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Research paper

Effects of plant row spacing on growth and yield of curry plant (*Murraya koenigii*) in south-south Nigeria

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Abstract

Curry plant (*Murraya koenigii*) is a herbaceous plant of the Rutaceace family. It is one of the less known under-exploited plant species that lack basic literature information on the cultivation and agronomic techniques, but has high economic importance. The plant shoots; leaves, fruits and roots are use as food, culinary, spices, vegetables, medicinal, cosmetics and other domestic purposes. Thus, studies were conducted to determine the effects of spacing (planting distance) on the growth and yield of Curry plant (*Murraya koenigii*) in Cross River University of Technology, Obubra, in the Agronomy Teaching and Research Farm, Cross River State South-South, Nigeria. The design of the study was a randomized complete block design (RCBD). Treatments were six spacing (planting distance inter and intra rows respectively. Result indicated that closer spacing of 60 x 30cm, 70 x 50cm significantly reduce number of leaves, branches, dry weight of leaves and stem per plant but gave taller plant height than wide plant spacing of 100 x 100cm and 120 x 100cm in 2015 and 2016 cropping seasons.

Curry plant fresh leaf yield per plant was significantly higher in wider row spacing than close row plant spacing. The plant spacing of 120 x100cm produced the highest fresh and dry leaf yield per plant of 79.11g/plant and 6.59g/plant in 2015 and 76.35g/ha and 6.37g/plant in 2016 respectively. On the other hand, the fresh leaf yield on per hectare basis was higher in close row spacing compare with wider row spacing. The highest fresh leaf yield of 0.061 t/ha in (2015) and 0.064 t/ha in 2016 were produced in plots with close spacing of 60 x 30cm. Farmers are encourage to introduce and cultivate Curry plant (*Murraya koenigii*) into the regular farming system at a spacing of 70 x 50cm and 80 x 60cm for both optimum fresh and dry leaves yield per plant and hectare based on these findings.

Keywords: *Murraya Koenigii; Plant Spacing; Curry Plant; Vegetable Plant; Rutaceace.*

1. Introduction

Curry plant (*Murraya koenigii*) belong to the family Rutaceace [1]. It is one of the under–exploited plant species, but has high economic importance. It is a small herbal plant that can grow up to the height of 50 to 90 or 100cm tall or more, with a girth diameter of about 15—50 mm depending on the soil fertility [2]. The leaves are pinnate with 1-2 leaflets, each leaflet is 2-4cm long and 1-2 cm broad. The flowers are small, white and produce small black shiny berries fruits [3]. The crop is widely used as spice, condiments and food additives. The aromatic spicy leaves are used extensively for culinary purpose, especially for seasoning and flavoring of dishes and food stuffs. Ethano botanical studies on Curry plant (*Murraya koenigii*) shows that it is a rich source of alkaloids [3]. The leaves contain nutrients such as amino-acids, vitamins, minerals and phytochemicals [4]. The constituent especially the phytochemicals are responsible for the aromatic and medicinal properties of the plants [4].

The plant is widely used in traditional medicine in the management of stomach ache, cough, dysentery and in checking vomiting and reducing cholesterol [3]. Despite the economic importance of Curry (*Murraya koenigii*) there is scanty literature information on the cultivation of the crop in regular farms and fertilizer requirement, spacing and weed control of the crop. Thus the objective of the study aimed to determine effects of spacing on the growth and yield of Curry plant (*Murraya koenigii*) in South-South Nigeria.

2. Materials and methods

Experiments were conducted in Obubra campus of Cross River University of Technology, Agronomy Department, Teaching and Research farm, Cross River state, South-South Nigeria. Obubra lies within the geographical location of longitude 080 18” and latitude 050 59”N.

2.1. Land preparation

The research area used for this study was under two years fallow period when it was cleared, ploughed, and harrowed. The land measured 27m x 20m, area (540m^2) was divided into four blocks . Each block was further sub- divided into six plots of 6 x 4m (24m^2) each on 20th APRIL 2015 and 2016 cropping seasons respectively, each plot had 0.5m path from adjourning plots.

2.2. Experimental design

The design for the study was a randomized complete block design (RCBD).Treatments comprised six plant spacing (planting distance) ; 60 x 30cm, 70 x 50cm, 80 x 60cm, 90 x 70cm,100 x 60cm, and 120 x 100 cm inter and intra row spacing respectively with four replications.

2.3. Planting of Curry plant (*Murraya konegii*)

Curry plant (*Murraya konegii*) was propagated by seeds, but seeds were not planted "in situ" (direct into the field). Mature seeds of curry plant were sown in a nursery to raise seedlings that were transplanted into the experimental plots.

Nursery site located near the experimental plot was prepared (by making seed bed of 2 x 6m ($12m^2$). The seeds were broadcasted on the seed bed on the 15th March, 2015 and 2016 and covered with mulching materials (dried grass). Seeds germinated within 5-7 days after planting. The seedlings were given intensive care (provision of shade, water, pests and diseases control) for four weeks before transplanting to the main experimental plots. Transplanting was done in early morning hours at the rate of one seedling per stand at various spacing as stated above according to their various designed treatments.

2.4. Cultural practices

Experimental plots were kept weed free by manual weeding using hoe at regular interval.

2.5. Harvesting

Sequential harvesting started at seven weeks after transplanting. The young shoots (leaves, small branches, and stems) of curry plants were harvested. At each interval of harvesting, only fresh young green succulent shoots and leaves were cut manually with kitchen knife and tie together and weighed with an electronic weighing balance.

2.6. Data collection

Data were collected on both vegetative and reproductive attributes: Number of leaves, branches per plant ,plant height (cm) leaf area index, (LAI) , Crop growth rate, Days to first and 50% flowering and fruiting , dry matter plant fraction, fresh leaf yield per plant and per hectare , Dry matter yield per plant and hectare.

Leaf Area Index was determined using LAI=La x (p)-1
Where; LAI = Leaf Area index
La = Total leaf area per plant
P = Feeding area available (for ground support). This supports the view of Radford and Brown [5].
Crop Growth Rate (CGR)
Where
CGR = Crop growth rate
CGR = W2- W1 (g/m2/day)
SA (t2- t1)
Where;
CGR = Crop growth rate
W1 and W2 = dry weight at beginning and end of the interval of growth period and t1 and t2 = Sampling time 1 and 2.
SA = the area occupied by the plant at sampling [5].

2.7. Statistical analysis

Analysis of variance (ANOVA) Procedure was used to analyse all data collected as described by Gomez and Gomez [6]. Treatments that showed significant difference were separated using Fishers Least Significant Difference (LSD) at 50% probability level according to Obi [7].

3. Results and discussion

Table 1. Summarized the man relative humidity, temperature and rainfall in 2015 were (79.1%, 30.5 0C, and 229.7mm) and (78.17%, 30.77 0C and 361.94mm) in 2016 cropping seasons respectively and seems adequate for curry plant vegetative growth and leaf yield. The physical and chemical properties of the soil in the area is shown in Table 2. The soil of the study area was sandy loam, acidic, low pH (5.02, 4.73 in water and KCl respectively in 2015) and (5.03 in water, 4.8 and KCl respective in 2016). Organic matter, nitrogen, calcium, potassium and magnesium were also low (Table2).

Table 1: Mean Weather Data of the Experimental Sites in 2015 and 2016 Cropping Seasons

Months	Rain fall (mm)	Temperature (^{0}C)		Relative Humidity (%)
		Maximum	Minimum	
2015 cropping season				
March	58.3	34.1	27.2	72.2
April	163.2	34.5	25.8	81.1
May	263.1	31.3	22.1	83.1
June	537.1	30.1	23.1	87.7
July	637.5	32.3	24.3	90.8
August	389.8	29.2	25.1	85.3
September	421.5	28.1	26.4	87.2
October	301.2	30.4	20.1	75.5
November	187.1	29.5	20.1	84.1
December	15.3	29.5	20.1	65.7
Total	2974.1	308	239.5	812.7
Mean	297.41	30.80	23.95	81.27
March	100.2	33.2	26.3	74.1
April	231.3	32.4	24.2	76.7
May	358.6	30.2	23.4	83.3
June	721.3	31.4	22.5	87.1
July	781.4	30.2	22.3	91.3
August	412.2	31.1	20.3	80.2
September	503.3	30.2	20.2	77.4
October	311.2	30.5	21.6	74.3
November	178.5	29.3	20.1	70.2
December	21.4	29.1	20.3	67.1
Total	3619.4	307.7	223.2	781.7
Mean	361.94	30.77	22.32	78.17

It was observed in the course of this study that there is lack of literature information on the agronomic and cultivation techniques of Curry plant in regular farming systems. Therefore, the authors used some closely related vegetables to curry plant in the discussion of results.

Table 2: Soil Physical and Chemical Properties of the Study Sites in 2015 and 2016 Cropping Seasons

Soil Properties	Values	
	2015	2016
Mechanical Properties		
Coarse sand (%)	15.1	14.8
Fine Sand (%)	67	64
Silt (%)	19.1	18.4
Clay (%)	5.4	7.1
Textural class	Sandy loam	Sandy loam
Chemical properties		
pH in water	5.02	5.03
pH in KCl	4.73	4.81
Organic carbon (%)	0.93	0.91
Organic matter (%)	1.44	1.47
Nitrogen (%)	0.08	0.07
Available phosphorus (cmol/kg)	4.13	4.22
Base Saturation (%)	1.721	1.811
Exchangeable cation (cmol /kg)		
Potassium	0.41	0.50
Magnesium	1.94	1.87
Calcium	4.22	3.86
Sodium	0.17	0.19
Aluminium	0.13	0.15
Hydrogen	0.48	0.66
Cation exchange capacity (cmol/kg)	83.5	85.2

Table 3: Effect of Spacing (Planting Distance) on the Growth: Number of Leaves, Branches per Plant and Plant Height (Cm) Curry Plant (*Muraya Konegii*) in 2015 and 2016 Cropping Seasons

Plant Row spacing (cm)	No. of leaves per plant			Leaf Area Index (LAI)			No. of branches per plant			Plant Height (cm)			
	7WAP	14WAP	21WAP	7WAP	14WAP	21WAP	7WAP	14WAP	21WAP	7WAP	14WAP	21WAP	LSD(0.05)
2015 Cropping season													
60 x 30cm	10.2	17.3	23.4	0.0913	0.9134	1.965	1.2	2.1	3.1	34.21	67.58	104.31	0.12
70 x 50cm	11.3	21.2	30.3	0.0752	0.7865	1.712	1.1	2.4	3.3	30.42	60.34	97.25	0.23
80 x60cm	14.2	24.1	38.2	0.063	0.6115	1.523	1.3	3.1	4.1	25.26	53.42	90.32	1.43
90x70cm	15.4	26.2	41.2	0.045	0.5832	1.232	2.2	3.3	5.3	20.52	47.32	86.46	1.52
100 x 100cm	16.1	28.1	45.3	0.023	0.3368	1.116	2.3	3.4	6.1	17.32	40.47	74.67	2.13
120 x 100cm	19.2	31.1	56.1	0.125	0.2579	1.023	3.1	4.1	7.3	15.45	34.23	65.42	2.33
LSD()0.05	1.1	1.5	2.3	0.011	0.121	0.11	0.01	0.02	0.03	2.1	3.1	3.3	
2016 Cropping season													
60 x 30cm	9.3	18.2	21.1	0.0899	0.863	1.867	1.1	2.2	3.2	36.65	80.38	118.21	0.13
70 x 50cm	12.1	19.2	28.3	0.0785	0.6756	1.652	1.2	2.2	3.1	31.34	71.47	100.42	0.24
80 x60cm	13.3	23.1	39.2	0.0598	0.5383	1.523	2.1	3.1	4.2	27.48	60 .21	91.89	1.21
90x70cm	16.3	25.2	48.1	0.051	0.4765	1.337	2.2	3.2	5.2	23.2	51.53	80.37	1.11
100 x 100cm	18.2	30.2	53.2	0.0389	0.3389	1.241	3.0	3.3	6.3	18.3	42.82	75.56	2.22
120 x 100cm	21.1	34.1	57.3	0.025	0.2812	1.123	3.2	4.2	7.2	16.8	37.62	68.77	2.13
LSD()0.05	1.1	1.3	2.2	0.010	0.0122	0.010	0.01	0.02	0.03	2.0	3.2	3.1	

The results of the effects of spacing on the leaves, branches and plant height is presented in Table 3. Curry plant leaves numbers per plant significantly decreased with increasing plant spacing either at 7, 14, or 21 weeks after planting in the two cropping seasons (2015 and 2016). Between 7 and 14 WAP, the number of leaves per plant become double and wider plant spacing of 100 x 100 and 120 x 100 cm recorded higher number of leaves per plant than close spacing 0f 60 x30 and 70 x 40 cm in 2015 and 2016 cropping seasons. On the other hand, Leaf area index (LAI) increased significantly with decrease in plant row spacing (Table 3). Narrow Curry plant row spacing of 60 x 30cm and 70 x 40cm had greater values of LAI than the other plant row spacing. The highest LAI values of 1.965 and 1.867 in 2015 and 2016 at 21 WAP respectively were observed in plots with close or narrow plant row spacing of 60 x 30 cm . Close or narrow plant row spacing significantly produced taller Curry plants with few number of leaves and branches per plant as compare with the plants of wide plant row spacing. The tallest plant of 104.31cm and 118.21cm were recorded in plot of 60 x 30cm at 21 Weeks after planting in 2015 and 201 6 cropping seasons respectively.

Branching in Curry plant significantly increased with increasing plant spacing in all periods of vegetative growth recorded at 7, 14 and 21 WAP in the two cropping seasons (2015 and 2016) as shown in Table 2. Wider plant row spacing of 100 x 100cm to 120 x 100cm recorded higher number of branches per plant than closer plant row spacing. This finding is in tandem with the observations of Agba et al., [8] and Ebi and Bob [9].

Table 4, summarized the effects of plant row spacing on crop growth rate on the growth of curry plant. There was significantly higher leaf growth rate measured in g/m^2/day in wider plant row

spacing of 100 x 100cm and 100 x 120cm than the other spacing. It was observed in this study that dry matter accumulation measured as crop growth rate increased as the age of the plant increases from 60 days after planting (DAP) to 150 DAP and it was slow at the early stage of 30-60 DAP. However, the leaf, stem and root growth rates double at 90-120 DAP with wider plant row spacing of 100 x100cm and 120 x100cm showing greater crop growth rate as compare with the other plant row spacing . The highest leaf growth rate of (4.0432 g/m^2/day in 2015), stem (3.2241g/m2/day in 2015) and in 2016 leaf (4.3122g/m2/day) and stem (3.1252g/m2/say) respectively were obtained in 120 x 100cm plots at 120-150DAP. Asiegbo and Agba [10] reported similar results where higher crop growth rates of leaf and stem of *Mucuna flagellipes* were recorded in wide spacing plots with few plant population per hectare.

Table 4: Effects of Spacing (Planting Distance) on Leaf and Stem Growth Rate (Gm^2/Day) of Curry Plant (*Muraya Konegii*) in 2015 and 2016 Cropping Seasons

Plant Row spacing (cm)	Leaf Growth Rate (g/m 2/day)				Stem Growth Rate (g / m 2/day)				
Plant Row Spacing	30--60DAP	60-90DAP	90-120DAP	120-150DAP	30-60DAP	60-90DAP	90-120DAP	120-150DAP	LSD(0.05)
2015 Cropping season									
60 x 30cm	0.0213	0.0301	0.2357	1.4421	0.0012	0.0241	0.2571	1.2142	0.002
70 x 50cm	0.0246	0.0342	0.4123	2.2217	0.0013	0.0278	0.2812	1.4352	0.003
80 x60cm	0.0324	0.0512	1.0023	2.6342	0.0021	0.0341	0.3245	1.7124	0.011
90x70cm	0.0431	0.0623	1.3204	3.1542	0.0022	0.0428	0.5101	2.1341	0.022
100 x 100cm	0.0622	0.0846	2.0142	3.4211	0.0043	0.0612	0.8013	2.3120	0.032
120 x 100cm	0.0672	0.0983	2.3106	4.0432	0.0056	0.0811	1.0125	3.2241	0.051
LSD(0.05)	0.001	0.002	0.121	0.0510	0.003	0.023	0.023	0.151	
2016 Cropping season									
60 x 30cm	0.0203	0.0296	0.2443	1.4403	0.0013	0.0256	0.2432	1.0321	0.002
70 x 50cm	0.0254	0.0354	0.5358	2.2109	0.0015	0.0281	0.2761	1.3842	0.003
80 x60cm	0.0355	0.0584	1.0051	2.7011	0.0022	0.0337	0.3451	1.6424	0.012
90x70cm	0.0481	0.0675	1.4022	3.1064	0.0045	0.0521	0.4243	2.1651	0.021
100 x 100cm	0.0642	0.0881	2.145	4.0115	0.0051	0.6701	0.7108	2.4323	0.033
120 x 100cm	0.0713	0.9011	2.5103	4.3122	0.0058	0.0732	1.1351	3.1252	0.052
LSD(0.05)	0.001	0.002	0.122	0.051	0.003	0.001	0.022	0.152	

Table 5: Effects of Spacing on Fresh and Dry Matter Leaf Yield of Plant Fractions (Leaf, Vine and Root) of Curry at Different Periods in 2015 and 2016 Cropping Seasons

Plant Row Spacing()	Leaf fresh weight per plant (g)					Leaf dry weight per plant (g)					Stem dry matter Yield per plant(g)					Fresh leaf Yield per hectare(t/ha)					
	7 WAP	11 WAP	15 WAP	20 WAP	24 WAP	7 WAP	11 WAP	15 WAP	20 WAP	24 WAP	7 WAP	11 WAP	15 WAP	20 WAP	25 WAP	7 WAP	11 WAP	15 WAP	20 WAP	24 WAP	LSD
2015 Cropping Season																					
60 x 30cm	6.38	11.45	19.36	28.13	15.2	0.016	0.121	1.02	4.32	2.31	0.03	0.83	2.14	5.23	9.12	0.019	0.09	0.151	0.0089	0.061	
70 x 50cm	8.22	13.73	24.21	40.31	19.19	0.034	0.153	1.06	5.12	3.25	0.06	0.97	2.68	6.41	12.31	0.017	0.08	0.132	0.0073	0.053	
80 x60cm	13.46	19.57	30.35	48.45	25.32	0.052	0.183	1.10	5.79	3.14	0.07	1.13	3.41	7.35	16.21	0.014	0.07	0.113	0.0052	0.041	
90x70cm	18.29	24.68	35.74	56.33	29.42	0.076	0.208	1.31	6.58	4.33	0.09	2.15	4.25	9.64	18.13	0.012	0.06	0.107	0.0044	0.032	
100 x 100cm	23.15	29.86	41.22	71.45	34.33	0.091	0.221	2.12	7.22	5.24	0.12	3.12	6.11	11.43	21.34	0.011	0.04	0.105	0.0023	0’024	
120 x 100cm	27.39	34.32	45.18	79.11	39.12	0.124	0.232	2.58	8.36	6.56	0.15	5.36	7.36	15.25	26.21	0.010	0.03	0.102	0.0020	0.012	
LSD (0.05)	1.1	2.0	3.2	5.2	2.5	0.01	0.02	0.01	0.51	0.45	0.01	0.31	0.73	0.13	1.11	0.002	0.01	0.002	0.001	0.001	
2016 Cropping season																					
60 x 30cm	7.01	12.23	18.96	29.41	15.10	0.014	0.123	1.01	4.26	2.45	0.02	0.82	2.15	5.34	8.67	0.020	0.08	0.157	0.0091	0.064	
70 x 50cm	8.58	13.44	25.31	39.68	20.11	0.036	0.157	1.08	5.22	3.37	0.07	0.92	2.59	6.52	11.47	0.017	0.07	0.141	0.0078	0.052	
80 x60cm	12.39	20.18	29.53	47.84	27.93	0.074	0.190	1.14	5.83	4.01	0.08	1.14	4.04	7.52	15.68	0.015	0.06	0.123	0.0061	0.032	
90x70cm	16.25	26.11	33.58	52.69	30.26	0.083	0.205	1.42	6.39	4.98	0.09	2.05	5.32	10.67	17.46	0.013	0.06	0.113	0,04	0.029	
100 x 100cm	24.31	30.29	40.34	68.95	32.86	0.091	0.209	2.26	7.34	5.32	0.13	3.14	6.12	12.25	23.21	0.011	0.03	0.103	0.0032	0.021	
120 x 100cm	27.87	36.13	46.24	76.35	40.12	0.141	0.238	2.49	8.55	6.37	0.16	5.28	7.46	15.61	27.11	0.010	0.02	0.106	0.0024	0.014	
LSD (0.05)	1.0	2.1	3.1	4.3	2.2	0.01	0.02	0.01	0.50	0.42	0.01	0.33	0.70	0.12	1.12	0.002	0.01	0.002	0.001	0.001	

Table 5. indicated that leaf dry matter yield per plant decreased significantly with increasing plant row spacing. There were more leaf dry matter yield per plant in wider plant row spacing plots than close spacing plots. At all periods of measurements either at 7,14 or 21 WAP, leaves dry mater yield per plant were significantly greater in wider plant spacing than in narrow or close row plant spacing in 2015 and 2016. The effects of plant row spacing on stem dry matter yield per plant closely followed the same trend as their effects on leaf dry weight per plant. The plant spacing of 120 x 100cm gave higher stem dry weight per plant than the other plant row spacing.

Fresh leaf yield per hectare was higher in close row plant spacing than in wider row plant spacing. However, in this study it was observed that curry plant fresh leaf yield for both on per plant and per hectare bases increased significantly with increasing plant age to the point where professed flowering began, after which the yield of succulent fresh leaves began to decreased .This could probably be due to post flowering senescence of the leaves and possibly change in the partitioning of the assimilate more to flower formation than leaves production. The plant row spacing of 60 x 30cm produced the highest fresh leaves yield per hectare of 0.061 and 0.064 t/ha at 24WAP in 2015 and 2016 cropping seasons respectively. This findings corroborated the work of Asiegbo and Agba [10]; Agba et al. [8]; Agba et al [11] who obtained similar decreased in fresh leaves yield in *Mucuna flagellipes* and Utasi (*Gongronema latifolium*) at close plant row spacing and during post anthesis, flowering and fruiting of the crops.

4. Conclusion

Farmers are encourage to introduce and cultivate Curry plant (*Murraya koenigii*) into the regular farming system at a spacing of 60 x 60cm ,70 x 40cm and 80 x 50cm for both optimum fresh and dry leaves yield per plant and hectare based on these findings.

References

[1] Burkill, H. M., (1985). Entry for *Adenodolichos paniculatus* (Hua) Hutch. & Dalz. [Family LEGUMINOSAE-PAPILIONOIDEAE]. In: The useful plants of west tropical Africa, Vol 3, Royal Botanic Gardens, Kew, UK.

[2] Ebi, Bob (2015).Effects of poultry manure and NPK 15:15:15 fertilizer on the growth and yield of Curry plant. B. Agric. project .Dept. of Agronomy ,Faculty of Agriculture and Forestry ,Cross River University of Technology,Obubra, Cross River State.

[3] Burkill, H.M. (1995) the Useful Plants of West Tropical African. Vol. 3, Families J-L., Royal Botanic Gardens, Kew.

[4] Burkill H. M (1997). The useful plants of tropical West Africa. 43rd Ed .Royal Botanic Gardens Kew. pp 166-179.

[5] Eleyinmi, A. F; Sporns, Pend Bressber O.I. (2007). Nutritional composition of *Gongronema latifolium* and *vernonia amygdalina*. Nutrition and Food Science 38 (2) 99 – 109. https://doi.org/10.1108/00346650810862975.

[6] Radford, P. J. and Brown, A C. (1984). Growth analysis formula: their use and abuse. Crop Sci. 7 (3): 171-175. Radford, P.J. and Brown, A. C. (1984). Growth analysis formula. Their use and abuse. Crop Sci. 7 (3) 171 – 175. https://doi.org/10.2135/cropsci1967.0011183X000700030001x.

[7] Gomez, K A. Gomez, A. A. (1984). Statistical procedures for Agricultural Research. 2nd edition. John Whaley and sons Inc. New York, USA.

[8] Obi, I. U. (2002). Statistical methods for detecting differences between treatments means for field and laboratory experiments. Second Edition published in Nigerian by A. P. Express published Limited 3 Obollo Road, Nsukka, Nigeria 117pp.

[9] Agba, O. A, Asiebgu, J.E, Mbah, B.N. Eze, S. O., Undie, L. U. and Ojikpong, T. O. (2016). Effects of spacing on the growth and yield of Utasi (*Gongronema latifolium* Benth). Proceedings of 3rd Annual Crop Science Society of Nigeria held at University of Nigeria, Nsukka, Enugu state.

[10] Asiegbu J.E and Agba, O.A. (2008). Studies on yield and yield component response of *Mucuna flagellipes* to lime and phospho-rus applications under field culture in a tropical ultisol. Journal of Tropical Agriculture, Food, Environment and Extension, 7 (1).58-65.

[11] Agba, O.A.,Undie, U.L.,Adiaha, M.S. and Osang, P.O,(2017). Responses of Utsai (*Gongronema latifolium*) to NPK 15:15:15 Fertilizer Rates in an Ultisol South-South Nigeria. International Journal of Scientific World, 52 126-130.