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EFFECT OF ORGANIC AND INORGANIC FERTILIZER ON THE YIELD AND NUTRIENT COMPOSITION OF JUTE MALLOW

[1]Aluko O.A., [1]Olanipekun T,O., Olasoji J.O., [2]Abiola I.O., [1]Adeniyan O.N., [1]Olanipekun S.O., [1]Omenna E.C., [1]Kareem K.O. and [3]Douglas A.I.,

[1]Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Nigeria
[2]Federal College of Forestry, P.M.B 5087, Ibadan, Nigeria.
[3]Federal college of Agriculture, Ibadan, Nigeria.

ABSTRACT: *Soil fertilization influences crop yield and nutrient composition of the leafy vegetable. An experiment was conducted to evaluate the effects of organic and inorganic fertilizers on the yield and nutrient composition of Jute Mallow. The treatment consists of eleven fertilizer applications (2.5t/ha OBF, 5.0t/ha OBF, 2.5t/ha OBF +50kg NPK, 2.5t/ha OBF+75kg NPK, 2.5t/ha OBF+100kg NPK,5.0t/ha OBF+50kg NPK, 5.0t/ha OBF+ 75kg NPK,5.0t/ha OBF+100kg NPK,50kg NPK,75kg NPK,100kg NPK) and a control. Jute seeds were sown into the pots at the rate of two plants per stand. The experiment was arranged in a Complete Randomised Design (CRD) with three replicates. Organic sunshine fertilizer was applied two weeks before planting to allow the fertilizer to mineralize in the soil for prompt absorption of nutrients after planting. Two weeks after planting, the supplementary application of inorganic fertilizer was carried out using compound fertilizer (N: P: K: Mg 12:12: 17: 2).The results demonstrated that at eight weeks after planting (8WAP), plant heights levelled-out across the treatments applied. There was significant difference($p<0.05$) in the number of leaves per treatment but a comparable highest number of leaves was found in pots treated with 2.5t/ha OBF+50kg NPK and 5.0t/ha OBF +75kg NPK.Whereas the control pots had the least number of leaves. The effect of fertilizer application significantly influenced the nutrient composition of Jute leaf number, yield performance, plant height, and stem diameter. There was a positive correlation between fertilizer application, crop yield and nutrient composition of jute mallow.*

KEYWORDS: Jute Mallow, Fertilizer, Nutrient Composition.

INTRODUCTION

Jute (*Corchorus olitorius*) or Jew mallow belongs to the family, Tiliaceae. It was proposed that *Corchorus olitorius* originated from South China from where it was introduced to India and Pakistan. It was however found wild in many parts of India as well as China and many parts of Australia and Africa especially in southwestern Nigeria. The major areas of production are in the South Western parts of Nigeria covers areas like Oyo, Ogun, Ondo Osun, Ekiti and Lagos states. It is one of the most popular vegetables in every home. Consequently, it is grown in nearly all home gardens, market gardens near the city and truck gardens around the world.

Corchorus olitorius is widely grown in the tropics for the viscosity of its leaves either fresh or sundried. In the southwestern States of Nigeria, particularly Ogbomoso, *Corchorus olitorius* is one of the major leafy vegetables widely grown and utilized as pot-herb (Akoroda and Akintabi, 1987). The leaves are cooked into thick viscous soup added to stews and eaten with starchy staples (Asoegwu and Ibitoye, 1983), and are rich sources of vitamins and minerals (Tindall, 1983).

It has been reported that most Nigerian leafy vegetables are rich and are relatively cheap sources of ascorbic acid, and minerals and the dietary ash constituents are calcium, phosphorus and iron (Tindall, 1983). The edible leaves of *Corchorus olitorius* on the average, contains 85-87g water, 5-6g protein, 0.7g oil, 5g carbohydrate, 1-5g fibre, 250 - 266Mg Ca, 4-8mg iron, 3000iu vitamin A, 0.1mg thiamine, 0.3mg riboflavin, 1.5mg nicotinamide and 53 – 100mg ascorbic acid (per 100g).

Soil fertility and plant nutrition are important aspect of cropping system and these include adequate supply of essential nutrients for soil productivity, plant nutrition and qualitative crop yield. The availability of these nutrients to plant contributes a lot to its growth and yield. Deficiency of mineral elements essential for plant crop is evident in poor yield and yield quality. Adequate supply of mineral elements is of importance in the tropics where the soil is poorly formed and continuous cropping is on the increase. For any sustainable crop production, soil fertility amelioration is essential.

Adequate soil fertility is essential for sustainable vegetable production. Tropical soils are inadequate in soil nutrients. Thus, the application of fertilizer or manure for amelioration of soil fertility is an integral part of leafy vegetable production. Leafy vegetables require nitrogen for good vegetative growth. The quality of the harvest and storability are influenced by the availability of essential minerals in balance proportion. Any deviation from the balanced proportion of nutrients is easily noticed on the leaves of vegetable crops as deficiency symptoms.

Plant roots require certain conditions to obtain these macro and micro-nutrients from the soil. The soil must be sufficiently moist to allow the plant roots take up and transport the nutrients. The soil moisture content, pH and temperature must fall within an optimum range for the nutrients to be release-able from the soil particles. Sometimes, correcting improper watering strategies will eliminate nutrient deficiency symptoms. This invariably affects the acceptability and market value of the vegetable.

Fertilizer studies in South- Western Nigeria showed positive responses of *Corchorus olitorius* to nitrogen (NIHORT, 1986). Phosphorus is important in root development and helps hasten maturity of the fruit. Tropical soils are often low in available phosphorus and therefore require adequate inputs of phosphorus for optimum plant growth, especially for rapid growing of annual crops such as leafy vegetables (Zapata and Axman, 1995).Leafy vegetables play crucial roles in alleviating hunger and food security. Besides economic potentials, vegetables also have aesthetic value, useful in food preservation, prevent micronutrients deficiencies, enhance nutritional quality of diets and provide little dietary energy (Muller and Krawinkel, 2005). Epidemiological studies have shown that low intake of carotenoids, ascorbic acid, flavonoids and phenolics found in vegetables and fruits increase the risk of cardiovascular diseases and other health challenges (Joshipura *et al*., 2001; Liu *et al*., 2010). Vegetables contain antioxidants and micro nutrients that possess ability to neutralize (scavenge) free radicals or their actions (Nicoli *et al*., 1999; Oke and Hamburger, 2002), thereby preventing terrible diseases of man such as cancer, cardiovascular disease, neural disorders, oxidative stress, diabetes and arthritis (Yoshikawa *et al.,* 2000; Devassagayam *et al.*, 2004).

The leafy vegetable of jute is popularly used in soup preparation and folk medicine for the treatment of fever, chronic cystitis, cold and tumours (Oboh *et al*., 2009). The young shoot tips can be eaten raw or cooked and it contains high levels of protein and vitamin C (Shittu and Ogunmoyela, 2001). Jute is usually recommended for pregnant women and nursing mothers because it is believed to be rich in iron (Oyedele *et al*., 2006).

AVRDC, (1991) and Fayemi, (1999) reported that leafy vegetables such as *Corchorus olitorius* and *Celosia argentia* performed best on well-drained alluvial soils with adequate reserve of organic matter and soil moisture. Leafy vegetables have been found to perform well in peat soils, very rich in organic matter (Siemonsma, 1991). They require a lot of nitrogen for protein synthesis in the leaves (Akanbi and Togun, 2002). Thus, cultivation sustainable of leafy vegetables is hinged on availability of soil nutrient adequately.

Fertilizer is any organic or inorganic material of natural or synthetic origin that is added to a soil to supply one or more plant nutrients essential to the growth of plants. Conservative estimates report 30 to 50% of crop yields are attributed to natural or synthetic commercial fertilizer (Stewart *et al*., 2005). Organic fertilizers are fertilizers derived from animal or vegetable matter. Naturally occurring organic fertilizers include manure, slurry, worm castings, peat, seaweed, humic and poultry guano. The complementary application of organic and inorganic fertilizers as been found to meet the immediate soil nutrient deficits, improve the soil physical properties and enhance yield stability. This study was carried out to investigate the performance of containerized vegetable Jute as influenced by fertilizer variations in homestead gardening.

MATERIALS AND METHOD

The Experiment was conducted at the screen house of Institute of Agricultural Research and Training, Ibadan (IAR&T) between August and October, 2013. The pots were filled with 10 kg soil. Seeds of *Corchorus olitorious* were obtained from kenaf and Jute improvement programme of the Institute of Agricultural Research and Training (IAR&T), Obafemi Awolowo University, Moor Plantation, Ibadan. The seeds were treated using hot water treatment to break the dormancy. The floating unviable seeds were discarded and the good seeds were air dried. After 24 hours, seeds were sown into pots at the rate of two plants per stand. Twelve fertilizer treatments were applied with the control. These were replicated three times and arranged in Completely Randomized Design. Sunshine Organic fertilizer (Produced by Ondo State Government, Nigeria) was applied two weeks before planting to allow the fertilizer to mineralize for prompt uptake of nutrients after planting. Two weeks after planting, the supplementary application of inorganic fertilizer was carried out using compound fertilizer (N: P: K: Mg 12:12 17: 2). The rate of each fertilizer applied was computed using the formula:

$$\text{Amount of fertilizer required /pots} = \frac{\text{Soil weight x Rate x 100}}{2.24 \times 10^6\text{kg} \quad \text{x Fertilizer x 1}}$$

Data Collection

Data were collected on numbers of leaves by counting the number of leaves on the plant. Plant height was determined by using a meter rule. Stem diameter (mid and butt) was determined with the use of Venier Calipers. The yield of plant at harvesting (plant dry matter) was done by oven drying (Carbolite oven) the plant samples at 80^0C till constant weight was attained. These were weighed with sensitive weighing scale (AND GF 2000 Digital Scale). Data collected were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) version 17.

List of Treatments applied
1. 2.5t/ha OBF
2. 5.0t/ha OBF
3. 2.5t/ha OBF + 50kg NPK
4. 2.5t/ha OBF + 75kg NPK
5. 2.5t/ha OBF + 100kg NPK
6. 5.0t/ha OBF + 50kg NPK
7. 5.0t/ha OBF + 75kg NPK
8. 5.0t/ha OBF + 100kg NPK
9. 50kg NPK
10. 75kg NPK
11. 100kgNPK
12. Control

RESULTS

At 8WAP plant height level-out across the treatments applied. Thickest mid stem diameters were obtained in pots treated with 2.5t/ha organic and 100kg NPK. Thinnest stem mid diameter was found in control pots. Stem butt was thickest in the pots treated with 2.5t/ha OBF. Stem butt diameter was lowest in control pots, this was similar to 2.5t/ha OBF + 50kg NPK, 2.5t/ha OBF + 100kg NPK, 5.0t/ha OBF + 50kg NPK, 5.0t/ha OBF +100kg NPK, 50kg NPK and 75kg NPK. Comparable highest number of leaves were found in pots treated with 2.5t/ha OBF + 50kg NPK, 5.0t/ha OBF + 75kg NPK. The control pots had the least number of leaves. However, the number of branches were similar across the treatments applied (Table 1).

Control pots had the least dry matter content. The highest values of leaf dry weight, stem dry weight and root dry weight were recorded in pots treated with 5 t/ha + 50 kg/ha NPK, 75 kg/ha NPK and 100 kg/ha NPK respectively (Table 2).

The effect of fertilizer significantly influenced the nutrient composition of Jute leaf. The different rates and types of fertilizer may be implicated. Percentage Moisture content ranged from 11.34 % (5 t/ha + 75 $kgha^{-1}$ NPK) to 10.64 % (2.5 t/ha). Ash % was highest in 2.5 t/ha + 75 kg/ha NPK (15.65 %) with the lowest in pots treated with 5 t/ha + 100 kg/ha NKP (11.27 %) (Table 3).

Treatments	Plant height (cm)	Stem mid girth (cm)	Stem butt (cm)	Number of leaves	Number of branches
2.5t/ha OBF	96.33	0.70^{a}	1.33^{a}	168^{ab}	26
5.0t/ha OBF	97.33	0.68^{ab}	1.10^{ab}	180^{ab}	42
2.5t/ha OBF + 50kg NPK	85.00	0.60^{ab}	1.05^{abc}	134^{ab}	34
2.5t/ha OBF + 75kg NPK	82.00	0.63^{ab}	1.23^{ab}	229^{a}	45
2.5t/ha OBF + 100kg NPK	65.00	0.57^{ab}	0.97^{abc}	163^{ab}	40
5.0t/ha OBF + 50kg NPK	95.83	0.63^{ab}	0.95^{bc}	134^{ab}	37
5.0t/ha OBF + 75kg NPK	84.33	0.63^{ab}	1.13^{ab}	196^{a}	52
5.0t/ha OBF + 100kg NPK	92.33	0.63^{ab}	1.00^{abc}	175^{ab}	45
50kg NPK	101.00	0.58^{ab}	0.87^{bc}	129^{ab}	36
75kg NPK	97.67	0.67^{ab}	0.90^{bc}	135^{ab}	27
100kg NPK	94.67	0.77^{a}	1.23^{ab}	172^{ab}	40
Control	82.00	0.45^{b}	0.68^{c}	88^{b}	22
SE	7.32	0.05	0.07	19.76	6.13

Means with different superscripts in a column are significantly different
Table 1: Effect of Fertilizers on agronomic parameters of *Corchorus olitorius* at 8 WAP

Treatments	Leaf yield/plant (g)	Stem yield/plant (g)	Root yield/plant (g)
2.5t/ha organic	4.43^{abc}	9.23^{ab}	1.51^{d}
5.0t/ha organic	4.90^{abc}	9.37^{ab}	3.22^{abcd}
2.5t/ha + 50kg NPK	4.92^{abc}	8.86^{bc}	2.31^{cd}
2.5t/ha + 75kg NPK	3.36^{c}	6.36^{bc}	2.25^{cd}
2.5t/ha OBF + 100kg NPK	5.26^{abc}	7.81^{bc}	2.21^{cd}
5.0t/ha OBF + 50kg NPK	5.02^{abc}	7.26^{bc}	2.46^{bcd}
5.0t/ha OBF + 75kg NPK	5.38^{abc}	9.38^{ab}	4.27^{abc}
5.0t/ha OBF + 100kg NPK	6.62^{a}	9.34^{ab}	4.68^{a}
50 kg NPK	4.25^{bc}	6.93^{bc}	2.40^{cd}
75kg NPK	5.72^{ab}	13.60^{a}	4.66^{ab}
100kgNPK	6.23^{ab}	10.23^{ab}	4.76^{a}
Control	3.93^{bc}	4.27^{c}	1.93^{d}
SE	0.45	0.90	0.43

Means with different superscripts in a column are significantly different

Table 2: Effect of fertilizer application on dry weight of *Corchorus olitorius* at 8 WAP

Treatments	M/C %	Ash %	C/F %	Ether Extr	C/P %	NFE %	CHO %
2.5t /ha	10.64^{h}	11.75^{g}	5.48^{f}	3.46^{d}	15.31^{a}	53.35^{g}	58.84^{h}
5t/ha	10.91^{e}	14.69^{b}	5.97^{b}	3.41^{e}	14.09^{c}	50.92^{i}	56.89^{i}
2.5t/ha + 50kg NPK	11.25^{b}	15.65^{a}	5.81^{c}	3.22^{fg}	13.61^{d}	50.46^{j}	56.27^{j}
2.5t/ha + 75 kg NPK	10.81^{f}	11.94^{f}	5.47^{f}	4.05^{a}	13.61^{d}	54.12^{e}	59.59^{f}
2.5t/ha + 100kg NPK	11.34^{a}	11.24^{i}	5.43^{f}	3.22^{fg}	14.15^{c}	54.61^{c}	60.04^{cd}
5t/ha + 50 kg NPK	10.76^{g}	13.33^{c}	5.78^{c}	2.49^{i}	13.15^{e}	54.18^{e}	59.96^{d}
5t/ha + 75 kg NPK	11.31^{a}	11.65^{h}	5.32^{g}	3.09^{h}	13.56^{d}	55.06^{b}	60.39^{b}
5t/ha + 100 kg NPK	11.22^{bc}	11.27^{i}	5.36^{g}	3.67^{c}	14.09^{c}	54.39^{d}	59.75^{e}
50 kg NPK	11.14^{d}	11.79^{g}	5.62^{d}	3.19^{fg}	13.14^{e}	55.12^{b}	60.74^{a}
75 kg NPK	11.13^{d}	10.63^{j}	4.68^{h}	3.24^{f}	14.87^{b}	55.44^{a}	60.12^{c}
100 kg/ha NPK	11.19^{c}	12.45^{e}	6.03^{a}	3.91^{b}	13.59^{d}	52.82^{h}	58.85^{h}
Control	10.93^{e}	13.26^{d}	5.53^{e}	3.18^{g}	13.17^{e}	53.91^{f}	59.45^{g}
LSD (P< 0.05)							
SE	0.04	0.25	0.06	0.07	0.11	0.26	0.22

Values with different superscripts in a column are significantly different.

Table 3: Nutrients composition of Jute leaves as influenced by fertilization

DISCUSSION

The effects of organic and inorganic fertilizers were significantly different on the growth of Jute as evident in parameters evaluated. The least performance of the plants in the control pots was a reflection of soil nutrients deficit. This is in consonance with Ikeorgu (1999), Okpara et al., 2007 and Philips, 1977.

The overall plant performance at harvest 8WAP showed that plant treated with fertilizer had thicker stems, more leaves and higher dry matter than the unfertilized plants. Increasing the rate of nitrogen fertilizer affected leaf dry weight because nitrogen stimulates plant vegetative growth and increases leaf area; as a result increments in leaf area increase the rate of plant photosynthesis and thus higher dry matter production. This is in line with the results of different studies conducted by Gulser (2005) and Takebe et al., (1995) on Spinach, and Tei et al., 2000 and Mahmoudi kliber (2005) on Lettuce (cv' Siah Karaj). Combined application of OBF and inorganic fertilizers had fairly comparable plant performance with sole application of either OBF or inorganic fertilizer. This reflected plant nutrients availability in both sources of fertilizer. However, the residual benefits of OBF on the soil physical and biological properties and on follow-by crop cannot be under estimated. Adediran *et al.*, (2004), reported a significant increase in maize yield and subsequent increase in the yield of cowpea following maize when organic and inorganic fertilizers were used.

The combine application of fertilizers may be highly rewarding in nutrient depleted or marginal soils for remediation and immediate nutrients supply especially in homestead gardening or peri-urban cropping where continuous cultivation is practiced. The dosage can be as high as 5.0t/ha OBF + 100 kg/ha NPK this can gradually reduce to 5.0t/ha OBF + 50kg/ha NPK as the case may be. Even with balanced use of only chemical fertilizer, high yield level could not be maintained over the years because of deterioration in soil physical and biological properties (Khan et al., 2008). The comparative advantage of OBF on the soil physical and biological properties should be considered over sole application of inorganic fertilizer in cropping activities (Adediran et al., 2001; Adetunji, 1991).

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