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Yield And Yield Components Of Roselle (*Hibiscus sabdari*) as affected by Poultry Manure

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ABSTRACT
Experiments were carried out in 2029 and 2020 to determine the effects of poultry manure rates at (0, 1.5, 2.5, 3.5, 4.5,6,5 8 and 10 t/ha) on the growth and yield of Roselle (Hibiscus sabdari) using randomazied complete block design replicated three times. The study was conducted in the Cross River University of Technology, Faculty of Agriculture and Forestry, Department of Agronomy, Obubracmpus. Results showed that application of 10 t/ha poultry manure significantly increased the growth and gave the highest plant height(123.3cm in 2019 and 119.9 cm in 2020) , number of leaves (20.4 in 2019 and 18.2 in 2020) , branches (6.2 in 2019 and 6.3 n 2020) dry weight of leaf (43.59g in 2019 and 51.57g in 2020) and stem (101.45g in 2019 and 112.39g in 2020) per plant at 50% flowering . poultry manure at 8.0 t/ha prouducedthe highest number of flowers, fresh weight ofCalyses(9.13 in 2019 and 9.2 in 2020), pod (101.55g in 2019 and 112.87g) and seed yield per plant and hectare in 2019 and 2020 croppng seasons . Farmer should apply 8.0t/ha poultry manure to cultivate Roselle for optimum growth and yield under obubra , South-Soulthagroecological zone, Nigera.

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I. INTRODUCTION

Roselle (*Hibiscus sabdariffa*L.) is of *malvaceae* family commonly called "zoborodo ororzobo" plant in Cross River state and South east, Nigeria (Obiafuna and Sofola, 1994). In Africa ,especially Nigeria, the crop has high economics value. The leaves ,shoot and flowers Calyces are used in making drinks and herbal medicine for various ilement (some diseases associated with stomach and liver abnormalities) (Fasoyiro*et al;*2005). Roselle seeds are rich in proteins, oil, minerals, and important raw materials in local bervege and vegetable oil extraction for cooking and factories uses (Fayagi and Tarkhani , 1999 and Obiafuna and Sofala, 1994). The stem bark is used as fibre in making ropes and local brushes. In Nigeria both fresh and dry leaves , flowers , fruit and seeds are used in making soup, foods addictives and traditional medicine.

Despite the economic importance of Roselle , there is scanty information on the agronomic or cultivation techniques (fertilizers requirement , plant row spacing , planting date) among others.

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In South – South Nigeria especially Cross River State, many user of Roselle usually purchase it from Northern Nigeria for their food and medicinal uses. Large scale or commercial cultivation of the crop has not been achieved in South- South, South east and Cross River State probably due to lack of appropriate literature on it cultivation techniques . Also the few peasant famers that grow the crops at sub-subsistent level with no records on the performance growth, yield and agronomic techniques of Roselle crop.

Eairlier researchers work on nitrogen and farm yard manure on dry matter accumulation in Roselle plant but do not includes the fresh leaves , flowers and seeds yield of Roselle which are valuable for food , medicine and other uses.(Maunde*et al;* 2013).

Therefore, this study examine the yield and yield component of Roselle crops as affected by poultry manure and also determine the appropriate poultry rate needed for optimum growth and yield of Roselle crop..

II. MATERIALS AND METHODS

Experimental Sites

Field experiments were conducted in the Teaching ResearchFarm , Faculty of Agriculture and Forestry, Obubra campus , Cross River University of Technology , Cross River state , Nigeria,during two wet seasons (2019 and 2020). Geographically, Obubra is situated at longitude 08^0 6'' E and latitude 05^0 59''N of the equeator in the rain forest ecological zone of South –South , Nigeria.

LAND PREPERATION

The site for experiment was at three years fallow period as at the time it was cleared , stumped , parked ,ploughed and harrow manually using cutlass , hoe and rake.The field was marked out into four blocks , that were sub divided into eight plots of 6x 4m ($24m^2$) each plot was separated by 0.5m path-way and 1.0m between adjourning plots .

SOIL ANALYSIS

After land preparation, soil samples were collected at random from experiment field using soil urger at the depth of 0-40cm. These were bulked , mixed thoughly from where a composite sample was collected for laboratory analysis to determine the physical and chemical properties of the site using standard laboratory methods.

Experimental Design

The design of the experiment was randomized complete block design (RCBD).Seven rates of poultry manure at 0, 1.5, 2.5 , 3.5, 4.5, 6.5, 8.5 and 10t /ha Comprise the treatments replicated four times. It was observed that local peasant farmers have difficulties in getting higher rate of poultry manure in the studied area.

Well cured poultry manure was collected from broilers pens in commercial poultry farm in Obubra town, Cross River state. The manure was tied in sack bags and stored for (6) weeks to decompose before application. Each of the seven plot per block were labeled properly for easy identification of the treatment to be applied. The appropriate cured poultry manure rate applied to each of the plot according to seven treat of 0, 1.5, 2.5, 3.5, 4.5, 6.5, 8.5,and 10 /ha. With the zero(0) rate not receiving any poultry manure and served as the control. These low rate of poultry manure were used in this studies to enable peasant poor resource farmers to afford and apply the manure with ease. It was observed that rural farmers in this area find it difficult to obtain high rate of manure above 10t/ha.

DATA COLLECTION

Data were collected on vegetative and reproductive parameters of Roselle crpsuch as numbers of leaves , branches per plant , stem aiameter (girth) (cm). plant height , leaf area index, dry matter of plant fractions number of (flowers number flower calyses) per plant , number of pods and seeds weight per plant and per hecters.

Data collection began at six weeks after plantiong (WAP). All the plants in two middles rows were tagged for measurement of roselle vegetative growth.

Number of leaves and branches per plant were determine by physical counting of leaves of all plants in the middle rows and the means (average) calculated and recended as number of leaf per plant. The same produce was used to determine number of branches per plant.

Plant heigth of rosellecropwas determine by using matter rule that was stretches from ground to the terminal end of the plant. This produce was carried out on the ten plants from the middle in each plot. The mean was calculated and recorded as plant height.

CULTURAL PRACTICES

Weed control

Weed control in Roselle farm was done using manual method of weeding with small hoe at 4, 8 and 12 weeks after planting.

Pest and disease control

Roselle plant were spray with vetox 75 insecticide at rate of 1.6kg active ingredient (a.i/ha) according to manufactures recommendation to control flea beetle and other insect pest . Spraying was stopped eight days before harvest.

STATISTICAL ANALYSIS

Data collected were statistically analyze using analysis of variance procedure (ANOVA)for randomnized complete blocked design as outline by Gomez and Gomez (1986). Significant treatment were separated using fisher least significant difference (F-LSD) at 0.05 probability level according to Obi (2002) .

Leaf area index.

Portable leaf area meter T- area meter (model MK-2) was used to determine roselleplantLeaf area. Roselle leaf area index was determine by calculation using total leaf area per plant divides by the feeding area of plant as described by shortail (2000)as showed by the relationship $LAI = (LA \times P^{-1})$

Where ;

LAI= leaf area index

LA= Total leaf area

P= ground area (feeding area of the crop)

Dry weight of plant fraction (leaf, stem and root) per plant was done through destructive sampling. At six weeks after planting (WAP) and 50 % flowering, two roselle plants were uprooted fromthemiddle row of each plot. They were separated into fractions (leaves, stem and roots) and put in well label envelops taken to laboratory and oven dried in electronic oven at 60 ^{0}C for three days until the attain steady weight that was recorded as dry weight of leaf, stem and root per plant for each treatment.

III. RESULTS AND DISCUSSION

The soil of the experimental site was sandy loam with soil reaction pH values of 5.2, 5.3 in water and 4.81 and 4.82 in KCl in 2019 and 2020 seasons respectively as presented in Table 1.The sil has low organic matter (1.12% in 2019, 1.06% in 2020) and total Nitrogen of (0.04% in 2019 and 0.05% in 2020) with moderate macro nutrients of Phosphorus, Potassium, Magnesium and Calcium. The low soil nutrient status of this study site has also been reported by Attoe and Undie*et al,* 2013.They recommended the application of poultry manure or fertilizers to increase the soil fertility for high crop yield.

The result of chemical properties of poultry manure used for the study in Table 2. It shows that Nitrogen is (2.34%), Phosphorus (1.28%), Potassium (0.87%), Magnesium (1.95%), Calcium (7.24%), organic matter (30.67%) and organic carbon (50.28%). The application of poultry manure significantly increased the number of leaves and branches per plant (Table 3). Roselle plant height and number of leaves per plant increased with increase in rate of poultry manure. The tallest plant (123.3cm in 2019 and 119.9cm in 2020) with highest number of leaves (20.4 in 2019 and 18.2 in 2020) at 50% flowering was observed in poultry manure rate of 10.0t/ha.

At the early stage of Roselle growth at 6WAP, number of branches per plant and leaf area index were not affected by the used of 1.5 – 3.5t/ha rates of poultry manure (Table 3).However, at advance stage of growth and development, that is at 50% flowering, the application of poultry manure significantly increased number of branches and leaf area index. The lack of significant increased in number of branches and leaf area index of Roselle during early 6 WAP observed in this study could probably be due to the slow process of decomposition of poultry manure applied in the soil. Ubi*et al,* (2013) similarly reported low values of crop growth parameter due to low mineralization of farm yard manure in the soil. The increased in Roselle plant number of leaves and plant height is as a result of the beneficial effects of poultry manure that increased availability of soil nutrients require by the plant.Maunde*et al,* (2013) obtained increased in Roselle growth occasion by farm yard manure application.The application of 10t/ha poultry manure rate produced the highest leaf area index of 3.71 in 2019 and 3.85 in 2020 at 6 weeks after planting and 6.21 in 2019 and 6.05 in 2020 at 50% flowering respectively (Table 3).The significant increased in the vegetative parameters (leaves and branch number per plant, girth diameter and leaf area index) showed better growth performances of Roselle plants that received poultry manure than the control plots with no poultry manure. This agreed with the findings of Ikeh, 2017 that organic manure treatment of the soil, supply plant nutrients for crop growth and affected the plant physiological processes which serve as important instrument in yield development.

Table 4 presents significant increased of the dry matter (leaf, stem and root) of Roselle as affected by poultry manure.Results showed that accumulation of dry matter in the plants increased significantly with increases in the poultry manure rates.The poultry manure rate of 10t/ha produced the highest dry matter weight of the leaf (52.31g and 51.57g) at 10WAP, stem dry weight (101.45g, 112.39g) foot (75.49g, 81.21g) at 50% flowering in 2019 and 2020 seasons respectively. The significant higher accumulation of dry matter in Roselle leaf, stem and root observed from poultry manure plots over the control treatment could be that the appliedpoultry manure improved the soil nutrient, physical and chemical properties of the soil which could have been responsible for the high dry matter production and accumulation in the Roselle plant parts.

This observation agrees with the findings of Ogunwale and Aleka, (2010) that application of organic matter promotes high vegetative growth of crops.

The result further showed significant increased in the yield of Roselle plant (Table 5). The yield components such as number of flowers, calyses, pod and seed weight per plant increases with incremental rate of poultry manure to up to 8t/ha beyond this rate there was a significant decrease in both the number and weight of the yield components as the poultry manure rate increased.Agba*et al*(2012)reported similar trend in which the yield and yield components especially 1000-seed weight and maize grain yield per hectare increased significantly with each progressive increase in poultry manure rate and reached a threshold at 18t/ha beyond which there was a significant declined.

In this studies, it was observed that 8.5t/ha poultry manure proved to produce the highest fresh pod weight yield (112.89g, 101.58g) and seed weight per plant (97.16g and 93.93g)and yield components of number of flowers per plant (13.14g, 12.02g) calyses fresh(9.13g, 9.21g and dry weight (5.43g, 5.22g) 100 seed weight (8.48g, 8.11g) in 2019 and 2020 cropping seasons respectively (Table 5).

The highest vegetative growth, dry matter accumulation in leaf, stem and Roselle plant yield and yield components in poultry manure especially by 8t/ha poultry manure than control (with no poultry manure application) is attributed to the manure application that could have supplied the balance nutrient requirement which led to increase in merismatic and photosynthetic activities and enhanced greater assimilates production which was translocated into dry matter production and increased yield and yield components.

This confirms the report that general increase in vegetative growth and yield is obtained with manure application (Said *et al* (2015).

IV. CONCLUSION

BASED on the findings of his studies farmers are recommended to apply 8.0t/ha poutry manure to cultivate Roselle for optimum growth and yield in ObubraCrorss River, South- South agroecological zone

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Table 1: Physochemical properties of the soil of experimental site in 2019 and 2020

PROPERTIES	**VALUE**	
	2019	**2020**
Mechanical		
Coarse Sand (%)	14.1	13.45
Fine Sand (%)	66.2	65.3
Clay (%)	5.1	5.4
Silt (%)	17.2	18.2
Texture class	Sandy loam	Sandy loam
Chemical Properties		
pH in water	5.2	5.3
pH in KCl	4.81	4.92
Organic Carbon (%)	0.83	0.85
Organic Matter (%)	1.12	1.06
Total Nitrogen (%)	0.04	0.05
Available Phosphorus (Mg/Kg)	4.13	4.06
Potassium (Mg/100g/soil)	1.11	1.23
Base Saturation (%)	54.7	61.4
Magnesium (Mg/100g/soil)	1.58	1.49
Calcium (Mg/100g/soil)	2.09	2.52
Sodium (Mg/100g/soil)	0.05	0.07
Aluminum (Mg/100g)	1.47	1.28
Cation Exchange Capacity (CEC) (Mg/100g)	7.98	7.86

Table 2: Chemical properties of Poultry manure use in experiment

PROPERTY	**CHEMICAL COMPOSITION**
Nitrogen %	2.84
Phosphorus %	1.28
Potassium %	0.87
Magnesium %	1.95
Calcium %	7.24
Organic Matter %	30.67
Organic Carbon %	50.28

Table 3: Effects of Poultry Manure on Vegetative growth (No. of leaves, branches per plant) in 2019 and 2020 sessions

Treatments (Poultry manure Rates) (t/ha))	Numbers of leaves per plant				**Leaf Area Index**				Numbers of Branches per plant				**Plant Height (cm)**				**Stem Girth (diameter cm)**			
	6WAP		50% Flowering		6WAP		50% Flowering		6WAP		50% Flowering		6WAP		50% Flowering		6WAP		50% Flowering	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
0	3.2	3.1	6.21	6.2	0.35	0.44	1.31	1.14	1.2	1.1	2.1	2.3	10.4	11.3	36.5	38.1	10.34	10.21	22.41	20.57
1.5	4.3	4.4	8.2	8.3	1.12	1.35	2.034	2.11	2.1	2.2	3.2	3.1	15.2	14.6	51.6	53.2	31.23	29.34	42.16	38.98
2.5	5.1	5.3	8.3	9.1	1.43	1.52	2.52	2.42	2.3	2.2	4.1	4.2	17.3	16.8	59.3	60.2	37.51	35.42	48.52	46.75
3.5	6.2	6.1	9.2	9.3	1.75	1.,8s7	2.86	2.89	2.3	2.4	4.3	4.4	18.2	19.3	65.8	69.4	42.63	40.57	56.34	53.81
4.5	7.1	6.3	9.4	10.1	2.18	2.21	3.17	3.21	3.2	3.3	5.1	5.3	21.4	23.8	71.4	75.5	50.42	51.82	61.76	60.45
6.5	7.1	7.2	10.1	11.2	2.34	2.35	4.23	4.34	4.1	4.2	6.1	6.2	24.5	24.8	92.1	87.6	56.33	55.24	68.45	66.73
8.5	8.1	8.2	11.3	12.3	3.17	3.24	5.17	5.23	5.3	5.1	7.1	7.2	30.7	31.4	103.4	105.8	61.46	60.35	72.56	70.47
10.5	8.4	8.4	20.1	20.3	3.71	3.85	6.21	6.05	6.2	6.3	8.3	8.2	43.8	50.2	123.3	119.9	68.24	66.57	81.33	82.52
LSD(0.05)	0.01	0.01	0.1	0.1	0.01	0.01	0.21	0.22	0.02	0.02	0.03	0.03	1.1	1.2	3.2	3.3	4.2	4.1	5.3	5.2

WAP = Weeks after planting, 50% flowering = period when half of Roselle plants had flower

Table 4: Effects of poultry manure on Roselle dry matter (leaves, stem and root per plant) in per plant in 2019 and 2020 sessions

Treatments(Poultry manure Rates(t/ha))	leaves dry weight per plant (g)						Stem dry weight per plant (g)						Root dry weight per plant (g)					
	2019			2020			2019			2020			2019			2020		
	6WAP	10WAP	50% Flowering 2019	6WAP	10WAP	50% Flowering 2019	6WAP	10WAP	50% Flowering 2019	6WAP	10WAP	50% Flowering 2019	6WAP	10WAP	50% Flowering 2019	6WAP	10WAP	50% Flowering 2019
0	9.36	14.25	12.36	18.57	14.18	11.24	1.52	13.21	32.43	1.61	15.31	34.15	3.31	15.42	23.50	3.27	13.78	21.73
1.5	11.28	20.44	17.19	10.34	21.23	18.31	2.34	26.35	51.75	2.42	38.72	49.98	7.56	21.38	35.34	6.73	20.11	33.41
2.5	12.41	23.26	20.45	12.15	24.16	20.73	2.51	28.64	54.32	2.71	31.24	53.29	7.81	23.21	40.12	6.95	21.83	38.32
3.5	14.52	25.18	21.34	13.73	27.35	20.87	3.23	33.71	61.52	3.43	34..82	62.7	8.34	28.17	43.43	7.83	26.71	41.14
4.5	16.11	31.29	26.53	15.22	30.92	24.17	4.15	35.89	68.41	5.12	40.31	70.81	9.57	33.48	52.32	8.62	31.35	50.46
6.5	17.39	36.32	30.28	18.11	35.85	31.51	6.78	51.37	84.37	6.83	54.18	89.43	11.16	40.62	57.14	10.71	42.73	54.23
8.5	20.27	44.27	38.73	21.14	43.46	35.34	7.67	63.42	96.11	7.78	65.26	94.82	14.57	53.58	69.73	15.11	52.16	66.52
10.5	23.46	52.31	43.59	24.37	51.57	41.99	8.13	74.81	101.45	9.24	77.34	112.39	18.39	62.17	75.47	17.45	60.34	81.21
Mean	0.7	0.6	1.4	1.4	2.1	2.3	0.2	0.3	3.1	0.12	4.1	5.1	0.4	2.1	2.3	0.02	1.4	1.2
LSD()0.05																		

WAP = Weeks after planting, 50% flowering = period when half of Roselle plants had flower

Table 5: Effects of poultry manure on Roselle yield and yield components in 2019 and 2020 sessions

Treatments(poultry manure Rate (t/ha))	Number of flowers per plant		Calyses fresh weight per plant		Calyses dry weight per plant (g)		Number of pods per plant		pods fresh weight per plant (g)		pods fresh weight per hectare (t/ha)		Seed weight per plant (g)		100 seed weight (g)		
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	
0	5.11	4.22	3.25	2.79	1.36	1.03	5.11	4.12	45.43	37.26	0.342	0.235	37.28	31.42	2.17	2.14	
1.5	8.23	7.31	5.73	4.25	2.47	2.12	6.23	5.34	63.52	58.15	1.435	1.216	53.57	50.38	3.63	3.51	
2.5	8.34	8.12	5.82	5.14	2.34	2.23	6.34	5.42	65.38	61.73	1.511	1.321	57.34	54.19	3.82	3.74	
3.5	9.12	8.22	6.12	6.04	3.11	3.02	7.15	6.34	72.45	65.38	2.113	2.083	64.28	62.36	4.15	3.92	
4.5	9.31	9.14	6.27	6.35	3.25	3.14	8.22	7.13	78.51	73.25	3.121	3.084	74.59	70.24	4.32	4.17	
6.5	11.12	10.11	7.34	7.41	4.24	4.27	11.33	9.41	93.74	88.42	4.143	4.125	86.48	89.86	5.58	5.32	
8.5	13.14	12.02	9.18	9.21	5.43	5.22	16.12	13.17	112.87	109.58	6.252	5.813	97.16	93.93	7.03	6.84	
10.5	10.12	10.13	7.46	7.32	3.14	3.12	8.41	9.23	81.39	77.97	3.125	3.046	84.77	76.28	4.36	4.02	
LSD()0.05	0.2	0.3	0.02	0.02	0.01	0.01	0.03	0.03	2.1	2.1	0.01	0.01	4.2	4.1	0.01	0.01	

WAP = Weeks after planting, 50% flowering = period when half of Roselle plants had flower