used as food vegetables [13]. The leaves contains anti oxidative phenolic compounds and ionone glycosides have also been isolated from the leaves; they showed inhibitory activity on histamine release from rat peritoneal exudates cells induced by antigen antibody reactions. The seeds are poisonous to mammals and insects and contain cardiac glycoside [13] – this is of medical relevance.

This study therefore, will help to generate data on the response of jute mallow to different levels of organic and inorganic fertilizers; as fertilizations of this often viewed minor leafy vegetable are not common among farmers' plots. The research therefore seeks to:

i. Evaluate effect of organic fertilizer on the growth and development of *Corchorusolitorius*;
ii. Evaluatethe effect of inorganic fertilizer on the growth and development of *Corchorusolitorius*;
iii. Evaluate effect of organic fertilizer on the yield (leaf and seed) of *Corchorusolitorius*, and.

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iv. Evaluate the effect of inorganic fertilizer on the yield (leaf and seed) of *Corchorusolitorius.*

II. Materials and Methods

The experiment was conducted in the raining seasons of 2016 and 2017 at the Kogi State University Teaching and Research farm to evaluate effect of cow dung and mineral NPK (15:15:15) on the performance of *Corchorusolitorius*. The experiment, a 2*4 Factorial trial with four replications consisted of two nutrient sources (cow dung and NPK 15:15:15) both at four levels: cow dung (0 ton/ha, 2 ton/ha, 4 ton/ha and 6 ton/ha) and NPK 15:15:15 (0 kg/ha, 50 kg/ha, 100 kg/ha, and150 kg/ha) replicated four times.

NPK 15:15:15 fertilizer was applied at seed sowing, while for those plots requiring organic treatment, cow dung was mixed thoroughly with the soil two weeks before seed sowing to allow for proper decomposition and mineralization.

The seeds of *Corchorusolitorius* were a local variety obtained from the Agricultural Development Project (ADP) office Anyigba, Kogi State, Nigeria. Prior to seed sowing, the seeds were immersed in hot water at 97 °C for 10 seconds and then allowed to dry overnight before direct seeding onto flat top ridges. Weeding was manually carried out using hoes complemented with by hand pulling. Data collected include:

i. Number of leaves was determined by physical counting of leaves on sampled plants;
ii. Leaf area was determined using regression equation as described by Salau *et al*. [14];
iii. Plant height was determined by measuring the plant from the ground level to the top most point of the plant as described by Farnham [15].
iv. Number of branches was determined by physical counting the number of branches on each plant.
v. Freshleaf weight [16] was determined by weighing each of the harve sted leaves/plant using an electronic weighing balance.
vi. Number of fruit yield was determined by counting the number of fruits per plant from sampled population.

III. Results and Discussion

The soil analysis is an indication that the soil of the experimental site is critically limited by various macro nutrients N, P and K, based on the critical levels of these elements required for optimum crop production in Nigeria [17]. The soil textural class was sandy loam with 84.36 % sand, 14.64% clay and 1.00% silt. It contains 0.016 % total N, 1.28 mol/kg value for K while available P was 5.19 mg/kg. (Table 1).The cow dung was analysed for its P^H, organic matter and nutrient element composition. Details are as shown on table 2 below. Of the macro nutrients required for crop growth, P constitute 1.74 %, K was 1.01 %, while N constitute 1.46 %. Total amount of N, P and K added by the addition of 0, 2, 4 and 6 t/ha of cow dung is contained on table 2.1 below.

Table 1: Results of Soil Analysis

Soil properties	Value	Units
Clay	14.64	%
Silt	1.00	%
Sand	84.36	%
Textural class	Sandy Loam	-
P^H	5.8	-
Organic carbon	0.31	-
Available phosphorus	5.19	%
Total nitrogen	0.016	mg/kg
Calcium (Ca)	3.68	mg/kg
Magnesium (Mg)	1.62	Cmol/kg
Potassium (K)	1.28	Cmol/kg
Sodium (Na)	0.58	Cmol/kg
Exchangeable acidity	1.19	Cmol/kg
Total Exchangeable bases	7.16	Cmol/kg
Effective Cation Exchange Capacity	9.07	Cmol/kg

Table 2: Result of Cow Dung Analysis

Nutrient	Compoition
P^H	7.30
Nitrogen	1.46%
Potassium (K)	1.01%

Phosphorus	1.74%
Magnesium (Mg)	6.75 mg/kg
Sodium (Na)	2.30 mg/kg
Calcium	2.30 mg/kg

Table 2.1: Nutrient addition with the incorporation of Cow Dung

Nutrient % composition	Cow dung t/ha			
	0	2	4	6
Nitrogen (1.46 %)	0	29.2 kg/ha	58.4 kg/ha	87.6 kg/ha
Phosphorus (1.74 %)	0	34.8 kg/ha	69.6 kg/ha	104.4 kg/ha
Potassium (K) (1.01 %)	0	20.2 kg/ha	40.4 kg/ha	60.6 kg/ha

Plant heights as well as number of branches responded significantly ($p \leq 0.05$) to nutrient additions (Table 3). Additions of plant nutrients regardless of nutrient source led to incremental height and branch responses. Thus the least performances were consistently observed in the control treatment while addition of cow dung at 6 t/ha, or NPK 15:15:15 at 150 kg/ha consistently gave the highest height and branch responses. At 8 WAP plots treated to cow dung manure consistently performed better that those treated to NPK fertilizers for each nutrient additions.

The positive proportional relationships between plant heights, crop branching in jute mallow in response to incremental nutrient additions are in line with observations made by Ayoola and Adeniyan [18] on that performance of okra, soybean, jute mallow, cassava, tomato and melon under cow dung manure. Makinde *et al*. [19] had also observed that the most satisfactory method of increasing yield was by application of organic manure. While Dart *et al.* [20] observed that applying NPK 15:15:15 fertilizer had relatively greater effects on vegetative growth than on seed or pods production.

Table 3: Effect of varying levels of cow dung and NPK 15:15:15 on plant height and branching in jute mallow

Nutrient source	Mean plant height (cm)			Mean number of Branches		
	4WAP	6 WAP	8WAP	4 WAP	6 WAP	8 WAP
Organic Manure						
0t/ha	7.81	17.58	45.50	3.75	7.00	14.00
2t/ha	31.38	63.43	100.20	12.25	15.50	21.00
4t/ha	53.40	68.75	106.90	13.50	18.50	22.75
6t/ha	66.38	106.85	124.86	15.75	19.75	23.50
Inorganic manure						
0 kg/ha	9.70	11.33	27.75	4.00	5.00	14.50
50 kg/ha	11.39	25.03	63.03	4.25	7.75	16.75
100 kg/ha	11.16	30.68	80.03	5.50	9.00	16.50
150 kg/ha	11.07	49.53	84.15	7.50	10.25	17.25
Cv (%)	6.89	19.81	4.04	27.53	9.44	18.56
LSD	Ns	8.900*	3.97*	2.210*	Ns	2.450*

*Ns -Not significantly different at 5% level of probability; *- Significantly different at 5% level of probability.*

Number of leaves as well as leaf area responded significantly ($p \leq 0.05$) to nutrient additions (Table 4) at 2, 4, 6 and 8 WAP. Similar to responses of plant height and branching to nutrient additions (Table 3), increasing plant nutrients regardless of nutrient source led to incremental leaf number and leaf area responses, with the control treatment consistently giving the least response while addition of cow dung at 6 t/ha, or NPK 15:15:15 at 150 kg/ha consistently gave the highest responses. At 8 WAP plots treated to cow dung manure also consistently performed better that those treated to NPK fertilizers for each nutrient additions in respect of these parameters. The positive responses in number of leaves and leaf areas obtained in this trial could have resulted from the previously observed height increases and branching with increasing fertilization (Table 3). Increasing leaf number must have impacted on leaf areas.

Table 4: Effect of varying levels of cow dung and NPK 15:15:15 on number of leaves and leaf area in jute mallow

Nutrient source	Mean number of leaves			Mean leaf Area		
	4 WAP	6 WAP	8 WAP	4WAP	6 WAP	8WAP
Organic Manure						
0t/ha	45.00	26.00	37.00	11.58	20.70	22.75
2t/ha	158.00	110.50	126.50	71.88	80.90	80.90
4t/ha	354.00	135.75	177.00	95.65	105.75	105.88

6t/ha	503.00	217.50	240.75	112.30	125.82	125.95
Inorganic manure						
0 kg/ha	8.00	14.00	199.00	10.40	7.13	7.85
50 kg/ha	13.75	51.50	103.50	28.35	34.85	34.90
100 kg/ha	16.67	64.75	113.50	31.85	108.98	108.98
150 kg/ha	19.75	88.50	119.25	43.98	136.05	136.05
Cv (%)	22.6	8.11	5.17	21.17	7.85	6.94
LSD	5.080*	6.040*	9.010*	9.36*	9.05*	7.69*

*Ns - Not significantly different at 5% level of probability; *- Significantly different at 5% level of probability.*

That cow dung manure performed better that NPK 15:15:15 could be due to the fact that cow dung supplied micronutrients such as magnesium, sodium and calcium which are essential for jute mallow growth and yield [21, 22].In addition, organic manure improves cohesiveness of the soil, increases its water retention capacity and promotes a stable structure of the soil which could have brought about better performance in comparison with NPK 15:15:15 [23]. In line with the observation Agele [24] also found that organic manure litters resulted in better growth and yield of vegetable crops than NPK fertilizer alone.

Although Dart *et al.* [20]had observed that applying NPK 15:15:15 fertilizer had relatively greater effects on vegetative growth than on seed or pods production, however number of pods, fresh pods weight and dry pods weight also responded significant to increasing nutrient additions (Table 5). Plots treated to cow dung did better than those treated to NPK 15:15:15 in regard to pod yield in jute mallow.

Table 5: Effect of varying levels of cow dung and NPK 15:15:15 on yield of jute mallow

Nutrient source	Pods yield / plant (g)		
	No. of pods	Fresh podswt.	Dry pod wt.
Organic Manure			
0t/ha	22.50	29.98	8.11
2t/ha	36.25	66.60	24.65
4t/ha	50.25	68.18	24.15
6t/ha	69.14	151.03	24.88
Inorganic manure			
0 kg/ha	5.25	29.38	7.74
50 kg/ha	11.00	44.28	12.05
100 kg/ha	17.00	66.78	11.93
150 kg/ha	9.00	96.89	21.80
Cv (%)	11.20	8.62	31.11
LSD	1.82	7.88	6.41

*Ns - Not significantly different at 5% level of probability; *- Significantly different at 5% level of probability.*

IV. Conclusion

In this study, jute mallow performed better in terms of growth and yield under cow dung manure treatment in comparison with NPK 15:15:15. This could be attributed to increase nutrient use efficiency or could be due to the fact that cow dung, as any organic manure supplies other micronutrients such as magnesium, sodium and calcium which are essential for jute mallow growth and yield, as against NPK, which basically supplies nitrogen, phosphorus and potassium.

Increasing nutrient supply irrespective of nutrient source led to reciprocate increase in growth and yield responses. Thus application of cow dung manure at the rate 6t/ha gave the highest yield for all the growth and yield characters such as: number of leaves, number of branches, plant height, leaf area and number of pods, fresh weight of plant, as well as dry weight of plant. While for the NPK treatment the best responses where always gotten from the application of 150 kg NPK 15:15:15/ha.

Clearly plant growth was generally enhanced by organic manureor NPK fertilizer across the parameters investigated. Thus higher rates of nutrient addition is recommended for jute mallow production.

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