POULTRY MANURE RATE AND OKRA POPULATION ON GROWTH AND YIELD OF EGUSI MELON INTERCROP

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ABSTRACT
Poultry manure contains appreciable amounts of nutrients required by plants, It decomposes in the soil, releasing for nutrients crop uptake. Field experiment was conducted at the Federal University Agriculture, Abeokuta, to determine poultry manure rate and population of okra that gives optimal yield in 'Egusi' melon-Okra intercrop. The experiment was carried out using Randomized Complete Block Design (RCBD) in a split plot arrangement, replicated three times. Poultry Manure rate (0, 5 and 10 t/ha) was the main plot treatment and okra population (25,000, 33,333 and 50,000 plants/ha, including Sole Okra of 55,555 and Sole Egusi melon of 10,000 plants/ha) was the subplots treatment. Plot size was 4 x 3m, with 2m margin round each plot. Okra yield was significantly affected by poultry manure rate and plant population but not their interactions. Application of 10 t/ha PM produced significantly ($P \leq 0.05$) taller plants, more leaves and branches/plant, higher leaf area index and pod yield/ha than either 0 or 5 t/ha. Okra intercropped at 25,000 plants/ha grew significantly taller, with more branches and leaves/plant, and higher leaf area index than either 33,333 or 50,000 plants/ha while plants at 50,000 plants/ha had a higher pod yield/ha than either 33,333or 25,000. For optimal yield of 'Egusi' melon-okra intercrop, it is appropriate to apply 10 t/ha PM with 50,000 plants/ha of Okra.

Key words: Poultry manure (PM), Intercrop, Nutrient, Yield.

1 INTRODUCTION

Intercropping is the cultivation of two or more crops at the same time in the same field (Ouma and Jeruto 2010). Ekwere *et al*., (2013) also expatiated that it is a stable and sustainable agro-ecosystem in the humid tropics. Okra [*Abelmochus esculentus* (L.) Moench] is a vegetable crop of economic importance in the Malvaceae family and cultivated throughout the tropics and subtropics (Kochhar 1986; Hammon and van Sloten, 1989). Egusi melon (*Citrullus lanatus Thumb) is* one of the popular seed vegetables grown in Nigeria, especially in South Western and Eastern parts of Nigeria (Olaniyi, 2008). The plant is primarily cultivated for its seed, which is the major produce of economic importance. Poultry Manure is the organic waste material from poultry, consisting of animal faeces and urine. (Hochmuth *et al.,* 2009). This study was conducted to establish the poultry manure rate and population of okra that gives optimal yield in 'Egusi' melon-Okra intercrop.

2 MATERIALS AND METHODS

The field experiment was conducted at the Federal University of Agriculture Abeokuta, (FUNAAB) on longitude ($7^0$15' N; $3^0$25' E) in the derived savanna zone both in south-western Nigeria. The experimental site was ploughed, harrowed and then leveled. The soil had gone through different forms of fertilizer amendments from organic to inorganic.

The trial was arranged in a split- plot fitted into Randomized Complete Block Design (RCBD) with three replications. The main plot was manure at 0t/ha, 5t/ha and 10t/ha and sub-plot was population at 25,000, 33,333, 50,000 plants/ha^{-1}. There were also sole crops of okra and 'egusi' melon). Plot size was 4m x 3m ($12m^2$), with 1.5m intra row spacing and a 2m margin around each plot. Okra seeds were an improved variety, sourced from the Institute of Agricultural Research and Training Ibadan, while 'egusi' seed was sourced from an open market. The variety of melon used was black edged 'Bara' commonly cultivated in South Western, Nigeria. Planting was done two weeks after application of poultry manure, Egusi seeds and okra seeds were sown the same day.

The spacing for egusi melon was 1m by 1m at a planting depth of 2-3cm, with two seeds per hole. The population of okra was varied based on the treatment definition at seeding rate of two seeds per hole. Thinning and supplying were done 2 Weeks After planting, for 'egusi' melon and okra. Thinning of 'egusi' melon to one plant per stand was done to give a population of 10,000 plants per hectare. Thinning of okra was done based on the treatment definition. Data

were collected on vegetative and yield characters of okra. Data on growth parameters for okra were taken on weekly basis from 2 to 12 WAP. Parameters taken for okra include: Plant height, Leaf Area Index (cm^2). Yield Parameters; Weight/Pod (g), Yield/plant. Statistical analysis of the data was carried out subjecting the data to Analysis of Variance (ANOVA) using GENSTAT Discovery Statistical package. Means separation was carried out using Least Significant Difference (LSD) at 5% probability level ($p \leq 0.05$).

3 RESULT.

Total rainfall observed during the period of the experiment from May to November was 528.9 mm. The peak of rainfall was in June (164.9mm) while the lowest monthly rainfall was in August (29.4 mm). Maximum temperature (May to November) ranged from 30^{0C} to 34^{0C} while minimum temperature ranged from 22^0C to 24^0C. Highest temperature during the period was 33.5^0C in November while the lowest temperature was 22.1^0C in August. Highest relative humidity during this period was 73% in July, while the lowest was 61.9% in May. (Table 1). The soil was almost neutral (7.20) with organic carbon and nitrogen contents of 23.00 and 2.00 g/kg, respectively (Table 2). Available P was 5.20 mg/kg and exchangeable K was 2.31 cmol/kg. (Table 2). The manure was almost neutral (7.55) with an organic carbon and nitrogen contents of 53.20 and 4.60 g/kg, respectively. The P content was 50.5 mg/kg (Table 3).

3.1 Okra Vegetative Growth

Okra plant height was affected by poultry manure rate and okra population. Between 2 and 12 Weeks After Planting (WAP), plants that received 10 t/ha poultry manure (PM) were significantly taller than plants that received 5 t/ and 0t/ha. The effect of population on Okra plant height, all through the period of observation, was significant. Sole Okra plant with population of 55,555 plants per hectare was the highest and was significantly taller than intercrop treatments (Table 4). The interaction of poultry manure and population on okra plant height was significant only at 6 to 12 WAP. (Table 6).

Plants that received 10 t/ha PM produced significantly more leaves (19.17) per plant all through the period of observation than plants fertilized with 5 t/ha (16.83 leaves) and 0 t/ha (14.17 leaves). Population affected number of Okra leaves/plant significantly all through the period of observation. Sole Okra plants had significantly more leaves (25.53 leaves) than from intercropped plants (Table 5). The interaction of manure and population on number leaves all through the period of observation was significant except at 10 weeks after planting. Plants that received 10 t/ha PM with intercropped okra population of 25,000 plants/ha had more leaves. (Table 6) Poultry Manure was not significant on the leaf area index (LAI) of Okra plants, except at 12 weeks after planting. Application of 10 t/ha PM gave the highest leaf area index. The effect of population on leaf area index was significant all through the period of observation. (Table 7).

3.2 Flowering and Fruiting Attributes of Okra

Manure and population had effect on number of days to first flowering; plants that received 10 t/ha poultry manure flowered earlier (45 days) compared to other rates. Sole Okra flowered earlier (48 days) than intercropped plants. 50% flowering was attained from 48-53 days; there was significant effect of manure on 50% flowering, Sole okra flowered earlier compared to intercropped plants. (Table 8)

First pod harvest was attained from 56-60 days. Manure was significant on days to first pod harvest; sole crop okra crop was harvested earlier compared to intercrop. Manure rate was similar on okra weight/pod. Weight/pod of intercropped okra plant was lower compared to sole crop (Table 8). Plants that received 10 t/ha poultry manure had significantly higher yield/plant (187.90 g/plant) compared to 5 t/ha (181.20 g/plant), and 0 t/ha (161.00 g/plant) t/ha. Okra yield/plant was reduced with intercrop compared to sole crop. (Table 8)
Effect of manure was similar on number of pods/plant. Sole crop had higher value compared to intercrop. Population and spacing were not significantly different on number of harvest times. (Table 8)

Table 1: Weather data during the Experimental period (January to December)

Month	Total Rainfall (mm)	Relative Humidity (%)	Temperature	
			Maximum	Minimum
January	0.00	47.70	35.40	20.50
February	51.30	61.40	34.30	24.60
March	66.80	60.40	35.30	25.10
April	69.00	62.80	33.80	24.100
May	60.40	61.90	32.80	23.80
June	164.90	70.80	30.80	22.80
July	65.60	73.00	31.50	22.80
August	29.40	70.30	29.50	22.80
September	71.10	71.90	30.40	22.50
October	70.20	69.20	31.60	23.00
November	67.30	62.30	33.50	23.80
December	56.70	36.10	33.50	19.30
Total	772.70	747.80	392.40	275.10

Source: Metrological Station, Federal University of Agriculture, Abeokuta

Table 2: Soil chemical analysis.

Soil chemical analysis	
pH	7.20
Organic Carbon (g/kg)	23.00
Nitrogen (g/kg)	2.00
Available P(mg/kg)	5.20
Exchangeable K+ (cmol/kg)	2.31
Mg^{2+}	2.17
H+ (cmol/kg)	2.21
Base saturation	73.10
Mn (mg/kg)	178.20
Fe (mg/kg)	110.20
Zn ()mg/kg)	7.30
Cu (mg/kg)	1.90

Table 3: Manure chemical analysis

Manure chemical analysis	
Ph	7.55
Organic Carbon (g/kg)	53.20
Nitrogen (g/kg)	4.60
Phosphorus (g/kg)	5.00
Potassium (g/kg)	3.22
Calcium (g/kg)	1.25
Sodium (g/kg)	0.70
Magnesium (g/kg)	3.96

Table 4: Plant Height of Okra as Affected by Poultry Manure rate and Okra Population

Treatments	**Plant height**					
Plant height	**Weeks After Planting**					
Manure (t/ha)	2	4	6	8	10	12
0	5.25	14.40	23.70	27.00	65.30	67.80
5	6.50	16.80	22.60	29.80	70.50	72.90
10	7.83	20.00	26.40	36.80	92.80	101.80
LSD	0.82	1.89	Ns	1.550	1.320	2.760
Population						
Sole	8.11	22.60	30.80	40.70	91.30	97.10
'Egusi' melon-Okra (55,555)	5.78	12.80	21.40	25.30	62.50	66.30
'Egusi' melon-Okra (33,3333)	6.11	15.20	21.30	27.10	71.80	69.70
'Egusi' melon-Okra (25,000)	6.11	17.70	23.40	31.70	79.30	90.30
LSD	0.477	1.450	2.290	2.030	2.050	2.390
LSD Interaction	ns	ns	4.560	3.220	3.200	4.110

Table 5: **Number of leaves of Okra as affected by poultry manure rate and okra population**

Treatment	**Number of Leaves**					
	Weeks After Planting					
Number of leaves						
Manure(t/ha)	2	4	6	8	10	12
0	4.50	7.75	9.17	11.00	13.79	14.17
5	6.00	9.03	10.50	12.87	13.80	16.83
10	6.58	9.71	12.00	15.55	15.33	19.67
LSD	0.55	0.38	0.68	1.34	ns	1.00
Population						
Sole	8.00	11.87	16.00	18.67	19.90	25.33
'Egusi' melon-Okra (55,555)	4.89	7.67	8.78	10.33	11.89	12.78
'Egusi' melon-Okra (33,3333)	4.89	7.78	8.78	10.89	12.67	13.00
'Egusi' melon-Okra (25,000)	5.00	8.00	8.67	12.67	12.78	16.44
LSD	0.269	0.330	0.316	0.762	2.297	0.852
LSD Interaction	0.599	0.565	0.727	1.550	ns	1.470

Table 6: Interaction of Manure and Okra population on Plant height and Number of leaves

Table 7: Leaf Area Index of Okra as influenced by Manure and Population.

Treatments		Weeks After Planting					
Manure (t/ha)	Population	Leaf Area Index Weeks After Planting			Plant height		
Treatments		6	8	10	12		
Plant height		2	4	6	8	10	12
Manure(t/ha)							
0	Sole	0.18	0.42	1.37	1.68	72.00	76.00
5	'Egusi' melon-Okra (55,555)	0.35	0.55	1.42	1.76	59.10	60.50
10	'Egusi' melon-Okra (33,333)	0.44	0.99	2.00	3.30	62.30	65.50
LSD	'Egusi' melon-Okra (25,000)	ns	Ns	ns	0.31	68.00	69.30
Population							
Sole	'Egusi' melon-Okra (55,555)	0.57	1.21	2.33	3.28	77.00	80.30
'Egusi' melon-Okra (55,555)	'Egusi' melon-Okra (33,333)	0.36	0.55	1.22	1.61	61.20	65.20
'Egusi' melon-Okra (33,333)	'Egusi' melon-Okra (25,000)	0.23	0.41	1.29	1.77	69.00	66.70
'Egusi' melon-Okra (25,000)	Sole	0.20	0.42	1.55	2.33	74.90	79.60
LSD	'Egusi' melon-Okra (55,555)	0.134	0.186	0.442	0.173	125.00	135.00
LSD Interaction	'Egusi' melon-Okra (33,333)	ns	ns	ns	0.376	67.00	73.30
	'Egusi' melon-Okra (25,000)					28.80	84.10
LSD						29.80	77.00
						38.50	95.10
		ns	Ns	4.560	3.220	3.200	4.110
	Number of Leaves						
0	Sole	6.00	10.00	14.00	17.00	18.50	22.00
	'Egusi' melon-Okra (55,555)	4.00	7.00	7.67	9.00	12.00	10.67
	'Egusi' melon-Okra (33,333)	4.00	7.00	7.67	9.00	12.33	10.67
	'Egusi' melon-Okra (25,000)	4.00	7.00	7.33	9.00	12.33	13.33
5	Sole	8.00	12.10	16.00	18.80	19.20	26.00
	'Egusi' melon-Okra (55,555)	5.33	8.00	8.67	10.67	12.00	13.33
	'Egusi' melon-Okra (33,333)	5.33	8.00	8.67	10.67	12.33	13.33
	'Egusi' melon-Okra (25,000)	5.33		8.67	11.33	11.67	14.67
10	Sole	10.00	13.50	18.00	20.20	22.00	28.00
	'Egusi' melon-Okra (55,555)	5.33	8.00	18.00	11.33	11.67	14.33
	'Egusi' melon-Okra (33,333)	5.33	8.33	10.00	13.00	13.33	15.00
	'Egusi' melon-Okra (25,000)	5.67	9.00	10.00	17.67	14.33	21.33
LSD	'Egusi' melon-Okra (55,555)	0.599	0.565	0.727	1.550	ns	1.470

Table 8: Yield and Yield Components of Okra

Manure (t/ha) Treatments	Days to first Flw	Days to 50% Flw	Days to Ist Pod	No of Hvst time	No of Pods/plt	Pod yield/plt	Pod yield/ha
0	50.25	55.25	60.58	9.50	10.38	161.00	5.44
5	48.00	52.75	57.92	9.583	10.78	181.20	6.47
10	45.75	50.75	56.25	9.50	11.50	187.90	6.55
LSD	0.567	1.388	2.348	Ns	ns	13.49	0.621
Population							
Sole	48.67	48.67	55.67	48.67	15.83	236.70	8.68
'Egusi' melon-Okra (55,555)	54.56	54.56	59.67	54.56	6.76	121.40	5.91
'Egusi' melon-Okra (33,3333)	54.56	54.56	59.44	54.56	9.74	156.50	5.22
'Egusi' melon-Okra (25,000)	53.89	53.89	58.22	53.89	11.21	192.20	4.81
LSD	0.495	0.595	1.583	0.415	2.145	23.41	0.717
LSD Interaction	0.845	1.450	ns	ns	ns	39.15	ns

4 DISCUSSION

This study has established that intercropping okra with 'Egusi' melon, fertilized with Poultry Manure has high prospects and potentials in the humid tropics. The observed differences in Okra plant height corroborated the reports of Ajari *et al.*, (2003); Saidu *et al*., (2011); Tiamiyu *et al*., (2012) and; Kol *et al*., (2012) that organic manure, especially PM could increase the height of crops. Population that had significant effect on plant height of Okra intercrop with Egusi melon responded to different populations, the observed reduction in okra height under intercropping could have been caused by the intense overcrowding effect of the intercrops when evaluated with sole cropping for available nutrients. This finding agrees with Madu and Nwosu (2001), who reported that yam planted sole, had superior efficiency in utilizing growth environment. Number of leaves of okra plant being significant as a result of the applied PM stressed its importance during the vegetative growth of crop plants (Tindall, 1992). The differences in number of leaves with sole crop being higher than intercropping agrees with Silwana and Lucas (2002) who reported that intercropping reduced vegetative growth of component crops. Okra leaf area index despite the increasing rate of PM was similar except at 12 weeks confirms the report of Ojeniyi (2000) that fertilizer treatment does not give a significant variation on leaf area per plant on any crop. The difference in okra leaf area index at different populations with sole crop being evident was observed. The differences observed due to the applied PM in the yield and yield components were in conformity with the findings of Premsekhar and Rajashree (2009) that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil, resulting in better supply of nutrients. Impact of 10 t/ha PM being evident than 5 t/ha in Yield/plant, Number of pods/plant, Number of days to first Flowering, Number of days to 50% flowering, Number of days to first pod harvest and Number of harvest times corroborate with the findings of Ogundiran (2013) and Sanni *et al.* (2015) that yield increase with an increase in PM rate suggesting that PM supplies nutrients which enhance vigorous growth which are important indices that culminate in increase in fruit yield. The observed differences in all the fruit and fruiting attributes of okra due to different population agrees with the findings of Baloch *et al.* (2002) that plants with sufficient space will compete for little or no environmental factors.

5 CONCLUSION

Intercropping Okra with 'Egusi melon enhanced an effective harmonizing biological approach for suppressing of weeds, and total crop yields. Application of 10 t/ha PM was adequate for 'Egusi melon-Okra intercrop and Okra population of 55,555 plants per hectare gave the optimum economic yield in an 'Egusi'melon-Okra intercrop and can be adopted by farmers.

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