

Evaluation of the Effect of Compound Fertilizer Rates on the Productivity of Cassava/Maize/Egusi/Melon Intercrop Under the Farmers Production Systems

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Abstract

On-farm experimentation was conducted in the 1987/88 cropping season in Rivers State, Nigeria to determine the optimum fertilizer rate for cassava - maize - egusi (melon) intercrop using N:P:K Mg. 12:12:17:2 as source of nutrients.

On the average, the use of the best compound fertilizer rate of 600kg/ha N:P:K Mg. 12:12:17:2 gave net benefit of N11,973/ha (185% higher) compared with no fertilizer value of N5,509/ha in Rivers State of Nigeria.

For Bori and Etche locations, 600kg/ha gave the highest overall productivity (10.68, 689 Kcal/ha) while for Oyigbo location, the highest yield (4.54 Kcal/ha) was by 400kg/ha⁻¹. In good environments, 600 and 900Kg ha⁻¹ were similar but better than 300 and 0 Kg ha⁻¹. In very poor environments, however, zero or highest yielding rate of 300 Kg ha⁻¹ should be used.

Introduction

Cassava is an important food crop for both man and animals. Some attributes of cassava in the indigenous farming include high yield per unit time and land compared with other crops (Ezeilo, 1978), good storage properties in the ground, ability to grow in a wide range of ecological conditions and ability to grow in sub-optimal soils.

Cassava is most commonly inter-cropped with maize, egusi, yam etc in West Africa (Ezeilo 1978). In Rivers State, Nigeria, (Unamma et al, 1985) noted that cassava/maize/egusi, melon is the commonest intercropping system. They also showed that 65% of the farms were cropped for 3 - 5 years before they were left to fallow for 5 - 6 years as against 10 years fallow period. In many other farms continuous cropping is already being practised. These practices have contributed to the deteriorated soil condition identified as one of the major production constraints in the area (Odurukwe et al, 1986).

Fertilizer use is generally low in the area under study as farmers attribute the rot on their yams, cassava and cocoyams to the use of fertilizers. In the few cases where

fertilizer was used, the doses were inadequate compared with 400kg/ha¹ which had been recommended for sole cassava and which is currently being adapted for mixture involving cassava. This is used as a blanket recommendation pending the identification of the appropriate fertilizer for cassava - based crop mixture. The objective of this trial is to determine, under the farmers production systems, the optimum fertilizer rate for maximum productivity of cassava/maize/egusi-melon intercrop.

Methodology

The trial was conducted in Bori, Etche and Oyigbo all in the Eastern part of Rivers State, Nigeria in the 1987/88 cropping season. The annual rainfall in these areas ranges from 2361 to 2803mm and is spread throughout the year (Oyenuga et al 1986). The pre-cropping nutrient status is shown in Table 1.

Traditional land preparation method was used and consisted of clearing, burning packing the unburnt trash and making small mounds about 30 - 40 cm high. The mounds were formed in rows, spaced 100cm apart.

Four rates of N.P.K. Mg. 12:12:17:2, fertilizer, 0, 300,600 and 900 kg ha⁻¹, were evaluated using a randomized complete block (RCB) design and replicated three times in each of the three locations. Each replicate was sited in a different farm, but within the same location. The test crops were cassava (*Manihot esculenta* Grantz) variety TMS 30572, Maize (*Zea mays* L.) variety TZESR-I and a local variety of egusi-melon (*Colocynthis citrallus* L. Ktze).

Cassava was planted at one cutting at the centre of the mounds spaced 100cm apart within the row. (10,000 stands per hectare). Maize was planted two seeds per stand, 100cm apart within the row spaced 25cm away from both sides of the cassava row and positioned half-way between two cassava stands (40,000 stands/ha).

Egusi-melon was planted 2 seeds per stand spaced 50cm apart along the same row as the cassava but be-

tween the cassava and the pair of maize stands (40,000 stands/ha).

Two weeding, at 4 and 16 weeks after planting (w.a.p.) were done. The fertilizer treatments stated above were applied at 4 w.a.p. (i.e. after first weeding) by hand between rows of maize and cassava/egusi.

Egusi (melon) was harvested at 14 w.a.p., maize at 16 w.a.p. and cassava at 48 w.a.p.

Analysis of variance technique was used to compare the yield of component crops in relation to the treatments. Subsequent analyses on the productivity of the system were based on the relative yields (energy value using data from Oyenuga 1968) and monetary value using farm gate prices. Modified yield stability analysis and partial budget analysis were discussed.

Results and Discussion

Cassava Yield

The fresh tuberous root yield of cassava increased as fertilizer rate was increased up to 600kg ha⁻¹ after which it declined (Table 2). These was also significant differences in cassava yield among locations, with highest yield in Bori and lowest in Oyigbo. There was significant fertilizer rate x location interaction. In Oyigbo, 300kg ha⁻¹ fertilizer gave the highest significant tuberous root yield, whereas in Etche and Bori locations, application of 600 and 900kg ha⁻¹ were similar but produced higher yield than those of 300 and 0kg ha⁻¹.

Maize Grain Yield

Maize grain yield (at 14% moisture content) significantly increased with increase in fertilizer rate. Yield also differed significantly among locations (Table 1). The highest maize yield was realised in Etche while the lowest came from Bori. The fertilizer rate x location interaction was not significant indicating similar trend in fertilizer rate response in all the locations studied.

Egusi (Melon Seed) Yield

The only differences detected in the seed yield of egusi-melon were due to location (Table 1). Yields of egusi - melon seeds were generally very poor. This could be attributed to the population of maize and egusi-melon used. Egusi-melon and maize were each planted at 40,000 seeds per hectare. Unamma et al (1985) had reported that such population of maize and egusi-melon were meant for weed control in mixtures involving them, and little or no yields of melon should be anticipated.

Energy Yields

Table 3 shows the analysis of variance (Anova) table for the combined crops productivity (expressed in energy values) of the mixture. Location had highly significant (P = 1%) effect on productivity with highest productivity in Bori followed by Etche and least in Oyigbo. The productivity was also highly significantly (P = 1%) influenced by fertilizer rate. Both the linear and quadratic components were significant (P = 1% and P = 5%, respectively). There was significant fertilizer rate x location interaction which was mainly due to the differences in the

linear part of the yield response in different locations (Table 4).

Thus about 627,621 and 432 Kg ha⁻¹ fertilizer would be optimal for cassava/maize/egusi-melon intercrop in Bori, Etche and Oyigbo areas respectively. This trend was expected considering the nutrient status (Table 1). Organic matter and consequently nitrogen regemes were low in Bori and Etche and medium in Oyigbo location. The sites in Bori and Etche were left fallow for two and three years, respectively, while in Oyigbo the trial followed a four year fallow period.

The results of the modified yield stability analysis (figure 1). shows that the coefficient of determination (R²) for 300, 600 and 900kg ha⁻¹ fertilizer rates were significantly high indicating a very good fit, while that of 0 Kg ha⁻¹ shows a poor fit, hence it was low (r² = 0.621). At P = 5%, there was heterogeneity of the regression and correlation coefficients. Thus the fertilizer rates studied behaved differently in various environments. While the response of 600 and 900 Kg ha⁻¹ were similar; they differed from that of 300 and 0 Kg ha⁻¹.

In good environments, (Environmental index (e) greater than 5.3 x 10⁴ Kcalha⁻¹ fertilizer treatments were better than zero fertilizer rate in the order of 600 greater than 900 greater than 300 Kg ha⁻¹.

In poor environments, (ec53 x 10⁴ Kcalha⁻¹ however, it was best not to use fertilizer. Higher doses may even result in negative yield.

Partial Budget Analysis and Conclusion

Fertilizer at 600 Kg ha⁻¹ gave both the highest net benefit and marginal rate of returns (MRE) (Table 2) at Bori and Etche, while 300 Kg ha⁻¹ at Oyigbo. Farmers' will realise as much as N8 and N56 for every N1.00 invested in fertilizer use at 600 Kg ha⁻¹ in Bori and Etche, while N7.00 in fertilizer use at 300 Kg ha⁻¹ in Oyigbo.

In conclusion, this trial suggests that farmers growing cassava/maize/egusi-melon intercrop in Bori, Etche and areas with similar environment have similar fertilizer recommendation of about 621kg⁻¹ while those in Oyigbo and similar environments may use 432Kg ha⁻¹.

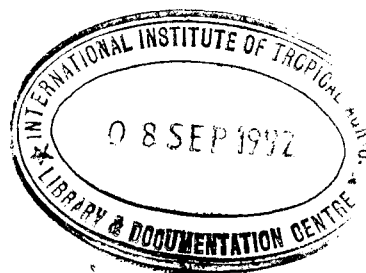


Table 1: Nutrient Status of the On-farm Trial
Locations: River State Nigeria 1987/88

<u>Location</u>	<u>Ca</u>	<u>Mg</u>	<u>K</u>	<u>(pm)</u>	<u>O.M.</u>	<u>N</u>	<u>PE(H2O)</u>
Bori	0.46	0.35	0.121	1.58	1.20	0.065	5.17
Etche	1.18	0.72	0.171	2.69	2.25	0.109	5.0
Oyigbo	1.340	0.800	0.140	3.04	2.55	.175	5.60

Table 2: Partial Budget Analysis of Fertilizer rates on the productivity of Cassava/Maize/Egusi-Melon Intercrop in Rivers State, Nigeria 1987/88

PERTILIZER RATES KGHA⁻¹

Yield element	Bori				Eche				Oyigbo						
	0	300	600	900	Means	0	300	600	900	Means	0	300	600	900	Means
Yield (t/ha):															
Cassava	9.63	14.07	27.17	26.87	17.19	5.87	6.77	15.46	12.87	10.27	7.03	10.73	10.73	7.43	8.86
Maize	0.10	0.73	0.90	0.80	0.14	1.53	2.17	2.50	3.17	2.34	0.43	1.13	1.13	1.13	1.37
Egusi-melon	0.01	0.03	0.02	0.02	0.02	0.09	0.07	0.05	0.04	0.06	0.28	0.33	0.24	0.15	0.25
Cross Field benefit (N/ha)	5903	9247	17252	16972	5277	6.407	11901	10998	5348	8393	8132	6203			
Total Variable Costs N/ha.	366.0	462.00	558.00	-	-	6.041	11,439	10,440	5,348	8,027	7,670	5,645			
Net Benefit N/ha	5,903	8,881	16,790	16,414	-	5,277	208.7	5622.9	-040.6		732.0	-371.4	-2109.4		
Marginal Rate of Return(%)	813.7	8238.5	-391.7	-	-	39.46									
Minimum rate of Return (%)			39.46												
Acceptable to the farmer															

LSD 915% for Fertilizer rate means :- Cassava 3.23,

Maize:- 0.53 Egusi-melon N.S.**

LSD (5%) for location means:- Cassava: 5.59, Maize: 092

Cassava tuber @ N600 per tonne

Maize @ N1,000 per tonne

Egusi-melon @ N2,500 per tonn

Table 3: Analysis of variance of Energy Yield (X 105 kcla ha⁻¹ With partitioning of the main Effects (Fertilizer Rates and Location) Sum of Squares (ss) and Corresponding Interaction SS.

Rivers State Nigeria - 1987/88

Sources of Variation	Degree of Freedom(df)	SS	M.S.	Computed P - Values
Location	2	95.55	47.78	25.09**
Reps. within location	2	24.97	12.49	6.56*
Fertilizer rat'	3	97.16	32.39	17.01**
Fertilizer quadratic(Fq)	1	11.02	11.02	5.78**
Fertilizer linear (Fl)	1	79.47	79.47	41.73**
Fertilizer cubic (Fc)	1	6.67	6.67	3.50N.S.
Fertilizer x Locaiton	6	48.50	8.08	4.24**
FL x Locatio	2	39.51	19.76	10.37**
FQ x Location	2	2.40	1.2	0.63N.S.
FC x Location	2	6.59	3.30	1.73N.S.
Error	18	34.28	1.90	
Total	35	300.46		

* = Significant at 5% level of probability
 ** = Significant at 1% level of probability
 N.S. = Not Significant.

Table 4: Response Curves of the Effect of Rate on the Productivity of Cassava/Maize/Melon, Rivers State, Nigeria 1987/88

Location	Regression	Coefficient	Coefficient of determination(L)
Bori	$9 = 3.26 + 0.008xX -$	$0.0000067x^2$	0.904*
Etche	$9 = 1.20 + 0.0072x -$	$0.0000058x^2$	0.887*
Oyigbo	$9 = 318 + 0.0057x -$	$0.0000066x^2$	0.851*

Significant at 5% level of probability.

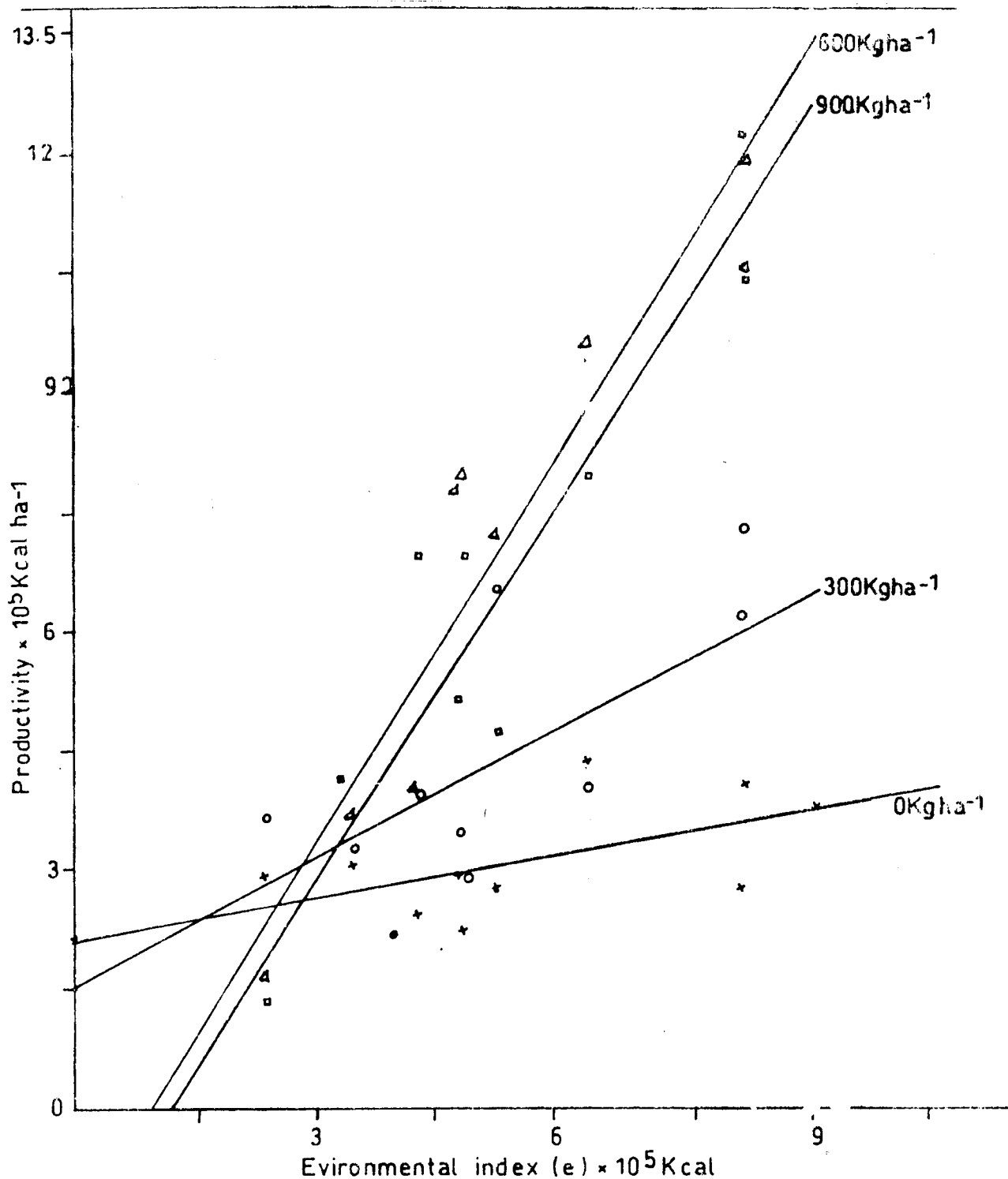


Fig: 1. Response of total productivity (energy/yield) cassava, maize/egusi-melon under different rate of fertilizer to the environment (e) Rivers State, Nigeria 1987/1988.

$x-x \hat{Y}0Kgha^{-1} = 2.08 + 0.175X (R^2 = 0.626NS)$; $\Delta-\Delta \hat{Y}600Kgha^{-1} = -1.66 + 1.665X (R^2 = 0.902^*)$
 $o-o \hat{Y}300Kgha^{-1} = 1.53 + 0.559X (R^2 = 0.505^*)$; $\square-\square \hat{Y}900Kgha^{-1} = 1.94 + 1.605X (R^2 = 0.884^{**})$

$*$ = Significant at 5%, $**$ = Significant at 1% level of probability
 NS = Not significant at 5% level.

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