

IMPACT OF CROPPING RATIOS OF MAIZE (*zea mays*)-EGUSI MELON (*cucurbitis citrullus*) AND NPK FERTILIZER ON SOIL PRODUCTIVITY RATING OF AN ULTISOL IN EDO STATE, NIGERIA.

ABSTRACT

Three separate field studies were conducted at the University of Benin farm in Nigeria to determine soil productivity index rating for ultisol in which seven cropping ratios of maize (MA) and egusi-melon (EM); (MA:EM 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, six rates (0, 200, 400, 600, 800, 1000 kg) of the fertilizer in experiment 3. The design of the experiment was factorial fitted in a randomized complete block design that was 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 data at the end of experiment 2 in table 1 denotes the difference between the soil at the end of experiments 1 and 2 respectively while those for experiment 3 are the differences between experiments 2 and 3 respectively. 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. And in experiment 3, the highest nutrient rate was obtained in maize in ratios of 1:2 and 1:3 with egusi melon.

21 In the case of egusi melon, soil productivity ratings were all positive, either where
22 planted sole or intercropped with maize under the various cropping ratios, thus
23 suggesting no nutrient depletion.

24 Egusi melon in sole or intercrop with maize had positive soil producing rating under the
25 various fertilizer rates indicating that it did not use all the applied fertilizers and thus
26 favoured the use of the soil for further productivity as nutrients were still available for
27 this in the soil. It further suggests that egusi melon in mixture with maize does not require
28 as much nutrient as maize does. This does not indicate insufficiency of fertilizer use
29 rather economic.

30 INTRODUCTION

31 The type of cropping systems and crops determine soil fertility and nutrient contents
32 because nutrients are derived from the soil by crop for growth [5] stresses experienced by
33 land resource systems and the soils are quite many. Such stresses may include soil
34 acidity, salinity, poor drainage, erosion [4] and nutrient imbalance or deficiency. These
35 stresses result in reduction in soil productivity. [12] proposed some methodologies and
36 procedures to assess these factors relating to nutrient stress which includes land use and
37 management systems

38 Owing to scarcity and high cost of the mineral fertilizers, farmers seldomly apply the
39 fertilizers to their crops. And reliance on shifting cultivation system as means of nutrient

40 recovery is no longer feasible due to upsurge in human population mounting pressure on
41 available lands for other purposes [8].

42 Most small-scale farmers practice intercropping in which different crops are grown in
43 mixtures or combinations; and no adequate information on the fertilizer needs of such
44 crops in mixtures. Farmers usually base their information in the fertilizer need of crops
45 grown in mixtures on any one of the crops. The need for basic understanding of the soil
46 fertility and cropping systems would therefore be relevant. The knowledge of the impact
47 of crops combination will afford the understanding of suitable fertility management
48 approach for the different crop combinations.

49 The objective of this work was to evaluate the restorative and depletive effect of maize
50 and egusi-melon under various cropping ratios using NPK 20:10:10 as the soil quality
51 indicators.

52 MATERIALS AND METHOD

53 This study was conducted for three consecutive cropping seasons (2009, 2010 and 2011)
54 on the University of Benin teaching and Research farm in Benin City, Nigeria (5° 04' and
55 6° 43'E, 6° 14'S and 7° 34'N) between March and August of each year. Soil samples were
56 obtained at depth of 0 – 30cm in the plots under maize and egusi melon tested to various
57 cropping ratios and fertilizer rates. Standard procedures for the analysis of the soil's
58 physical (sand, silt, clay) and chemical (P^H , % C, N, P, K, Ca, Mg, Na, S) were used as

described by [5] to determine these properties prior to planting and after harvest of the crops.

The experimental site was manually cleared and mapped out for the three experiments (2009, 2010, 2011) as experiments 1, 2 and 3 respectively. The experiment consisted of 4 levels (0, 200, 400, 600 kg/ha) of NPK 20:10:10 and seven cropping ratios of maize and egusi melon functional in a randomized complete block design replicated three times. The factorial combination of the experiment resulted in 28 treatments replicated three times amounted to 84 plots of 16.2m² each for experiments 1 and 2; while in experiment 3 the fertilizer rates were increased to six (0, 200, 400, 600, 800 and 1000 kg/ha) under the same test crops, plot size and NPK 20:10:10 fertilizer rates. 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 as described by [1] were the test crops under four rates (0, 200, 400, 600 kg/ha) of NPK 20:10:10 for experiments 1 and 2, respectively and six rate (0, 200, 400, 600, 800, 1000 kg/ha) in experiment 3.

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 75cm x 90cm as recommended [10] at 3 seeds per stand in 16.2m² plot and thinned to 2

80 seeds/stand at 5 days after seedling emergence. Manual weeding was done thrice each
81 year using hand hoe.

82 Maize was harvested dry at 85 days after planting (DAP) and for egusi-melon, pods were
83 partially split open to allow for fermentation to occur before seed extraction and sun
84 drying (for 5 days) when the leaves had dried up completely (98 DAP).

85 The objective of this study was to develop soil productivity rating index (PI) for various
86 crops using maize and egusi-melon as the test crops under varying fertilizer rates and
87 cropping ratios. The PI procedure is used to develop an index of soil productivity rating
88 which can be used by farmers to calculate or predict safe and unsafe cropping systems.
89 Soil productivity index (PI) as described by [4] states that:

90 Pre cropping yield =

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

91

92

RESULTS

Soil Productivity of maize and egusi melon in sole and intercrop

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 **where planted sole** 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 1); whereas, in the case of egusi melon, soil productivity ratings were all positive thus indicating no nutrient depletion (Table 2). The maize depleted **the soil more of nutrients** than did egusi-melon (Tables 3, and); 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.

112 **Table 1: Determination of soil productivity of maize in sole and intercrop with**
 113 **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
Maize in 1:1 ratio with melon + 0 kg NPK	+13	-23
Maize in 1:1 ratio with melon + 200 kg NPK	+02	-24
Maize in 1:1 ratio with melon + 400 kg NPK	+05	-26
Maize in 1:1 ratio with melon + 600 kg NPK	+02	-24
Maize in 2:1 ratio with melon + 0 kg NPK	-19	-10
Maize in 2:1 ratio with melon + 200 kg NPK	-09	-10
Maize in 2:1 ratio with melon + 400 kg NPK	+09	-14
Maize in 2:1 ratio with melon + 600 kg NPK	-07	-18
Maize in 3:1 ratio with melon + 0 kg NPK	-14	-25
Maize in 3:1 ratio with melon + 200 kg NPK	-05	-24
Maize in 3:1 ratio with melon + 400 kg NPK	-07	-11
Maize in 3:1 ratio with melon + 600 kg NPK	-08	-16
Maize in 1:2 ratio with melon + 0 kg NPK	-16	-57
Maize in 1:2 ratio with melon + 200 kg NPK	-03	-35
Maize in 1:2 ratio with melon + 400 kg NPK	-03	-36
Maize in 1:2 ratio with melon + 600 kg NPK	-04	-28
Maize in 1:3 ratio with melon + 0 kg NPK	+15	-40
Maize in 1:3 ratio with melon + 200 kg NPK	+15	-42
Maize in 1:3 ratio with melon + 400 kg NPK	+07	-44
Maize in 1:3 ratio with melon + 600 kg NPK	-04	-30

114 Rates of 800 and 1000kg-ha of 20:10:10 NPK fertilizer were not applicable in
 115 experiments 1 and 2.

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118 **Table 2: Determination of Soil Productivity of Egusi-Melon in Sole and Intercrop**
 119 **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
Maize in 1:1 ratio with melon + 0 kg NPK	+33	+18
Maize in 1:1 ratio with melon + 200 kg NPK	+33	+18
Maize in 1:1 ratio with melon + 400 kg NPK	+36	+24
Maize in 1:1 ratio with melon + 600 kg NPK	+06	+34
Maize in 1:2 ratio with melon + 0 kg NPK	+35	+20
Maize in 1:2 ratio with melon + 200 kg NPK	+35	+18
Maize in 1:2 ratio with melon + 400 kg NPK	+34	+24
Maize in 1:2 ratio with melon + 600 kg NPK	+37	+34
Maize in 1:3 ratio with melon + 0 kg NPK	+33	+10
Maize in 1:3 ratio with melon + 200 kg NPK	+31	+3
Maize in 1:3 ratio with melon + 400 kg NPK	+33	+9
Maize in 1:3 ratio with melon + 600 kg NPK	+36	+30
Maize in 2:1 ratio with melon + 0 kg NPK	+37	+19
Maize in 2:1 ratio with melon + 200 kg NPK	+32	+18
Maize in 2:1 ratio with melon + 400 kg NPK	+34	+23
Maize in 2:1 ratio with melon + 600 kg NPK	+35	+35
Maize in 3:1 ratio with melon + 0 kg NPK	+32	+21
Maize in 3:1 ratio with melon + 200 kg NPK	+35	+19
Maize in 3:1 ratio with melon + 400 kg NPK	+37	+31
Maize in 3:1 ratio with melon + 600 kg NPK	+28	+15

120 Rate 800 and 1000kg-ha 20:10:10 NPK fertilizer were not applicable in experiments 1
 121 and 2.

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

Soil Parameters Experiment 1	Before planting	Cropping Ratios							S.E
		1:0	01: ←	1:1 After	1:2 Harvest	1:3	2:1 →	3:1	
Experiment 1									
P^H (H ₂ O)	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									
P^H (H ₂ O)	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									
P^H (H ₂ O)	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*

*($P < 0.05$)

***($P < 0.001$)

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

Soil Parameters Experiment 1	Before planting	Cropping Ratios						S.E
		0	200 After	400 Harvest	600	800	1000	
Experiment 1								
P^H (H ₂ O)	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)	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								
P^H (H ₂ O)	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)	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								
P^H (H ₂ O)	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	227.7	0.53***
						0		
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

130 Rates of 800 and 100 kg-ha of 20:10:10 NPK fertilizer were not applicable in
 131 experiments 1 and 2.

132
 133 *(p<0.05)
 134 ***(P<0.001)

136 **Table 5: Effect of 20:10:10 NPK Fertilizer rates (kg-ha) on some soil properties in**
 137 **maize-egusi melon in experiment 3**

Soil Parameters Experiment 1	Before planting	1:0	01:	1:1 After	Cropping Ratios			3:1	S.E
					1:2 Harvest	1:3	2:1		
P ^H (H ₂ O)	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	

138 *(P<0.05)

139 *** (P<0.001)

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DISCUSSION

143 In maize intercropped with egusi melon, nutrient depletion occurred mainly in maize-
 144 egusi melon sown at 2:1 and 3:1 ratios and the intensity of nutrient depletion in soil was
 145 highest when no fertilizer application (0kg/ha of 20:10:10 NPK) took place. At the end of
 146 Experiment 2, the PI was positive for cropping ratios of both 1:1 and 1:3 which was
 147 indicative that a maize-egusi melon mixture of either a similar population component or a
 148 higher component of egusi melon did not deplete the soil nutrients and favoured the use
 149 of the soil for further productivity as nutrient was still available for this in the soil.

150 At the end of experiment 3, the PI became negative in all the treatments irrespective of
 151 cropping ratios and fertilizer rates (Table 1) and the soil nutrient depletion was highest in
 152 intercropped maize, compared with sole maize, and the intensity of this generally
 153 increased  the lower the rate of 20:10:10: NPK application as shown in mixture ratios of
 154 3:1, 1:2 and 1:3 respectively. On the other hand, the intensity of soil nutrient depletion
 155 increased with higher fertilizer rates in maize-egusi melon ratio of 2:1 while the PI was
 156 similar at all rates in the 1:1 crop mixture.

157 The depletion in nutrients by maize intercropped with egusi melon at the end of
 158 experiment 3 was higher in the mixture ratio of 1:3 and next was the crop mixture of 1:2
 159 ratio which was indicative of the poor competitive ability of the high egusi melon
 160 component in the mixtures for nutrient.

161 The trend in the PI rating of the soil was similar for all the treatments of egusi melon, that
 162 is, egusi melon grown as either sole crop or intercropped with maize and at various
 163 cropping ratios and fertilizer rates (Table 2). At the end of Experiments 2 and 3
 164 respectively the soil productivity rating was positive, which indicated that egusi melon
 165 did not use all the applied fertilizer nutrients, an indication that nutrients were still
 166 available in the soil. This was reflected in the high amounts of nutrients left in the soil
 167 after harvest as shown in tables 3, and 4. This suggests that egusi melon intercropped
 168 with maize does not require as much nutrient as maize does. It does not suggest
 169 insufficiency of fertilizer use by the egusi melon. The implication of these ratings for the
 170 maize and egusi melon components of the crop mixture is that maize depleted soil
 171 productivity more than egusi melon at the end of Experiment 2 and 3 respectively. The
 172 few +PI ratings recorded for maize suggest moderate influence of the egusi melon on
 173 maize uptake of fertilizer nutrients [9]. It is reasonable to assume that the soil
 174 productivity would therefore increase or decrease according to the changes in the soil
 175 nutrient content.

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

178 Results from this study suggest that the ascribed index rating can be used to predict the
 179 restorative or depletive power of both crops. However, it needs to be emphasized that
 180 NPK fertilizer is not the only factor that can determine soil productivity; as many factors
 181 interactively govern the appreciation and depreciation of soil productivity [2] ; [4]

182 It is reasonable to emphasize that egusi melon is a poor competitor with maize for applied
 183 fertilizers [4] as cowpea was with millet [13] and that maize will deplete the soil more of
 184 nutrients than the egusi melon. Furthermore, egusi melon in mixture with maize can help
 185 to improve total productivity of the later crop [7] as cowpea was with millet [13] and that
 186 maize will deplete the soil more of nutrients than the egusi melon. Furthermore, egusi
 187 melon in mixture with maize can help to improve total productivity of the later crop [7]
 188 as was the case of the former crop with Okra in a similar experiment [7].

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CONCLUSION

191 Maize depleted the soil of nutrients more than the egusi-melon. Intensity of the nutrient
 192 depletion increased with higher rates of the NPK fertilizers in maize-egusi melon ratios
 193 of 2:1 and 3:1. The few +PI ratings recorded for maize indicated moderate influence of
 194 the egusi melon on maize uptake of the nutrients and that egusi-melon had poor
 195 competitive ability with maize for the nutrients. Egusi-melon does not require as much
 196 nutrients as maize does. Maize and egusi-melon are compatible in intercrop with respect
 197 to nutrient demand.

198 The higher components of egusi melon with maize did not deplete the soil nutrients and
 199 thus favour the use of the soil for further productivity as nutrients were still available for
 200 this in the soil.

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REFERENCES

- 203 Adeniran, M.O., and Wilson G.F. (1981): Seed Type: classification of egusi melon in
204 Nigeria. 5th African Horticulture Symposium, University of Ibadan Nigeria 9 – 25
205 July 1981.
- 206 Agoume, V. and A.M. Birang (2009): Impact of Land use Systems on Some Physical and
207 chemical soil properties of an Exisol in the Humid Forest zone of Southern
208 Cameroon.
209 *Tropicultura* 27(1): 15 – 20.
- 210 Ali, A. Achor, I.O. and Adaikwu, A.O. (2014): Effect of leucaena *Leucocephala* Biomass
211 on Soil Physical and Chemical Properties in the sub-Humid Southern Guinea
212 Savanna Zone of Nigeria.
213 *Nigerian Journal of Soil and Tillage Research* 1:103-110.
- 214 Anikwe M.A.N (2004): Quantifying the Effects of Crops and Soil Management Practices
215 on Soil Productivity using N as a Soil Quality indicator *Tropicultura* 22(1) 40 –
216 46.
- 217 Awanlemhen, B.E. and Ojeniyi, S.O. (2014): Effect of Cropping System on Soil Profile
218 Nutrient Contents. *Nigerian Journal of Soil Science* 24(1): 217 – 220.
- 219 IITA (1984): Plant and Soil Analysis Procedures manual
220 International Institute for Tropical Agriculture (IITA) Ibadan, Nigeria and
221 University of Guelph.
- 222 Ikeorgu, J.E.G. Ezumah, H.C. and Wahua, T.A.T. (1989): Productivity of Species in
223 cassava/maize/egusi-melon complex mixtures in Nigeria.
224 *Field Crops Research* 21: 1 – 7.
- 225 Iren, O.B. John, N.M. and Imuke, E.A. (2014): Effect of sole and combined applications
226 of Organic Manures and Urea on soil Properties and Yield of Fluted pumpkin
227 (*Telfaria occidentalis*, Hook F).
228 *Nigerian Journal of Soil Science* 24(1) 125 – 133.
- 229 Mbagwu, J.s.C. (1992): Improving the productivity of a degraded utisol in Nigeria using
230 organic and inorganic amendments. Part 1: Effects on the Chemical Properties and
231 maize yield.
232 *Bioresource Technology* 42:149 – 154.
- 233 Norman D.W. (1992): Cucurbitaceae Crops in Tropical Vegetable crops.
234 A.H. Stockwell Limited Publishers. Great Britain 242p.

- 235 Norman, D.W. (1974): Rationalizing Mixed cropping under indigenous conditions. The
236 Example of Northern Nigeria.
237 Journal of development Study 11(1)3-21.
- 238 Pierce, F.J. and Larson, W.E. (1993): Developing Criteria to evaluate sustainability and
239 management. In: Proceeding of the Eightieth International Soil management
240 Workshop: utilization of soil survey information for sustainable land use.
241 May 3, 1993 J.M. Kimble (eds.) USDA soil cons. Serv. National Soil Survey
242 Center Lincolnl N.E. p.7-14.
- 243 Yamoah, C.F. Batiano, A. Shapiro, B. and S. Koala (2003): Soil Management Practices
244 to improve nutrient-use Efficiencies and Reduced Risk in Millet-based cropping
245 systems in the Sahel.
246 Tropicultura 21(2): 66 – 72.
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