

Effects of Population of low Growing Crops in intercrops and Fertilizer Levels on the Yield of different Low Growing Crops

By

Okonmah, L.U.

Department of Agronomy, Delta State University,
Asaba Campus, Asaba, Nigeria.
e-mail: Lawucheokonmah@gmail.com, Phone: 080345626174

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A study was carried out during the 2005, 2006 and 2007 cropping seasons at the Research and teaching Farm of the Agronomy Department of the Faculty of Agriculture, Delta State University, Asaba Campus, Asaba Nigeria to evaluate the effects of populations (0, 10,000, 20,000 and 30,000 population/ha and fertilizer levels (0, 200 and 400kg/ha) on the yield of three low growing crops (groundnut, egusi – melon and sweet potato) with a view to recommending the crop(s) with the highest yield to farmers in the area. The experiment was a split – split factorial experiment fitted into a randomized complete block design and replicated four times. The results showed that the three low growing crop grown in NPK treated soils performed significantly ($P \leq 0.05$) higher when compared with the control sub – plots without fertilizer treatment. The yield followed this trend sweet potato < egusi – melon < groundnut. From the above yield result of the various types of low growing crop, a prima facie prove has been established that they have added food advantage, besides their primary functions of suppressing weed as a cover crop and the fixing of atmospheric nitrogen into the soil by groundnut type of low growing crop. It is hereby recommended that these plants can be planted with other food crops as they have added food value besides their primary function of suppressing weeds as well as fixing atmospheric nitrogen into the soil.

Keywords: Population, fertilizer application, yield, low growing crops,

Introduction

Crop production is influenced by various factors including weed, fertility, management and continuous cropping (Carskey and Ndikawa, 1998). Weeds occupy and compete with crop plants for space, nutrient, light and moisture. Continuous cropping in an intercropped farming system leads to depletion of soil nutrients with the resultant poor performance of cultivated crops. There is need to return to soil, that which is removed from the soil when soils are exhausted. When such deficiencies occur, crop productivity is drastically reduced (Akabi, 2002; Brady, 2004). A major source of maintenance of soil fertility in Nigeria has been the fallow system (Bunch, 1993; Buresh *et al.*, 1997). Unfortunately, due to pressure on land, stemming from the earth teeming population; this system has not been effective hence the need for fertilizer application to improve soil fertility cannot be over emphasized. Attempts have been made by various workers (Carskey and Ndikawa, 1998; Fashina *et al.*, 2002) to introduce cover crops such as *Centrocema pubescens*, *Mucuna spp* etc to suppress weeds for farmers, but they found it difficult to accept

probably because they do not perceive the added value attributed to these crops mainly because most of these low growing crops seem not to have food value for average Nigerian farmers.

In mixed cropping systems where farmers intercrop with various crops such crops which are low growing crops found in farmers farms are sweet potato, egusi (melon) and groundnut among others. The realization that these crops besides their food value are generally accepted by Nigerian farmers and also have the ability to suppress weeds if properly incorporated formed the basis for this study. Mixture of cover crops and non-legume affords chance to take advantage of allelopathic potentials of cover crops to suppress weed through the exudation of substances that can suppress weeds (Abdul-Baki *et al.*, 1993). The present study has the objective of evaluating the effect of populations of low growing crops and fertilizer levels on their yield.

Materials and Methods

Study area

The study location was conducted in 2005, 2006 and 2007 at the Teaching and Research Farm of Agronomy Department, Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria (latitude 06°N, longitude 06°49'E, temperature: 28±6°C, rainfall: 1500mm – 1849, relative humidity: 77.2% - 80% and sunshine: 4.8 bars) (Asaba Metrological Station, 2007).

Experimental materials

Basic crop – maize (*Zea mays* Farz 27, low - growing crops (sweet potato, T1s 8250), groundnut (local variety and egusi melon local variety) and NPK (15 – 15 – 15).

Land preparation and planting

Composite soil sample was collected from 0 – 20cm depth with augur prior to treatment application. The samples were air-dried in a room temperature of 25 – 27°C for four days following the procedure of Okonmah and Agbogidi (2011) and then passed through a 2mm mesh sieve and neatly packed in a properly labeled air-tight polythene bags for physio-chemical analysis at the National Institute for Oil Research (NIFOR) near Benin-City, Edo State.

The land area was cleared and stumps and debris were allowed to dry. Experimental area was 82m x 26m (2132m²). Plot size was 5m x 5m, border line 2m to give 48 plots. Treatments were rates of NPK fertilizer (at 0, 200 and 400kg/ha), the three low growing crops (sweet potato, egusi – melon and groundnut crops (0, 10,000, 20,000 and 30,000 plants/ha). The experiment was a split – split factorial flitted into a randomized complete block design replicated four times (4 x 3x3) giving 36 treatment combinations and 48 plots. The populations of low growing crops were applied to the main plots while the levels of NPK fertilizer and basic crops were applied to the sub plots within the larger unit. Cassava was planted in vertical rows at 1m x 1m spacing, maize was aligned between horizontal rows of cassava at a spacing of 1m x 1m with 2 plants/stand while low growing crop were planted in the middle of any 4 stands of cassava plants at 1m x 1m. Weeds obtained from the quadrant were harvested, oven dried and weighed to constant weight using weighing balance. They were evaluated to determine treatment effects on weed incidence and plots were weeded after each evaluation.

Soil analysis

Particle size distribution of the soil samples was determined by hydrometer method using calgon solution as dispersed agent. Organic carbon was by the modified wet oxidation method and converted to organic matter. Total nitrogen was by micro-Kjeldahl digestion and distillation method. The soil pH was measured with a pH meter in a 1:1 soil/water ratio suspension. Exchangeable

cations were extracted with 0.1N Ammonium acetate at pH 7.00 while Na⁺ and K⁺ were measured by EDTA titration. Available phosphorus was determined by Bray No 1 acid fluoride solution while cation exchange capacity (CEC) was determined by Ammonium acetate technique.

Data analysis

Data collected were subjected to analysis of variance while the significant means were separated with the LSD – and minimum significant difference (MSD) using SAS (1999) when large means were involved.

Results and Discussion

Results (Tables 1, 2, 3, 4 and 5) presented are the outcome of three consecutive years' studies 2005, 2006 and 2007. Groundnut type of low growing crops recorded the highest yield at 10,000 populations and at zero fertilizer rates in the first year. This was followed by the yield at 30,000 populations and at zero fertilizer rate while the least was recorded with 20,000 populations at zero rate of fertilizer application. Yield reduced with increasing rate of fertilizer application excepting at 30,000 population, when the yield at 400kg/ha fertilizer was higher than 200kg/ha rate of fertilizer applied.

Yield was similarly highest in the 2nd year of cropping at zero rate application of fertilizer in all the populations of groundnut type of low growing crop. Yield decreased with increasing rate of fertilizer excepting at 10,000 populations when yield at 400kg/ha of fertilizer rate was higher than at 200kg/ha rate of applied fertilizer.

At the 3rd year of continuous cropping yield reduced with increasing rate of fertilizer application at 10,000 population of groundnut but there was no significant difference between yield at zero and 200kg/ha rates of fertilizer application. Highest yield was observed at 400kg/ha fertilizer rate, at 20,000 population of groundnut but the usual trend of reducing yield with increasing rate of fertilizer was not observed between 20,000 and 30,000 populations.

During the 1st year, melon at 20,000 population and at the rate of 400kg/ha gave the highest yield, followed by 10,000 and 30,000 populations at both 400kg/ha fertilizer rate which were not significantly different from each other. Yield increased with increasing rate of fertilizer application throughout various populations in all the various types of low growing crops. The least yield was recorded at zero rate of fertilizer application, similar trend was observed in the 2nd year of cropping with the highest yield being recorded still at 20,000 population and 400kg/ha fertilizer application followed by 10,000 and 30,000 at 400kg/ha fertilizer rate and also 20,000 population recorded same high yield at zero rate of fertilizer application. The three yields were not significantly different from each other.

Generally, yield increased with increasing years of continuous cropping across the years of cultivation. The yield of sweet potato increased with increasing rate of fertilizer up to 400kg/ha, virtually in all the population of sweet potato. Usually, the highest yield was always recorded at 400kg/ha fertilizer rate and the least at zero rate of fertilizer application. This trend was common to yields recorded in the 3 years of continuous cropping. Again, there was a gradual increase across the years of cropping starting from the first year to the 3rd year.

The groundnut recorded the highest yield at zero rate of NPK fertilizer application indicating the importance of legume incorporation in productivity Carsky *et al.*, (1998), Fashina *et al* (2002) observed nutrient improvement through the application of mucuna leguminous crop Vesteege *et al.* (1998) and Akabi (2002) observed that maize yield increased from 480kg/ha to 1114kg/ha from groundnut treated plots and that legume is known to significantly improve the yield of subsequent maize crop than when compared with inorganic nitrogen fertilizer or rock-phosphate Buresh *et al.* (1997) and Brady (2004) observed that the yields of low growing crops increased significantly, this could be as a result of interaction resulting from applied various rates of N.P.K fertilizer. Fertilizer has been recognized to improve soil fertility, structure, soil biological activity. (Bunch, 1993; Arteaga *et al.*, 1997). This interaction encouraged low growing crops to develop fast coverage of the soil and moderate soil temperature; weeds were suppressed from competition with companion crops for nutrient, light, space and moisture (Vissoh *et al.*, 1998). In all, at 400kg/ha the yield of groundnut was 590.40kg, melon 604.83kg and sweet potato was 12.300 tons/ha.

The observed 6.20 value of the pH of the soil indicates that the soil is slightly acidic and this can be attributed to the high rainfall prevalent in the area leading to excessive leaching of the basic cations from the surface area of the soil. The low organic content and total nitrogen could be attributed to the effects of soil erosion, leaching and bush burning predominant in the study area.

Similarly, the low exchangeable cations may be due to the low clay activity and low organic content of the soil. The CEC was average (15.20 cmo/kg⁻¹) while the base saturation indicates that the study area has low fertility status which may be due to the long usage of the area for serious cropping without replenishing the lost nutrients through fertilizer application. The results of the pre-planting soil analysis agree with the findings of Enwerzor *et al.*, (1991) and Egbuchua (2007). Table 6 shows the soil physio-chemical properties before the experiment. The soil is sandy loam in texture with characteristics of 84.60% sand, 6.92% silt and 8.48% clay. The pH 6.2 indicated that the experimental site is slightly acidic. Both the organic matter (2.64 gkg⁻¹) and total nitrogen (0.9 gkg⁻¹) are relatively low.

Conclusion

From the above yield result of the various types of Low growing crop, a prima facie prove has been established that they have added food advantage, besides their primary functions of suppressing weed as a Cover Crop and the fixing of atmospheric nitrogen into the soil by Groundnut type of Low growing crop. Premised on the above the cover crop quality of these low growing crops is sustained Okonmah *et al.*, (2005).

Table 1. Effect of N.P.K (15: 15: 15) fertilizer on low growing crops yields (kg/ha)

Fertilization	1 st Year			2 nd Year			3 rd Year			SEM	CV%	G/nut	Melon	S/pot	SEM	CV%
	No	G/nut	Melon	S/pot	SEM	CV%	G/nut	Melon	S/pot							
0	12	573.33 ^a	336.08 ^a	8.9 ^a			557.67 ^a	414.42 ^a	9.05 ^a			568.33a	357.00c	9.11 ^c		
200	12	396.67 ^a	452.67 ^a	10.48 ^a			430.75 ^a	497.83 ^a	10.56 ^a			539.33a	481.67a	10.62 ^a		
400	12	380.67 ^a	572.67	11.37 ^a			431.67 ^b	586.67 ^a	11.56 ^b			544.33c	600.83a	11.62 ^a		
LSD at 5%		10.07	13.91	0.24			14.67	8.65	0.11			12.06	8.44	0.08		

Table 2. Influence of low growing crops at different populations on the yield of low growing types (kg/ha)

Pop.	No	Low growing crops	Mean	SEM	CV%	Mean	SEM	CV%	Mean	SEM	Cv%
0		Groundnut	-	-	--	-	-	-	-	-	-
10,000	12	"	461.00 ^a	88.90	19.28	483.25a	80.25	16.61	535.00 ^b	53.24	9.95
20,000	12	"	443.33 ^b	94.65	21.35	485.50a	63.56	13.09	579.00a	24.74	4.27
30,000	12	"	446.33 ^b	96.18	21.55	471.33a	82.41	17.46	538.00 ^b	43.15	8.02
LSD at 5%			9.6			14.4			12.0		
0		Melon	-	-	-	-	-	-	-	-	-
10,000	12	"	438.08 ^b	104.71	23.90	452.00 ^b	103.78	22.96	468.33 ^b	101.65	21.71
20,000	12	"	483.00 ^a	91.98	19.04	590.25 ^a	10.43	1.77	509.50 ^a	101.32	19.89
30,000	12	"	440.33 ^b	109.46	24.86	456.67 ^a	111.65	24.45	461.67 ^b	112.05	24.27
LSD at 5%			13.4			9.1			9.5		
0		S/potato	-	-	-	-	-	-	-	-	-
10,000	12	"	9.68c	0.79	8.96	9.74 ^c	0.77	7.88	9.78 ^c	0.78	7.95
20,000	12	"	10.81 ^a	1.33	12.29	10.98 ^a	1.39	12.70	11.04 ^a	1.38	12.54
30,000	12	"	10.38 ^b	1.09	10.57	10.45 ^b	1.10	10.51	10.53 ^b	1.10	10.43
LSD at 5%			0.2			0.1			0.1		

Table 3. The Effects of Interactions Between the Levels of N.P.K. (15:15:15) Fertilizer and Types of Low Growing Crops on Low Growing Crop Yield (kg/ha)

Fert level	No	Low Growing Crops	Mean	SEM	CV%	Mean	SEM	CV%	Mean	SEM	CV%
0		Groundnut	573.33 ^a	12.06	2.10	577.67 ^a	10.65	1.84	568.33 ^a	12.18	2.14
200	12	"	396.67 ^b	23.44	5.91	430.75 ^b	30.92	7.18	539.33 ^b	42.39	7.86
400	12	"	380.67 ^c	25.90	6.80	431.67 ^b	27.00	6.25	544.33 ^b	64.47	11.85
LSD			9.6			14.4			12.0		
0	12	Melon	336.08 ^c	31.75	9.45	414.42 ^c	125.26	30.23	357.00 ^c	28.34	7.94
200	12	"	452.67 ^b	29.89	6.60	497.83 ^b	68.99	13.86	481.67 ^b	32.63	6.78
400	12	"	572.67 ^a	19.21	3.36	586.67 ^a	12.32	2.10	600.83 ^a	17.78	2.96
LSD			13.4			9.1			9.5		
0	12	S/potato	8.97 ^c	6.29	3.26	9.05 ^c	0.17	1.89	9.11 ^c	0.19	2.08
200	12	"	10.48 ^b	0.68	6.48	10.56 ^b	0.70	6.62	10.62 ^b	0.69	6.49
400		"	11.37 ^a	0.72	6.37	11.56 ^a	0.76	6.55	11.62 ^a	0.76	6.58
LSD			0.2			0.1			0.1		

Table 4. Effects of the interactions among the population of low growing crops and levels of N.P.K. (15: 15: 15) fertilizer and types of low growing crops on yield of low growing crop (kg/ha)

Low growing crops	Population	Fertilizer	No	Mean	SEM	CV%	Mean	SEM	CV%	Mean	SEM	Cv%
			1 st Year				2 nd Year				3 rd Year	
Groundnut	0	0	0	-	-	-	-	-	-	-	-	-
"	0	200	0	-	-	-	-	-	-	-	-	-
"	0	400	0	-	-	-	-	-	-	-	-	-
"	10,000	0	4	580.00 ^a	10.10	1.74	585.00 ^a	9.93	1.70	575.00 ^b	5.72	0.99
"		200	4	408.00 ^{dc}	9.76	2.39	405.75 ^d	26.90	6.63	565.00 ^b	6.48	1.15
"		400	4	395.00 ^d	18.57	4.70	459.00 ^b	14.00	3.05	465.00 ^c	21.24	4.57
"	20,000	0	4	565.00 ^b	14.72	2.61	568.00 ^a	5.94	1.05	560.00 ^b	16.57	2.96
"		200	4	415.00 ^c	7.79	1.88	457.50 ^b	23.69	5.18	570.00 ^b	6.83	1.20
"		400	4	350.00 ^f	12.25	3.50	431.00 ^c	11.69	2.71	607.00 ^a	16.99	2.80
"	30,000	0	4	575.00 ^{ba}	7.70	1.34	580.00 ^a	8.83	1.52	570.00 ^b	8.98	1.58
"		200	4	367.00 ^e	8.12	2.21	429.00 ^c	20.70	4.83	483.00 ^c	11.75	2.43
"		400	4	397.00 ^d	8.98	2.26	405.00 ^d	19.87	4.91	561.00 ^b	22.45	4.00
"	MSD = Kr			14.76			22.29			18.79		
Melon	0	0	0	-	-	-	-	-	-	-	-	-
"	0	200	0	-	-	-	-	-	-	-	-	-
"	0	400	0	-	-	-	-	-	-	-	-	-
"	10,000	0	4	321.25 ^g	9.71	1.74	340.00 ^e	10.80	3.18	3.60.00 ^g	15.45	4.29
"		200	4	428.00 ^c	16.57	2.39	436.00 ^d	19.80	4.54	450.00 ^e	12.25	2.72
"		400	4	565.00 ^b	4.40	4.70	580.00 ^b	8.16	1.41	595.00 ^b	3.56	0.60
"	20,000	0	4	377.00 ^f	10.13	2.61	583.25 ^b	11.03	1.89	386.00 ^f	7.53	1.95
"		400	4	592.00 ^a	5.94	1.00	600.00 ^a	8.16	1.36	622.50 ^a	4.93	0.79
"	30,000	0	4	310.00 ^{gh}	8.16	2.63	320.00 ^f	4.08	1.28	325.00 ^h	12.25	3.77
"		200	4	450.00 ^d	33.67	7.48	470.00 ^c	14.24	3.03	475.00 ^d	18.71	3.94
"		400	4	561.00 ^b	23.25	4.15	580.00 ^b	8.21	1.45	585.00 ^b	10.80	1.85
"	MSD = Kr			14.16			14.00			14.58		
S/potato	0	0	-	-	-	-	-	-	-	-	-	-
"	0	200	-	-	-	-	-	-	-	-	-	-
"	0	400	-	-	-	-	-	-	-	-	-	-0.27
"	10,000	0	4	8.80 ^c	0.41	4.70	8.85 ^g	0.08	0.94	8.88 ^g	0.02	0.73
"		200	4	9.68 ^d	0.09	0.95	9.74 ^e	0.06	0.66	9.78 ^e	0.07	1.57
"		400	4	10.57 ^c	0.21	1.96	10.64 ^d	0.11	1.07	10.69 ^d	0.17	0.57
"	20,000	0	4	9.12 ^c	0.23	2.54	9.20 ^f	0.04	0.44	9.27 ^f	0.05	0.56
"		200	4	11.25 ^b	0.18	1.59	11.33 ^c	0.22	1.93	11.38 ^c	0.06	1.02
"		400	4	12.05 ^a	0.51	4.27	12.40 ^a	0.04	0.29	12.46 ^a	0.13	1.02
"	30,000	0	4	9.00 ^c	0.14	1.57	9.10 ^f	0.11	1.19	9.17 ^f	0.14	1.51
"		200	4	10.51 ^c	0.08	0.77	10.61 ^d	0.22	2.10	10.69 ^d	0.11	1.0
"		400	4	11.50 ^b	0.35	3.05	11.64 ^b	0.10	0.83	11.72 ^b	0.07	0.57
"	MSD = K – ratio = 100 =			0.37			0.16			0.13		

Table 5. Effects of the population of low growing crops on weeds incidence (gm/m²)

First Year				Second Year															
Popu	No	3WAP	SEM	CV%	6WAP	SEM	CV%	9WAP	SEM	CV%	3WAP	SEM	CV%	6WAP	SEM	CV%	9WAP	SEM	CV%
0	36	590 ^a	196	33.2	630 ^a	212	33.6	556 ^a	146	26.4	669 ^a	157	23.4	599 ^a	141	23.5	561	84	14.9
10,000	36	553 ^b	166	30.0	526 ^b	184	34.9	474 ^b	130	27.4	630 ^b	138	21.9	542 ^b	140	25.9	483	82	16.9
20,000	36	517 ^c	138	26.7	463 ^c	176	38.1	383 ^c	118	30.8	567 ^c	137	24.2	462 ^c	136	29.5	393	91	23.2
30,000	36	471 ^d	119	25.2	423 ^d	164	38.7	291 ^d	137	47.1	542 ^d	144	26.6	365 ^d	137	37.7	323	108	33.4
LSD		13.6			6.32			12.8			15.1			11.0			5.1		

Table 5 continues

Third Year										
Popu	No	3WAP	SEM	CV%	6WAP	SEM	CV%	9WAP	SEM	CV%
0	36	754 ^a	157	20.9	647 ^a	172	26.6	619 ^a	104	16.8
10,000	36	677 ^b	147	21.7	554 ^b	132	23.9	508 ^b	96	18.9
20,000	36	612 ^c	123	20.1	504 ^c	108	21.5	439 ^c	86	19.7
30,000	36	549 ^d	131	23.9	411 ^d	107	26.0	350 ^d	102	29.2
LSD		11.2			12.0			6.0		

Table 6. Physiochemical properties of soil before experiment

Soil properties	Values
Sand	84.60
Silt	6.92
Clay	8.48
pH (H ₂ O)	6.20
Organic matter gkg ⁻¹	2.64
Total N	0.9
Available P (mgkg ⁻¹)	8.27
Exchangeable cation (cmo/kg ⁻¹)	
Ca	1.30
Mg	1.16
K	0.21
Na	0.43
CEC (cmo/kg ⁻¹)	15.20
% BS	20.4

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