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RESEARCH ARTICLE

Effects of organic, inorganic and organo-mineral fertilizer on the growth, yield and nutrient composition of *Corchorus Olitorious (L)*

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Abstract:*Corchorus olitorius* (L.) is an important leafy vegetable known for its rich source of several nutrients and dietary fibre in Africa, Asia and some parts of America. One major limitation of cultivating *Corchorus olitorius* in the tropics is inadequate soil fertility. Fertilizer application is an integral part of the vegetable cultivation due to low soil productivity. The study therefore aims at evaluating the effects of organic, inorganic and organo-mineral fertilizer at different concertation on the growth, yield and nutrient composition of *Corchorus olitorious*. The experimental setup followed a complete randomized block design with three replicates. Treatments include control, 1,000 kgha^{-1} sole poultry manure (PM), 2,000 kgha^{-1} sole PM, 200 kgha^{-1} sole NPK, 400 kgha^{-1} sole NPK, 600 kgha^{-1} sole NPK, 1,000 kgha^{-1} PM+200 kgha^{-1} NPK, 1,000 kgha^{-1} PM+400 kgha^{-1} NPK, 1,000 kgha^{-1} PM+600 kgha^{-1} NPK, 2,000 kgha^{-1} PM+200 kg/ha NPK, 2,000 kgha^{-1} PM+400 kgha^{-1} NPK and 2,000 kgha^{-1} PM+600 kgha^{-1} NPK fertilizer combinations. The growth, yield and nutrient composition of *C. olitorious* plants were significantly enhanced in all fertilizer treated plots in comparison to the control. Significantly ($p<0.05$) higher growth parameters, yield and nutrient composition were recorded in the plots treated with combined application of both fertilizers at 2,000 kgha^{-1} PM+400 kgha^{-1} NPK and 2,000 kgha^{-1} PM+600 kgha^{-1} NPK when compared to other application combinations. This study affirms that the combined application of organic and inorganic fertilizer as a soil amendment could enhance growth, yield, and nutrient composition of *C. olitorious* in comparison with sole application of either fertilizers.

Keywords: *Corchorus olitorious,* fertilizer, growth, nutrient composition

INTRODUCTION

Corchorus olitorius known commonly as 'fruited jute', 'bush okra' or 'jute mallow' is a common tropical leafy vegetable found in Africa, Asia and some parts of the Middle East and Latin America (Odofin *et al.,* 2011). It has succulent leaves which soften rapidly with cooking, and thickens into a viscous mucilaginous soup which can be eaten with starchy foods (Adediran *et al.,* 2015). On average, 100 g of edible leaves of *Corchorus olitorius* contains 85-87g water, 5-6 g protein, 0.7 g oil, 5 g carbohydrate, 1-5 g fibre, 250 – 266 Mg and Ca, 4-8 mg iron, 3000 iu vitamin A, 0.1 mg thiamine, 0.3 mg riboflavin, 1.5 mg nicotinamide and 53–100 mg ascorbic acid (Aluko *et al.,* 2014). One of the major challenges of crop production in the tropics is inadequate soil fertility which results from soil erosion, denitrification, overgrazing, deforestation and other human activities (Adediran *et al.,* 2015). Deficiency or inadequate soil nutrients for proper plant nourishment is evident in poor yield and yield quality (Aluko *et al.,* 2014). Attempts made by agriculturists to meet the demands of the ever-growing population by application of fertilizer to replace the lost nutrient in the soil (Adediran *et al.,* 2015). Inorganic fertilizers have been used to ameliorate the soil nutrient level (Adejoro, 2011; Law-Ogbomo and Remison, 2007; Masarirambi *et al.* 2011) owing to their rapidly release of nutrients to be taken up by plants and also due to their easy handling (Adediran *et al.,* 2015). However, inorganic fertilizers have several limitations including high purchase costs, scarcity, pollution of ground water and deterioration of soil physical properties by depleting the soil organic matter on account of continuous usage over time (Ghoneim and El-Araby, 2003). Several studies have confirmed the use of organic manure as a better alternative to chemical fertilizer (Abd El-Megeed *et al*., 2000; Mahmoud *et al*, 2000; Mohamed and Gabr, 2002). This is because it is cheap and affordable, eco-friendly and it had a profound effect on the activity of soil microflora as well as soil physico-chemical properties (Ghoneim and El-Araby, 2003). Organic fertilizers also have their limitations including high risk of infection, high cost of transportation and labour on account of its bulkiness as well as a slow release of nutrients for plant uptake (Adediran *et al.,* 2015) Studies have also confirmed that the combination of organic and inorganic fertilizer in a sustainable ratio as a strategy to combat low available soil nutrients in the tropics (Law-Ogbomo and Osaigbovo, 2016). However, information comparing the three fertilizer application forms in the cultivation of an important leafy vegetable like *Corchorus olitorious* is scanty (Ghoneim and El-Araby, 2003). The aim of this study is to evaluate the effect of organic, inorganic and organo-mineral fertilizer applications on the vegetative growth, productivity and nutrient constituents of *Corchorus olitorious.*

MATERIALS AND METHOD

Source of Materials

Seeds of *Corchorus olitorious* ('oniyaya' cultivar) were obtained from National Horticultural Research Institute (NIHORT), Ibadan, Nigeria. Barnyard manure was

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obtained from a local poultry establishment at Tanke Oke-Odo, Ilorin, Nigeria. Inorganic fertilizer (NPK 15-15-15) was procured from an Agro-chemical shop in Ilorin.

Analysis of Soil and Organic Manure

Air-dried and pulverized poultry manure as well as a composite soil sample (0-30 cm depth) taken from the site were both analysed for physio-chemical properties using standard laboratory procedures outlined by Mylavapus and Kennelley (2002). The soil particle size distribution was determined by Hydrometer method. Organic carbon content was determined by modified wet oxidation method of Walkey and Black (1945). The soil pH was measured with ta pH meter (Oakton ™ water proof pH 450 portable meter) in 1:1 soil-water ratio suspension. Total nitrogen was determined by a semi-micro Kjedahl digestion distillation method (Bermer and Mulvalcy, 1982) while, the available phosphorous was determined by L-ascorbic method (Bray and Kurtz, 1945). The total exchangeable acidity was assessed by method described by Maclean (1982), while the cation exchange capacity (CEC) was determined via ammonium saturation of exchange site and analysis of saturated ammonium using an ammonium ion-selective electrode. (Soil and Plant Analysis Council, 2000). Similarly, exchangeable K, Ca, Mg, Na were determined using the KCl method and the percentage base saturation was calculated as the sum of exchangeable bases divided by the cation exchange capacity and multiplied by 100.

Experimental Design and Treatments

The experimental layout followed a complete randomized block design with three replications per treatment. The dimension of the gross plot measured 10 m × 8 m, while that of the net plots is 2 m × 2 m. Each net plot was separated from each other by 0.5 m. Plant spacing on each of the net plots was 0.3 m ×0.3 m. Treatments include control, 1,000 $kgha^{-1}$ sole poultry manure (PM), 2,000 $kgha^{-1}$ sole PM, 200 $kgha^{-1}$ sole NPK, 400 $kgha^{-1}$ sole NPK, 600 $kgha^{-1}$ sole NPK, 1,000 $kgha^{-1}$ PM+200 $kgha^{-1}$ NPK, 1,000 $kgha^{-1}$ PM+400 $kgha^{-1}$ NPK, 10,000 $kgha^{-1}$ PM+600 $kgha^{-1}$ NPK, 2,000 $kgha^{-1}$ PM+200 kg/ha NPK, 20,000 $kgha^{-1}$ PM+400 $kgha^{-1}$ NPK and 2,000 $kgha^{-1}$ PM+600 $kgha^{-1}$ NPK fertilizer combinations

The experimental plots were manually cleared and plant beds were prepared. The seeds dormancy of *Corchorus olitorious* L was broken by steeping in hot water between 80- 97^{o}C for 5 seconds (Tolorunse *et al*., 2015) to ensure rapid and uniform germination of seeds. Thereafter, seeds were sown at 0.3 m × 0.3 m using drilling method to give room for hand-weeding operations. Plots were hand-weeded at intervals of 2 weeks throughout the study period. Harvesting was done at 8 weeks (56 days) after planting.

Fertilizer Application

Sole organic fertilizer (poultry manure) at the rates of 1,000 $kgha^{-1}$ and 2,000 $kgha^{-1}$ poultry manure were uniformly spread on the plots and lightly incorporated into the soil with the use of a hoe. Sole inorganic fertilizer (NPK 15-15-15) containing 1.10% sulphur,0.02% boron, 0.05% copper, 0.1% iron, 0.05% manganese, 0.001% molybdenum and 0.05% zinc was also applied by ringing them around the plant at the rate of 200 $kgha^{-1}$, 400 $kgha^{-1}$ and 600 $kgha^{-1}$ while organomineral fertilizer was applied at the rates of 1000 $kgha^{-1}$ +200 $kgha^{-1}$, 1,000 $kgha^{-1}$ + 400 $kgha^{-1}$, 1,000 $kgha^{-1}$ + 600 $kgha^{-1}$, 2,000 $kgha^{-1}$ +200 $kgha^{-1}$, 2,000 $kgha^{-1}$ + 400 $kgha^{-1}$ and 2,000 $kgha^{-1}$ + 600 $kgha^{-1}$ poultry manure and NPK 15:15:15 combinations, respectively

Data Collection

The vegetative parameters such as plant height, stem girth, number of leaves and leaf area using CI-202 portable leaf area meter (CID Bio Science Inc) were recorded at 28, 42 and 56 days after planting. At harvest (56 days after planting), above-ground fresh and dry weight were determined. Yield components such as number of pods per plant, pod weight (fresh and dry) were also determined. Harvest was done at 56 days after planting by cutting at the soil level, and the fresh plants were weighed for total biomass using a Kern electronic weighing balance ABT 120-4M. The plant material obtained was oven dried at 80°C for 24 hours before taking the dry weight measurements.

Proximate and Mineral Analysis

The leaf samples were analysed for proximate composition (moisture, ash, crude fats, protein, crude fibre and carbohydrate) were determined according to the standard method described by AOAC (2010). Nitrogen content was deduced by the micro kjedal method (AOAC, 2010) while potassium and phosphorus contents were measured using an Atomic Absorption Spectrophotometer (PG 990) after digestion with nitric acid. All the samples were analysed in triplicate and the mean values were recorded.

Data Analysis

The data were subjected to analysis of variance (ANOVA) using Statistical Package of Social Science (SPSS version 20.0). Means were separated using Duncan multiple range test at 5% probability level.

RESULTS AND DISCUSSION

Soil Parameters

The soil is slightly alkaline (pH of 7.5) with 82.25, 10.09, and 7.66 % sand, silt and clay respectively with a textural class of sand (Table 1). The soil organic carbon, cation exchange capacity and base saturation are 1.22%, 2.95% and 27.45% respectively (Table 1). All other inherent mineral nutrients except exchangeable magnesium and organic matter were below the critical levels as suggested by Ibude *et al.* (1988) and Law-Ogbomo and Osaigbovo *(*2016). This result aligns with Akanbi and Togun (2002), who reported that most African soils are impoverished due to weathering, leaching and intensive cultivation. Similar result was also obtained by Law-Ogbomo and Osaigbovo (2016) in a study conducted on to evaluate of the use of food waste compost and inorganic fertilizer on the growth and yield of *Corchorus olitorius* in a humid ultisol of southwestern Nigeria.

Table 1: Analysis of the experimental field soil.

Soil parameters	Value	Critical Value*
pH	7.5	--
Total Nitrogen (%)	0.3	0.15
Organic Carbon (%)	1.12	---
Organic matter (%)	2.11	2.0
Sand (%)	82.25	---
Silt (%)	11.09	---
Clay (%)	7.66	---
Available Phosphorus (mg/kg)	1.50	8.50
Exchangeable K (cmol/kg)	0.04	0.16
Exchangeable Ca (cmol/kg)	0.08	1.50
Exchangeable Mg (cmol/kg)	0.68	0.28
Exchangeable Na (cmol/kg)	0.25	---
Acidity	1.96	---
C.E.C. (cmol/kg)	2.95	---
Base saturation (%)	27.45	---

*Ibedu et al., (1988); Law-ogbomo and Osaigboyo, (2016).

Table 2: Analysis of organic fertilizer used for the experiment.

Treatment	Value
pH	7.2
Total Nitrogen (%)	1.37
Organic Carbon (%)	22.80
Organic Matter (%)	36.62
Available Phosphorus (mg/kg)	0.92
K (cmol/kg)	0.35
Ca (cmol/kg)	6.04
Mg (cmol/kg)	1.40
Na (cmol/kg)	0.17

Chemical Composition of Organic Fertilizer

The organic manure contained organic carbon, organic matter, nitrogen, potassium, calcium and magnesium contents of 22.8%, 36.62 %, 1.37 %, 0.35 cmol/kg, 6.04 cmol/kg and 1.40 cmol/kg respectively (Table 2). The result of the organic manure analysis depicts a considerably higher nutrient status when compared to that of the field soil. This is an indication of the organic manure's capability of improving the soil nutrient status if allowed to mineralize for the release of its nutrients (Law-Ogbomo and Osaigbovo, 2016). A similar result was obtained by Adediran *et al.* (2015) in a study on the effect of different nutrient sources on the growth and yield of *Corchorus olitorious*.

Plant Growth Attributes

All morphological growth characters of *Corchorus olitorious* plants considered were significantly affected by the fertilizer treatments at $p<0.05$ (Tables 3). Plant height, number of leaves, and leaf area of *Corchorus olitorious* were significantly higher in plots treated with 2000 kg/ha poultry manure + 600kg/ha NPK compared to all other treatments considered at all sampling stages (Table 3). This was followed by plots treated with different concentrations of sole NPK fertilizer (T_3, T_4 and T_5) which were significantly higher than those treated with sole poultry manure at the initial stage of the study i.e. 28 and 42 days after planting. Thereafter, Plots treated with different concentrations of sole poultry manure became significantly higher than those of sole NPK fertilizer at 56 days after planting. Significantly lowest plant height, number of leaves, stem girth and leaf area were recorded in the control at all sampling stages (Table 3 and 4). Significantly the highest growth parameters obtained in plots treated with 2000 kg/ha poultry manure + 600kg/ha NPK compared to all other treatments considered could be due to the combined effect of both fertilizer forms as suggested by Ullah *et al.* (2008) in a study to evaluate the effects of organic and chemical fertilizers on the growth and yield of *Solanum melongena*. The combined application of poultry and inorganic fertilizers has been shown to integrate the attributes of sole organic and sole inorganic fertilizers (Okunola *et al*., 2011). Significantly higher growth parameters obtained in plants treated with sole NPK fertilizer in comparison to those treated with sole poultry manure during the initial stage of study could be attributed to the ready availability of nutrients in contrary to the slow release of nutrients through the decomposition of poultry manure as reported by Mogapi *et al.* (2013). Significantly higher growth parameters obtained in sole poultry manure treatments when compared to sole NPK 15:15:15 at 56 days after planting could be due to the fact that the nitrogen present in poultry manure is released slowly and consistently to meet the growth requirement of the plant throughout its growth stages unlike inorganic nitrogen source that is easily lost soon after application

(Adediran *et al*, 2015). Poultry manure has been reported to have a greater ability to conserve nitrogen when compared to NPK 15:15:15 which easily lost after application through rapid crop removal, run-off, volatilization, leaching and/or denitrification. (Olaniyi *et al*., 2010) As expected, the poor plant growth was reported in control plots as plants suffer due to the inherently poor soils. The results are similar to the study carried out by Mogapi *et al.* (2013) to check the effect of poultry manure and commercial fertilizer on growth of *Corchorus olitorius*. Significantly highest fresh and dry weight was recorded in plots treated with a combination of 20000 kg/ha poultry manure and 600 kg/ha NPK with values of 29.49 g and 7.95 g respectively when compared to all other treatments. This was followed by the various combined application of poultry and inorganic manure (1000 kg/ha organic fertilizer + 200 Kg/ha inorganic fertilizer, 1000 kg/ha organic fertilizer + 400 Kg/ha inorganic fertilizer, 1000 kg/ha organic fertilizer + 600 Kg/ha inorganic fertilizer, and 2000 kg/ha organic fertilizer + 200 Kg/ha inorganic fertilizer) all of which were significantly higher ($p<0.05$) compared to sole application of both fertilizers and the control. Fresh and dry biomass were significantly higer in sole organic manure treated plants when compared to the inorganic and the control while significantly lowest fresh and dry weight was recorded in the control plots (Table 4). Significantly higher fresh and dry biomass accumulation in the organomineral fertilizer treatments obtained in this study when compared to the sole application of either fertilizers and the control is an indication that organo-mineral fertilizer is a better alternative to the sole application of either fertilizers. The combinations of organic and mineral fertilizer have been reported to perform better on the yield of tomato, maize, and *Solanum macrocarpon* than sole application of either fertilizers.(Akanni *et al*., 2011; Ayeni, 2008; Ogunlade *et al*., 2011). . Significantly higher fresh and dry biomass in sole organic manure application compared to sole inorganic fertilizer could be due to better nutrient uptake in organic manure when compared to inorganic fertilizer (Mishra and Ganesh, 2005). Organic manure has been reported to improve plant nutrient uptake by acting as a buffering agent against undesirable pH fluctuations and by improving soil water availability through retention and aeration which ultimately contributes to better nutrients utilization by the crop (Adediran, 2015). This was evident in the higher fresh and dry matter accumulation of sole organic manure treated plot compared to sole inorganic manure treated plots and the control. The least fresh and dry weight of plants in the control plots is a reflection of the soil nutrients deficit as evident in the soil physicochemical properties. The result is in tandem with Aluko *et al.,* (2014) in a study on the effect of organic and inorganic fertilizer on the growth and yield of *Corchorus olitorius.* The fresh and dry pod weight as well as pod number followed similar trend as the fresh and dry biomass (Table 5). This could be due to reasons adduced to fresh and dry biomass accumulation as previously mentioned. Similar results were obtained by Mogapi *et al.* (2013) in a study on the effect of chicken manure and commercial fertilizer on performance of *Corchorus olitorious.*

Proximate and Mineral Composition

Proximate composition as well as percentage nitrogen, phosphorus and potassium of *Corchorus olitorius* were significantly influenced by different types and rates of fertilizer application. Percentage ash content, crude protein, crude fat, fibre and nitrogen, phosphorus and potassium were significantly highest in plants treated with combination of both organic and inorganic fertilizer when compared to sole application of both fertilizer types alone and the control. It should be noted that the aforementioned nutrient attributes were significantly enhanced in plants treated with sole organic manure when compared with sole inorganic manure. Plants in the control plots showed the lowest values. Combined application of poultry manure and inorganic manure has been shown to integrate the beneficial attributes of both organic and inorganic fertilizers (Okunola *et al*., 2011). This is evident in the higher ash content, crude protein, crude fat and fibre as well as nitrogen, phosphorus and potassium uptake recorded in the combined application of both fertilizer as compared to either of the sole applications and the control. Significantly higher levels of the aforementioned nutrients in sole organic manure treated plant when compared to its sole inorganic fertilizer could be attributed to a better nutrient uptake in organic fertilizer plots than in inorganic fertilizer. These trends had earlier been reported by Mishra and Ganesh (2005) where they tested how different fertilizers affect the nutrient status of *Abelmoschus esculentus.*

CONCLUSION

The observed increase in growth, yield and nutrient composition of *Corchorus olitorious* plants treated with different combinations and rates of both organic and inorganic fertilizers over the control suggests that fertilizer application is highly necessary for a successful production of the plant. However, combined application of organic and inorganic fertilizers could be a better soil nutrient amendment when applied at a rate of 2000 $kgha^{-1}$ PM + 400 $kgha^{-1}$ NPK and 2000 $kgha^{-1}$ PM + 600 $kgha^{-1}$ NPK in the cultivation of *Corchorus olitorious.*

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Table 3: Growth parameters of fertilizer treated Corchorus olitorius plants.

	Plant Height (cm)			Number of Leaves			Stem Girth (cm)			Leaf Area (cm^2)			Above-Ground Weight (g)		Pod Mass (g)		Pod Number/ plant
	24 DAP	42 DAP	56 DAP	24 DAP	42 DAP	56 DAP	24 DAP	42 DAP	56 DAP	24 DAP	42 DAP	56 DAP	Fresh Weight	Dry Weight	Fresh Weight	Dry Weight	
T_1	28.37^{c}	55.53^{d}	76.96^{f}	19.00^{f}	43.55^{e}	69.22^{e}	1.34^{c}	2.37^{c}	3.52^{c}	10.07^{d}	19.25^{f}	33.09^{e}	24.73^{f}	6.39^{f}	1.62^{d}	0.42^{d}	6.89^{e}
T_2	31.32^{b}	58.02^{bc}	82.59^{cd}	20.99^{ef}	43.22^{e}	69.78^{e}	1.40^{ab}	2.41^{ab}	3.62^{b}	10.10^{d}	20.10^{e}	33.67^{e}	26.63^{d}	6.69^{e}	1.68^{c}	0.47^{c}	8.45^{b}
T_3	31.01^{b}	56.82^{c}	70.80^{g}	22.11^{de}	49.11^{c}	74.11^{cd}	1.39^{ab}	2.47^{a}	3.36^{e}	10.69^{c}	20.36^{d}	33.54^{e}	22.30^{g}	6.04^{g}	1.52^{e}	0.35^{e}	4.22^{g}
T_4	33.70^{a}	57.88^{b}	74.64^{f}	24.22^{bcd}	45.34^{e}	77.55^{b}	1.41^{ab}	2.41^{ab}	3.42^{d}	10.89^{bc}	20.64^{c}	33.80^{e}	24.54^{f}	6.27^{f}	1.54^{e}	0.39^{d}	5.22^{f}
T_5	35.09^{a}	59.50^{a}	75.60^{f}	27.22^{a}	47.89^{d}	72.11^{de}	1.42^{a}	2.44^{a}	3.44^{d}	11.21^{b}	21.43^{cd}	34.44^{d}	25.08^{e}	6.41^{f}	1.54^{e}	0.40^{d}	7.11^{d}
T_6	30.68^{b}	54.59^{de}	80.02^{de}	22.11^{de}	47.89^{d}	75.56^{c}	1.39^{ab}	2.40^{b}	3.64^{a}	10.91^{bc}	21.86^{c}	36.97^{b}	26.67^{d}	7.28^{d}	1.66^{cd}	0.48^{c}	8.44^{b}
T_7	33.56^{a}	58.26^{b}	84.75^{bc}	25.78^{abc}	49.56^{c}	77.78^{b}	1.38^{b}	2.38^{bc}	3.59^{b}	11.66^{b}	22.33^{b}	37.07^{a}	27.82^{c}	7.56^{c}	1.70^{b}	0.49^{bc}	10.11^{a}
T_8	34.28^{a}	59.97^{a}	87.30^{b}	26.89^{a}	51.78^{b}	78.45^{ab}	1.37^{b}	2.38^{bc}	3.59^{b}	11.96^{ab}	22.82^{b}	37.77^{a}	28.09^{c}	7.66^{c}	1.73^{ab}	0.52^{ab}	10.11^{a}
T_9	31.15^{b}	53.86^{e}	79.73^{e}	23.89^{cd}	51.22^{bc}	74.22^{cd}	1.42^{a}	2.42^{ab}	3.66^{a}	11.92^{ab}	22.73^{b}	35.59^{c}	26.94^{d}	7.51^{c}	1.67^{bc}	0.48^{b}	8.22^{c}
T_{10}	33.30^{a}	54.78^{de}	86.96^{b}	26.22^{ab}	56.89^{a}	76.22^{bc}	1.42^{a}	2.42^{ab}	3.60^{b}	12.59^{a}	23.39^{a}	36.57^{b}	28.55^{b}	7.74^{b}	1.68^{c}	0.50^{b}	8.22^{c}
T_{11}	34.81^{a}	59.48^{a}	90.10^{a}	27.44^{a}	58.78^{a}	80.11^{a}	1.41^{ab}	2.41^{ab}	3.66^{a}	12.82^{a}	23.88^{a}	37.54^{a}	29.49^{a}	7.95^{a}	1.75^{a}	0.55^{a}	9.56^{a}
Control	24.17^{d}	39.27^{f}	48.20^{h}	15.27^{g}	30.89^{f}	45.44^{f}	1.09^{d}	1.66^{d}	2.62^{f}	9.29^{e}	17.11^{g}	26.98^{f}	18.87^{h}	5.21^{h}	1.28^{f}	0.31^{f}	4.22^{g}

Values with the same superscripts are significantly the same at $p<0.05$, N=3; DAP=Days After Planting T_1 =1000 $kgha^{-1}$ sole PM, T_2 =2000 $kgha^{-1}$ sole PM, T_3=200 $kgha^{-1}$ sole NPK, T_4= 400 $kgha^{-1}$ sole NPK, T_5 = 600 $kgha^{-1}$ sole NPK, T_6 = 1000 $kgha^{-1}$ PM + 200 $kgha^{-1}$ NPK, T_7 = 1000 $kgha^{-1}$ PM + 400 $kgha^{-1}$ NPK, T_8 =1000 $kgha^{-1}$ PM + 600 $kgha^{-1}$ NPK, T_9 =2000 $kgha^{-1}$ PM + 200 kg/ha NPK, T_{10} =2000 $kgha^{-1}$ PM + 400 $kgha^{-1}$ NPK T_{11} =2000 $kgha^{-1}$ PM + 600 $kgha^{-1}$ NPK.

Table 4: Nutrient composition of fertilizer treated Corchorus olitorius plants.

Treatment	ASH	M/C	C/P	C/FB	C/FT	CHO	N	P	K
	Percentage (%)						mg/100g		
T_1	10.29^{d}	10.58^{g}	1.29^{d}	33.10^{b}	1.87^{b}	42.89^{cd}	205.60^{e}	92.40^{c}	82.45^{g}
T_2	10.89^{a}	10.75^{f}	1.44^{b}	36.17^{a}	1.93^{a}	38.83^{e}	229.60^{c}	99.79^{b}	89.79^{f}
T_3	9.41^{f}	11.12^{d}	1.01^{f}	31.60^{e}	1.65^{e}	45.23^{b}	160.10^{f}	79.31^{e}	72.52^{j}
T_4	9.51^{e}	11.21^{cd}	1.11^{e}	31.89^{e}	1.62^{g}	44.68^{b}	176.80^{e}	87.39^{d}	78.68^{i}
T_5	9.56^{f}	11.44^{a}	1.30^{d}	32.95^{bc}	1.60^{f}	43.15^{c}	208.0^{e}	89.98^{cd}	80.92^{h}
T_6	10.43^{c}	10.81^{f}	1.32^{d}	33.37^{b}	1.66^{f}	42.43^{cd}	209.60^{e}	93.59^{c}	91.56^{e}
T_7	10.39^{c}	10.97^{e}	1.35^{cd}	33.43^{b}	1.73^{d}	41.64^{d}	215.20^{d}	98.42^{b}	94.16^{d}
T_8	10.26^{d}	11.15^{d}	1.43^{c}	33.54^{b}	1.78^{c}	41.85^{d}	228.0^{c}	99.03^{b}	99.73^{c}
T_9	10.89^{a}	11.22^{c}	1.41^{c}	35.53^{a}	1.70^{d}	39.26^{e}	225.60^{cd}	92.37^{c}	93.98^{d}
T_{10}	10.58^{b}	11.27^{c}	1.48^{b}	35.65^{a}	1.83^{b}	39.21^{e}	236.80^{b}	93.10^{c}	104.22^{b}
T_{11}	10.54^{b}	11.33^{b}	1.55^{a}	35.01^{a}	1.96^{a}	39.64^{e}	247.20^{a}	105.56^{a}	111.93^{a}
Control	7.35^{g}	10.11^{h}	0.76^{g}	29.60^{h}	1.45^{h}	50.74^{a}	121.80^{g}	64.58^{f}	57.02^{k}

Values with the same superscripts are significantly the same at $p<0.05$, N=3; DAP=Days After Planting T_1 =1000 $kgha^{-1}$ sole PM, T_2 =2000 $kgha^{-1}$ sole PM, T_3=200 $kgha^{-1}$ sole NPK, T_4= 400 $kgha^{-1}$ sole NPK, T_5 = 600 $kgha^{-1}$ sole NPK, T_6 = 1000 $kgha^{-1}$ PM + 200 $kgha^{-1}$ NPK, T_7 = 1000 $kgha^{-1}$ PM + 400 $kgha^{-1}$ NPK, T_8 =1000 $kgha^{-1}$ PM + 600 $kgha^{-1}$ NPK, T_9 =2000 $kgha^{-1}$ PM + 200 kg/ha NPK, T_{10} =2000 $kgha^{-1}$ PM + 400 $kgha^{-1}$ NPK T_{11} =2000 $kgha^{-1}$ PM + 600 $kgha^{-1}$ NPK.