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Impact of Cropping Ratios of Maize (*Zea mays*)-Egusi Melon (*Colocynthis citrullus*) and NPK Fertilizer on Soil Productivity Rating of an Ultisol of Edo State in Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author JOE designed the study, wrote the protocol and wrote the first draft of the manuscript. Author GOI reviewed the experimental design and all drafts of the manuscript. Authors EJF and EA managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Three separate field studies were conducted at the Research Farm of University of Benin in Nigeria to determine soil productivity index rating for ultisol in which seven cropping ratios of maize (MA) and egusi-melon (EM) Viz 1:0, 0:1, 1:1, 2:1, 3:1, 1:2 and 1:3) were tested using four rates (0, 200, 400, 600 kg/ha) of NPK 20:10:10 fertilizer for experiments 1 and 2 and six rates (0, 200, 400, 600, 800, 1000 kg/ha) of the fertilizer in experiment 3. The design of the experiment was factorial randomized complete block replicated three times. The soil productivity index rating (PI) was determined to measure the status of the soil for further productivity purposes after consecutive cultivations and harvests. The results showed that the highest nutrient depletion (with negative soil productivity rating) occurred in sole maize where no fertilizer was applied as opposed to maize plots treated with the fertilizer at the end of experiment 2. While in experiment 3, the highest nutrient rate

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was obtained in maize in ratios of 1:2 and 1:3 with egusi melon. Soil productivity ratings were all positive, either sole or intercropped with maize under the various cropping ratios, thus suggesting no nutrient depletion. It further suggests that egusi melon in mixture with maize does not require as much nutrient as maize does.

Keywords: Maize; intercrop; egusi melon; fertilizers; soil.

1. INTRODUCTION

The type of cropping systems and crops determine soil fertility and nutrient contents because nutrients are derived from the soil by crop for growth [1] Stresses experienced by land resource systems and the soils are quite many. Such stresses may include soil acidity, salinity, poor drainage, erosion [2] and nutrient imbalance or deficiency. These stresses result in reduction in soil productivity. The scientist proposed some methodologies and procedures to assess these factors relating to nutrient stress which includes land use and management systems [3]. Owing to scarcity and high cost of the mineral fertilizers, farmers apply the fertilizers to their crops. Seldom reliance on shifting cultivation system as means of nutrient recovery is no longer feasible due to upsurge in human population mounting pressure on available lands for other purposes [4].

Most small-scale farmers practice intercropping in which different crops are grown in mixtures or combinations; and there is no adequate information on the fertilizer needs of such crops in mixtures. The need for basic understanding of the soil fertility and cropping systems would therefore be relevant. The knowledge of the impact of crops combination will afford the understanding of suitable fertility management approach for the different crop combinations. The objective of this work was to evaluate the restorative and depletive effect of maize and egusi-melon under various cropping ratios using NPK 20:10:10.

2. MATERIALS AND METHODS

This study was conducted for three consecutive cropping seasons of (2009, 2010 and 2011) between March and August of each year on the University of Benin Teaching and Research Farm in Benin City, Nigeria. The farm lies within the geographical coordinates of longitude 05°04″ and 06°43″E and latitude 05°44″N and 07°34″N. Soil samples were collected at depth of 0 - 30 cm in the plots under maize and egusi melon tested to various cropping ratios and fertilizer rates. To determine the physical (sand, silt, clay) and chemical (pH, % C, N, P, K, Ca, Mg, Na, S) of soils prior of planting and after harvest of the crops standard procedures [5] were used. The experimental site was manually cleaned-up with hoes and cutlasses and mapped out for the three experiments conducted in (2009, 2010 and 2011) as experiments 1, 2 and 3. Experiments 1 and 2, were laid as a 4 x 7 factorial experiment fitted into a randomized complete block design with three replications. The treatments consisted of 4 levels (0, 200, 400, 600 kg/ha) of NPK 20:10:10 and seven cropping ratios of maize and egusi melon of maize (MA) and egusi-melon (EM) Viz (1:0, 0:1, 1:1, 2:1, 3:1, 1:2 and 1:3). While in Experiment 3 the fertilizer rates were increased to six levels of (0, 200, 400, 600, 800 and 1000 kg/ha) under the same test crops, this resulted in 42 experimental plots equally replicated three times translating to 126 plots. The reason for the increase in the treatments to six in experiment 3 was to validate the earlier results of experiments 1 and 2. Maize variety DMR-ESR-W (Downy mildew resistant, early maturing streak resistant white); and "serewe" variety of egusi melon were the test crops used in the experiments. In each experiment, maize (MA) and egusi melon (EM) were planted in seven cropping ratios (Ma – EM) as 1:0, 0:1, 1:1, 2:1, 3:1, 1:2 and 1:3, respectively, with plant population as 64:0, 64:0, 32:32, 48:24, 48:16, 24:48 and 16:48; both crops were spaced at 75 cm x 90 cm at 3 seeds per stand in 16.2 m^2 plot and thinned to 2 plants/stand at 5 days after seedling emergence. Manual weeding was done thrice each year using hand hoe. Maize was harvested at 85 days after planting (DAP) and for egusi-melon, pods were harvested at 98 DAP Soil productivity index (PI) was calculated as follows [2]:

$$\text{Pre cropping yield} = \frac{Yield\ in\ the\ previous\ year - yield\ in\ current\ year}{Yield\ in\ previous\ year} \times \frac{100}{1}$$

Data was collected on soil productivity and properties. The data obtained were subjected to statistical analysis of variance (ANOVA) using GENSTAT following the model for factorial experiment in a randomized complete block design and means were separated by Duncan Multiple Range Test (DMRT).

3. RESULTS

3.1 Soil Productivity of Maize and Egusi Melon in Sole and Intercrop Systems

The sole productivity index/rating (PI) is a measure of the status of the soil for further productivity purposes after two consecutive harvests. Thus, the data at the end of Experiment 2 in Table 1 denotes the differences between the soil status at the end of Experiments 1 and 2, respectively, while those for experiment 3 are for the differences between Experiments 2 and 3, respectively.

At the end of experiment 2, the highest nutrient depletion (that is the lowest negative soil productivity rating) occurred in maize sole crop under no fertilizer application compared with where 20:10:10 NPK fertilizer was applied (Table 1) while in Experiment 3, the highest nutrient depletion rate was obtained in maize 1:2 and 1:3 ratios with egusi melon (Table 3); whereas, in the case of egusi melon, soil productivity ratings were all positive thus indicating no nutrient depletion (Table 2). The maize depleted more soil nutrients than did egusi-melon (Tables 3); suggesting left over of nutrients in plots where egusi-melon was cultivated. Maize had more negative ratings indicating high nutrient depletion. The few positive ratings observed in maize occurred where it was combined with egusi-melon meaning that egusi-melon moderated rate of nutrient consumption by maize.

Table 1. Soil productivity of maize in sole and intercrop with egusi-melon

Cropping ratios/ 20:10:10 NPK fertilizer rates (kg/ha)	Soil productivity index (P1) experiments	
	2	3
Sole maize + 0 kg NPK	-28	-12
Sole maize + 200 kg NPK	-16	-17
Sole maize + 400 kg NPK	-12	-20
Sole maize + 600 kg NPK	-05	-17
Ma : Em 1:1 ratio + 0 kg NPK	+13	-23
Ma : Em 1:1 ratio + 200 kg NPK	+02	-24
Ma : Em 1:1 ratio + 400 kg NPK	+05	-26
Ma : Em 1:1 ratio + 600 kg NPK	+02	-24
Ma : Em 2:1 ratio + 0 kg NPK	-19	-10
Ma : Em 2:1 ratio + 200 kg NPK	-09	-10
Ma : Em 2:1 ratio + 400 kg NPK	+09	-14
Ma : Em 2:1 ratio + 600 kg NPK	-07	-18
Ma : Em 3:1 ratio + 0 kg NPK	-14	-25
Ma : Em 3:1 ratio + 200 kg NPK	-05	-24
Ma : Em 3:1 ratio + 400 kg NPK	-07	-11
Ma : Em 3:1 ratio + 600 kg NPK	-08	-16
Ma : Em 1:2 ratio + 0 kg NPK	-16	-57
Ma : Em 1:2 ratio + 200 kg NPK	-03	-35
Ma : Em 1:2 ratio + 400 kg NPK	-03	-36
Ma : Em 1:2 ratio + 600 kg NPK	-04	-28
Ma : Em 1:3 ratio + 0 kg NPK	+15	-40
Ma : Em 1:3 ratio + 200 kg NPK	+15	-42
Ma : Em 1:3 ratio + 400 kg NPK	+07	-44
Ma : Em 1:3 ratio + 600 kg NPK	-04	-30

Rates of 800 and 1000 kg/ha of 20:10:10 NPK fertilizer were not applicable in experiments 1 and 2.
Ma - Maize; Em - Egusi melon

Table 2. Soil productivity of egusi-melon in sole and intercrop with maize

Cropping ratios / 20:10:10 NPK fertilizer rates (kg/ha)	Soil productivity index (P1) experiments	
	2	3
Sole maize + 0 kg NPK	+26	+24
Sole maize + 200 kg NPK	+30	+26
Sole maize + 400 kg NPK	+35	+22
Sole maize + 600 kg NPK	+43	+40
Ma : Em 1:1 ratio + 0 kg NPK	+33	+18
Ma : Em 1:1 ratio + 200 kg NPK	+33	+18
Ma : Em 1:1 ratio + 400 kg NPK	+36	+24
Ma : Em 1:1 ratio + 600 kg NPK	+06	+34
Ma : Em 1:2 ratio + 0 kg NPK	+35	+20
Ma: Em 1:2 ratio + 200 kg NPK	+35	+18
Ma : Em 1:2 ratio + 400 kg NPK	+34	+24
Ma : Em 1:2 ratio + 600 kg NPK	+37	+34
Ma : Em 1:3 ratio + 0 kg NPK	+33	+10
Ma : Em 1:3 ratio + 200 kg NPK	+31	+3
Ma : Em 1:3 ratio + 400 kg NPK	+33	+9
Ma : Em 1:3 ratio + 600 kg NPK	+36	+30
Ma : Em 2:1 ratio + 0 kg NPK	+37	+19
Ma : Em 2:1 ratio + 200 kg NPK	+32	+18
Ma : Em 2:1 ratio + 400 kg NPK	+34	+23
Ma : Em 2:1 ratio + 600 kg NPK	+35	+35
Ma : Em 3:1 ratio + 0 kg NPK	+32	+21
Ma : Em 3:1 ratio + 200 kg NPK	+35	+19
Ma : Em 3:1 ratio + 400 kg NPK	+37	+31
Ma : Em 3:1 ratio + 600 kg NPK	+28	+15

Rate 800 and 1000 kg/ha 20:10:10 NPK fertilizer were not applicable in experiments 1 and 2.
Ma - Maize; Em - Egusi melon

4. DISCUSSION

In maize intercropped with egusi melon, nutrient depletion occurred mainly in maize-egusi melon sown at 2:1 and 3:1 ratios and the intensity of nutrient depletion in soil was highest where no fertilizer was applied. At the end of Experiment 2, the PI was positive for cropping ratios of both 1:1 and 1:3 which indicated that a maize-egusi melon mixture of either a similar population component or a higher component of egusi melon did not deplete the soil nutrients and favoured the use of the soil for further productivity as nutrient was still available in the soil.

At the end of experiment 3, the PI became negative in all the treatments irrespective of cropping ratios and fertilizer rates (Table 1) and the soil nutrient depletion was highest in intercropped maize, compared with sole maize, and the intensity of this depletion generally increased in the lower rate of 20:10:10: N P K application as shown in mixture ratios of 3:1, 1:2 and 1:3, respectively. Maize which depletes the soil more of its nutrients when intercropped with some other crops [6] On the other hand, the intensity of soil nutrient depletion increased with higher fertilizer rates in maize-egusi melon ratio of 2:1 while the PI was similar at all rates in the 1:1 crop mixture.

The depletion in nutrients by maize intercropped with egusi melon at the end of experiment 3 was higher in the mixture ratio of 1:3 and next was the crop mixture of 1:2 ratio which was indicative of the poor competitive ability of the high egusi melon component in the mixtures for nutrient. The reason might be that maize demands more N fertilizer for growth and development than the egusi melon [7]. The depletion of soil nutrients by maize occurred where its population was higher than that of egusi melon. Earlier reports indicated that increasing maize population in cassava/maize/melon [7,8] and cassava/maize/ melon mixtures [9] removed more N, P and K than the other crops in association with maize. Similar experience indicated that increasing maize population also decreased yield of cassava [10,11] and egusi melon [12] in separate trials. This confirms the indispensibility of N, P and K in the nutrition of maize [8].

The trend in the PI rating of the soil was similar for all the treatments of egusi melon, that is, egusi melon grown as either sole crop or intercropped with maize and at various cropping ratios and fertilizer rates. At the end of Experiments 2 and 3, respectively, the soil productivity rating was positive, which indicated that egusi melon did not use all the applied fertilizer nutrients, an indication that nutrients were still available in the soil. This was reflected in the high amounts of nutrients left in the soil after harvest. This is considered to be an advantage to the farmer as the cost of fertilizer input will be reduced with respect to egusi melon cultivation unlike interspecific competition by maize which prevented much vegetative growth of cassava crop and subsequently its yield in intercrop with maize [10,11,8]. This suggests that egusi melon intercropped with maize

Table 3. Effects of cropping ratios of maize and egusi melon on some soil properties in maize-melon plots

Soil parameters	Before planting	Cropping ratios							
		1:0	0:1	1:1	1:2	1:3	2:1	3:1	S.E.
		←		After	harvest	→			
Experiment 1									
pH (H_2O)	5.75	5.68	5.65	5.64	5.63	5.71	5.68	5.66	0.12
% C	1.08	1.30	1.23	1.42	1.36	1.40	1.32	1.38	1.05*
N (g-kg)	7.60	7.96	7.60	8.40	8.00	8.35	7.98	8.10	0.31*
P (c.mol. kg)	15.85	16.15	17.75	18.35	18.10	17.90	17.80	17.90	0.77*
Na (c.mol. kg)	7.90	7.80	7.90	7.80	8.00	7.90	7.75	7.70	0.31
K (c.mol. kg)	41.10	39.60	40.90	41.85	40.60	42.25	42.70	40.70	1.62***
Ca (c.mol. kg)	225.20	198.0	197.2	201.4	183.7	196.7	205.2	197.2	7.40***
Mg (c.mol. kg)	41.10	32.90	33.40	32.75	34.15	35.05	34.60	34.00	0.52***
S (c.mol. kg)	0.17	0.18	0.19	0.19	0.19	0.18	0.20	0.18	0.01***
Sand (%)	75.64	77.64	78.72	76.84	78.12	79.10	77.13	76.16	4.1
Silt (%)	12.34	11.35	12.24	12.06	12.14	11.56	12.09	12.60	1.28
Clay (%)	12.02	11.01	9.04	11.10	9.74	9.34	10.78	11.26	0.40***
Experiment 2									
pH (H_2O)	5.80	5.85	5.81	5.85	5.91	5.92	5.93	5.95	0.11
% C	1.30	1.43	1.27	1.43	1.88	1.85	1.94	1.96	0.07*
N (g-kg)	8.15	8.25	7.96	8.20	8.45	8.38	8.55	8.60	0.32*
P (c.mol. kg)	15.06	16.75	18.02	18.22	18.42	18.65	19.01	19.03	3.9
Na (c.mol. kg)	7.60	7.90	8.15	8.10	8.00	7.95	7.85	7.70	0.30*
K (c.mol. kg)	39.20	40.66	40.23	42.02	42.93	43.40	43.70	44.10	0.62*
Ca (c.mol. kg)	189.40	205.3	214.6	216.6	218.1	221.4	222.1	225.5	8.26*
Mg (c.mol. kg)	33.90	35.60	34.6	36.6	37.5	37.8	38.0	41.0	0.57*
S (c.mol. kg)	0.20	0.15	0.19	0.19	0.16	0.15	0.15	0.14	0.01*
Sand (%)	77.46	75.64	77.11	76.35	77.43	78.46	76.74	78.00	2.23
Silt (%)	11.35	12.34	11.35	11.74	11.57	7.66	11.11	12.60	0.49*
Clay (%)	10.19	12.02	11.54	11.91	11.00	13.88	12.15	9.40	0.52*
Experiment 3									
pH (H_2O)	5.95	5.83	5.87	5.84	5.84	5.90	5.86	5.88	0.09
% C	1.40	1.45	1.86	1.74	1.68	1.95	1.83	1.79	0.07*
N (g-kg)	7.86	8.62	8.78	8.50	8.53	9.10	8.20	8.35	0.79*
P (c.mol. kg)	21.14	22.92	23.85	21.73	22.84	22.99	22.70	23.10	2.10
Na (c.mol. kg)	6.50	5.70	6.75	6.70	6.85	6.80	6.70	675	0.30
Mg (c.mol. kg)	40.38	41.98	43.86	41.25	42.52	42.75	41.05	40.50	0.57
K (c.mol. kg)	44.25	42.34	45.15	43.75	44.80	43.60	42.41	41.85	0.71*
Ca (c.mol. kg)	231.60	229.16	234.46	231.13	235.10	236.20	229.88	227.37	8.51*
S (c.mol. kg)	0.17	0.16	0.18	0.18	0.19	0.18	0.12	0.18	0.07
Sand (%)	74.61	75.22	73.67	75.03	74.77	73.81	75.51	76.51	0.03
Silt (%)	13.33	14.34	15.21	15.01	15.06	14.33	13.46	13.73	0.52*
Clay (%)	12.06	11.44	10.12	9.96	10.17	11.86	11.03	9.85	0.51*

** significant at 5 % level of probability; ** highly significant at 1 % level of probability*

Table 4. Effect of 20:10:10 NPK fertilizer rates (kg/ha) on some soil properties in maize-egusi melon in experiments 1, 2 and 3

Soil	Before	0	200	400	600	Cropping ratios		
parameters	planting		after	harvest		800	1000	S.E
Experiment 1								
pH (H_2O)	5.75	5.73	5.72	5.76	5.88	-	-	0.07
% C	1.08	1.39	1.42	1.40	1.56	-		0.21
N (g kg^{-1})	7.60	7.48	7.87	7.78	7.92	-	-	0.26
P (c.mol. kg)	15.85	15.92	17.55	7.50	6.95	-	-	0.17
Na (c.mol. kg)	7.90	7.60	7.55	7.50	6.95	-	-	0.17^{***}
K (c.mol. kg)	41.10	42.13	41.85	42.40	43.51	-	-	0.88
Ca (c.mol. kg)	225.20	192.9	193.7	194.6	196.7	-	-	16.72
Mg (c.mol. kg)	41.00	32.75	33.50	34.40	35.00	-	-	0.36^{*}
S (c.mol. kg)	0.17	0.18	0.18	0.20	0.22	-		0.02
Sand (%)	75.64	77.00	77.02	76.76	74.68	-	-	1.67
Silt (%)	12.34	11.35	11.59	12.64	13.06	-	-	0.30^{*}
Clay (%)	12.02	11.65	11.39	12.10	12.26	-	-	0.78
Experiment 2						-	-	
pH (H_2O)	5.80	5.88	5.91	5.94	5.89	-	-	0.06
% C	1.30	1.74	1.65	1.88	2.01	-	-	0.53
N (g kg^{-1})	8.15	7.60	7.96	8.40	8.20	-		0.20^{*}
P (c.mol. kg)	15.06	16.15	17.31	18.02	18.22	-	-	0.52^{*}
Na (c.mol. kg)	7.60	7.85	7.93	7.85	8.10	-	-	0.33
K (c.mol. kg)	39.20	41.10	40.23	39.86	43.40	-	-	0.41^{*}
Ca (c.mol. kg)	189.40	225.2	225.2	221.4	220.1	-	-	18.41
Mg (c.mol. kg)	33.90	41.0	39.7	38.0	36.6	-	-	0.39^{*}
S (c.mol. kg)	0.20	0.17	0.19	0.18	0.19	-	-	0.02
Sand (%)	77.46	75.64	74.66	76.42	78.24	-	-	1.61
Silt (%)	11.35	12.34	12.12	12.36	10.60	-	-	0.30^{*}
Clay (%)	10.19	12.02	13.22	11.22	11.16	-	-	0.29^{*}
Experiment 3								
pH (H_2O)	5.95	5.83	5.85	5.84	5.81	5.84	5.86	0.07
% C	1.40	1.42	1.44	1.51	1.48	1.63	1.68	0.08
N (g kg^{-1})	7.86	8.20	8.90	9.32	9.47	9.56	9.72	0.09
P (c.mol. kg)	21.14	24.29	25.43	22.62	19.56	24.78	21.28	0.71^{***}
Na (c.mol. kg)	6.50	6.20	6.35	6.85	6.93	6.55	6.40	0.43^{***}
K (c.mol. kg)	231.60	198.8	223.60	222.10	216.30	221.50	227.70	0.53^{***}
Ca (c.mol. kg)	44.25	39.57	41.40	40.24	38.75	42.23	43.02	1.34
Mg (c.mol. kg)	40.38	20.29	20.96	21.33	21.84	22.54	24.82	1.06
S (c.mol. kg)	0.17	0.19	0.20	0.21	0.23	0.22	0.20	0.03
Sand (%)	74.61	76.61	75.21	74.83	75.41	73.31	73.16	2.01
Silt (%)	13.33	12.74	12.77	13.51	12.84	14.74	14.70	1.84
Clay (%)	12.06	10.65	12.02	11.66	11.75	11.95	12.14	1.54

Rates of 800 and 1000 kg-ha of 20:10:10 NPK fertilizer were not applicable in experiments 1 and 2.
** significant at 5 % level of probability; ** highly significant at 1 % level of probability*

does not require as much nutrient as maize does. It does not suggest insufficiency of fertilizer use by egusi melon. The implication of these ratings for the maize and egusi melon components of the crop mixture is that maize depleted soil productivity more than egusi melon at the end of Experiment 2 and 3 respectively. The few +PI ratings recorded for maize suggest moderate influence of egusi melon on maize uptake of fertilizer nutrients [12]. It is reasonable to assume that the soil productivity would therefore increase or decrease according to the changes in the soil nutrient content.

Table 5. Effect of 20:10:10 NPK fertilizer rates (kg / ha) on some soil properties in maize-egusi melon in experiment 3

Soil properties	1:0	0:1	1:1 After	Cropping ratios				
				1:2 harvest	1:3	2:1	3:1	S.E
Experiment 1								
P^H (H_2O)	5.95	5.83	5.85	5.84	5.81	5.84	5.86	0.07
% C	1.40	1.42	1.44	1.51	1.48	1.63	1.68	0.08
N (g-kg)	7.86	8.20	8.90	9.32	9.47	9.56	9.72	0.09
P (c.mol. kg)	21.14	24.29	25.43	22.62	19.56	24.78	21.28	0.71***
Na (c.mol. kg)	6.50	6.20	6.35	6.85	6.93	6.55	6.40	0.43***
K (c.mol. kg)	231.60	198.8	223.60	222.10	216.30	221.50	227.70	0.53***
Ca (c.mol. kg)	44.25	39.57	41.40	40.24	38.75	42.23	43.02	1.34
Mg (c.mol. kg)	40.38	20.29	20.96	21.33	21.84	22.54	24.82	1.06
S (c.mol. kg)	0.17	0.19	0.20	0.21	0.23	0.22	0.20	0.03
Sand (%)	74.61	76.61	75.21	74.83	75.41	73.31	73.16	2.01
Silt (%)	13.33	12.74	12.77	13.51	12.84	14.74	14.70	1.84
Clay (%)	12.06	10.65	12.02	11.66	11.75	11.95	12.14	1.54

** significant at 5 % level of probability; ** highly significant at 1 % level of probability*

In computing the PI in Tables 1 and 2, 800 and 1000 kg/ha fertilizer rates were not used as these rates were introduced as treatments only in Experiment 3.

Results from this study suggest that the ascribed index rating can be used to predict the restorative or depletive power of both crops. However, it needs to be emphasized that N P K fertilizer is not the only factor that can determine soil productivity; as many factors interactively govern the appreciation and depreciation of soil productivity [13,14].

It is reasonable to emphasize that egusi melon is a poor competitor with maize for applied fertilizers [14] as cowpea was with millet [15] and that maize will deplete the soil more of nutrients than egusi melon. Furthermore, egusi melon in mixture with maize can help to improve total productivity of the later crop [16] as cowpea was with millet [15] and that maize will deplete the soil more of nutrients than the egusi melon. Furthermore, egusi melon in mixture with maize can help to improve total productivity of the later crop as was the case of the former crop with Okra in a similar experiment [16].

5. CONCLUSION

Maize depleted more soil nutrients than egusi-melon. Intensity of the nutrient depletion increased with higher rates of the NPK fertilizers in maize-egusi melon ratios of 2:1 and 3:1. The few +PI ratings recorded for maize indicated moderate influence of the egusi melon on maize uptake of the nutrients and that egusi-melon had poor competitive ability with maize for the nutrients. Egusi-melon does not require as much nutrients as maize does. Maize and egusi-melon are compatible in intercrop with respect to nutrient demand. The higher components of egusi melon with maize did not deplete the soil nutrients and thus favour the use of the soil for further productivity as nutrients were still available in the soil.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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