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EFFECT OF COMPOUND FERTILIZER ON THE YIELD AND PRODUCTIVITY OF SOYBEAN AND MAIZE IN SOYBEAN/MAIZE INTERCROP IN SOUTHEASTERN NIGERIA.

[EFECTO DE LA FERTILIZACIÓN EN EL RENDIMIENTO Y PRODUCTIVIDAD DE SOYA Y MAÍZ EN UN CULTIVO INTERCALADO SOYA/MAÍZ EN EL SURESTE DE NIGERIA]

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SUMMARY

A field experiment was conducted during 2002 and 2003 cropping seasons to assess the effect of four N:P:K (20:10:10) fertilizer rates (0, 100, 200, 300 kg/ha) and two cropping systems (sole and intercrops) on the yield and productivity of the component. The treatments were laid out in a split plot arrangement in a randomised complete block design with three replications. The cropping systems were assigned to the main plots and the fertilizer rates were in the subplots. Intercropping reduced the yields of soybean and maize compared with their sole crops. Soybean yields were generally low due to the shading effect of the maize component. Applying fertilizer significantly increased the yield of the component crops in both seasons than when no fertilizer was applied. The results further showed that soybean benefited more from the highest rate (300 kg N: P: K/ha). There was no interaction between cropping system and fertilizer rate in both seasons. The productivity of soybean/maize mixture showed yield advantage of 68 (2002) and 79 % (2003). The highest monetary returns (₦72, 717.10 and ₦87, 165.40/ha) were achieved at the highest fertilizer rate used in the study in soybean/maize intercrop in both cropping seasons. This implies that the optimum productivity and monetary return of the mixture should be investigated beyond 300 kg/ha NPK fertilizer application.

Keywords: Soybean, maize, intercropping, fertilizer rate, productivity.

RESUMEN

Se evaluó el efecto de cuatro niveles de fertilización (0, 100, 200, 300 kg/ha) con N:P:K (20:10:10) y dos sistemas de cultivo (intercalado o cultivo único) sobre el rendimiento y productividad de los cultivos. El experimento se llevó a cabo durante las estaciones de cultivo 2002 y 2003. Se empleo un diseño de parcelas divididas donde la parcela principal fueron los sistemas de cultivo y las subparcelas los niveles de fertilización. El cultivo intercalado redujo el rendimiento de la soya y el maíz. El rendimiento de la soya fue menor principalmente debido al efecto de sombreado del maíz. La aplicación del fertilizante incremento el rendimiento de ambos cultivos. La fertilización a nivel altos (300 kg N:P:K) fue más benéfica para la soya. No se encontró interacción entre el sistema de cultivo y la fertilización. La productividad del cultivo soya/maíz fue superior en 68 (2002) y 79% (2003). El mayor retorno de capital se obtuvo con la mayor tasa de aplicación de fertilizante en el cultivo soya/maíz. Los resultados implican que la productividad optima del cultivo soya/maíz en el sureste de Nigeria debe ser investigada con niveles de fertilización superiores a los empleados en el presente trabajo.

Palabras clave: Soya, maíz, cultivo intercalado, tasa de fertilización, productividad.

INTRODUCTION

Intercropping, which is the growing of two or more crops simultaneously during the same season on the same piece of land is a common feature of production in the developing countries including Nigeria (Harris et al., 1987; Geiler et al., 1991 and Ekanayake, 1995). The system serves as a viable strategy for higher total crop yield and insurance against crop failure, provides for efficient resource use, reduces cost of production and increases monetary returns to the farmers (Ezulike et al., 1993; Omotunde, 1996; Muoneke and Asiegbu, 1997 and Mbah et al., 2003). Soybean production in the farming system of south eastern Nigeria is gaining increased awareness as a good source of human protein food and animal feed, and for soil conservation and fertility maintenance (Edwards, 1989). Maize, which is an important carbohydrate is a major source of energy for man and his livestock and is one of the most dominant and main crop component in intercropping situations in south eastern, Nigeria (Ikeorgu and Iloka, 1994). A number of studies have shown the importance of intercropping non-legumes with legumes aimed at maximizing the complementary effects between them in order to increase their yields. According to Chiezey and Yayock (1991) the use of improved varieties and inorganic fertilizers to maintain high yields of soybeans has become increasingly important due to poor yield associated with increasing pressure on arable land and diminishing soil fertility in relation to crop production in south eastern Nigeria.

Weiss (1983) concluded that extravagant use of fertilizers through large applications may result in increased rate of removal of trace elements in the produce. Hence, fertilizers must be efficiently and judiciously used in order to avoid wastes. In the forest agro-ecological zone of southeast, Nigeria fertilizer rate experiments with soybean have been limited to phosphorus (Onunka and Ugbaja, 1995; Ochulor, 1999) and nitrogen and potassium (Okpara et al., 2002). There is paucity of literature on the rate of NPK fertilizer required by the component crops in a soybean/maize intercropping system. Therefore, more research information is necessary for advising the farmers on appropriate use of NPK fertilizer in legume/non-legume cropping systems.

This study was carried out to determine the response of soybean and maize mixture to NPK fertilizer application and the most appropriate rate required by the component crops in the intercropping system.

MATERIAL AND METHODS

Field experiments were conducted in 2002 and 2003 cropping seasons at the Michael Okpara University of Agriculture, Umudike Research Farm (05º 29´ N, 07º 33´ E, 122 m above sea level) in the rainforest agro-ecological zone, southeastern Nigeria. The experimental site had total rainfall of 2352.4 mm in 137 rain days and 2241.3 mm in 133 rain days in 2002 and 2003, respectively. The soils of Umudike are formed on a coastal plain sand deposit (Arenic hapludult) (Obasi et. al., 2005). The study was conducted in a sandy loam soil characterised as ultisol (Agboola, 1979) with physico-chemical properties as follows: Soil P^H 4.8 and 4.6 (1:2.5; soil : water), organic matter 2.13 and 2.16 %, total N 0.08 and 0.07 %, available P 17.0 and 17.82 cmol (+)/kg, exchangeable K 0.14 and 0.13 mol. (+)/kg, base saturation 48.07 and 49.75 %, effective CEC 3.87 and 3.86 mmol (+)/100 g for 2002 and 2003, respectively.

The land was slashed, ploughed and harrowed twice with a disc harrow. After the experimental area had been ploughed, stumps of weeds that were not properly buried were removed manually to achieve a clean and weed free level field for planting. The plot size was 3.0 m x 2.0 m (6.0 m^2).

A medium maturing soybean variety (TGX- 1485- 1D) obtained from National Cereals Research Institute, Badeggi, Nigeria was used for the experiment. The maize variety used was Tropical Zea Early Streak Resistant Yellow (TZESR-Y) obtained from the International Institute of Tropical Agriculture, (IITA), Ibadan, Nigeria. It is an early maturing variety with medium sized, yellow and dented grains. The treatments consisted of factorial combinations of four rates of N:P:K 20:10:10 (0, 100, 200 and 300 kg/ha) and two cropping systems (sole crop soybean or sole crop maize and soybean/maize intercrop in alternate rows) in randomised complete block design with three replications. All possible combinations of N:P:K fertilizer treatments and two cropping systems for each component were laid out in a split plot arrangement. The cropping systems and fertilizer rates were assigned to the main-plots and sub-plots, respectively. Soybean and maize seeds were sown manually the same day at three seeds per hole on 3 August, 2002 and 1 August, 2003. The component crops (soybean and maize) were thinned to one per stand two weeks after planting (WAP) to achieve 266,000 plants/ha (0.75 x 0.05 m) and 53,000 plants/ha (0.75 x 0.25 m), respectively. The fertilizer rates were applied 3 WAP by band placement. Two hoe weedings, each at 3 and 8 WAP were done during the period of the experiment. Soil mounds were built around the plant stands at each weeding. Carbofuran (Furadan) 3G was applied to maize stands, one week after emergence at the rate of 750 g a.i per hectare to control stem borer (*Busseola fusca*).

The yield and yield components of soybean and maize taken from five and three plants respectively were randomly sampled from the two central rows of each plot. Harvesting of soybean was at16 WAP. The pods were threshed after sun drying. Harvest maturity in soybean was determined as when the plants had turned brown according to Johnson and Major (1978) while that of maize was at black layer formation. Maize was harvested 15 WAP. Data on number of pods per plant and weight of seeds per plant in soybean and number of grains per cob in maize as well as 100-seed weight and grain yield in both component crops were collected for evaluation.

The data were statistically analysed separately for each crop using the procedure outlined by Gomez and Gomez (1984) for a factorial experiment in a split plot design and significant mean differences were detected by Fisher's least significant difference (FLSD) at $P < 0.05$ according to Carmer and Swanson (1971).

The productivity from the mean yield data of both sole and intercropping system was determined by the land equivalent ratio (LER), which is the sum of the ratio of the yields of the intercrops to those of the sole crops (Trenbath, 1974; Fisher, 1977; Mead and Willy, 1980) and area x time equivalent ratio (ATER) (Hiebsch and McCollum, 1987).

ATER = {(Rys x ts) + (Rym x tm) / T},

Where;
Rys and Rym = relative yields of soybean and maize, respectively;
ts and tm = maturity periods of soybean and maize, respectively;
T = duration of the intercropping system.

Competition coefficient (C) was calculated according to Okigbo (1979).

C = (Relative crowding coefficient (RCC) of a given crop in the mixture)/(sum of RCC for all crops in the mixture)

Where;
RCC assumes that each crop species in a mixture has its own coefficient (K), which gives a measure of the yield advantage when two species are grown together. If the species has a coefficient less than, equal to, or greater than one it means it has produced less yield, the same yield, or more yield than the expected yield, respectively.

Monetary equivalent ratio (MER) was determined by the method of Adetiloye (1989).

MER = $(r_1 + r_2) / R$,

Where;
r_1 and r_2 = monetary returns of component crops in the mixture,
R = higher sole crop monetary return compared with the other.

Gross returns of the component crops were assessed based on the prevailing market prices.

RESULTS AND DISCUSSION

Soybean yield

Cropping system significantly ($P < 0.05$) affected number of pods per plant and grain yield of soybean in both seasons but had no effect on 100-seed weight in the two cropping seasons (Table 1). However, seed weight per plant was significantly ($P < 0.05$) influenced by intercropping in 2002. These yield responses variables showed higher values in sole soybean compared to soybean intercrop in both years. The results agreed with the findings of Enyi (1973) and Fisher (1977) in maize-cowpea mixtures as well as Olasantan and Lucas (1992) in maize-melon, and Lesoing and Francis (1999) in corn-soybean and sorghum-soybean intercrops that the sole crop components yielded higher than the corresponding crops in intercropping situation. In 2002 and 2003, the results showed that the rate of fertilizer applied in the cropping system significantly ($P < 0.05$) affected number of pods per plant, seed weight per plant, 100-seed weight and grain yield in soybean. These yield and yield components increased with increase in NPK fertilizer application from zero to the highest rate (300 kg/ha) used in the study. Similar positive response of soybean to NPK fertilizer application had been observed by some workers (Bhango and Albritton, 1972; Mandimba and Mondibaye, 1996). In addition, Kang (1975) reported a significant linear increase in yield of soybean to nitrogen (N) applied at 0, 30, 60 and 120 kg N/ha but noted that N at 30 kg/ha with inoculation gave significantly higher yields. Okpara et al. (2002) in their study with straight nitrogen within the range (0-100 kg N/ha) and potassium (0-80 kg K_2O/ha) fertilizers in the humid rainforest zone reported high response of soybean to fertilizer application and concluded that nitrogen alone was very effective in increasing soybean yield, with application of up to 100 kg N/ha. Similar work by Chiezey (2001) in the guinea savanna showed increased soybean grain yield with increased nitrogen fertilizer application from 0 to 80 kg N/ha. The results of the present investigation showed that soybean benefited more from the highest fertilizer range (300 kg NPK/ha) in the two seasons, hence, corroborate these reports.

The zero NPK treatment gave the least yield and yield components assessed. The soil analyses not before the experiment showed very low nutrient levels in the soils, therefore, it was surprising that yields would be low with these poor soils. In the cropping seasons, soybean yields were generally low due to the shading effect by the taller and faster growing maize component and heavier rainfall, which might have caused leaching of nutrients as well as competition for nutrients and space between the component crops. The results supported the findings of Mann and Jaworski (1970) as well Schou et al. (1978), which showed that shading of soybean plants resulted in abscission of half the pods and invariably leads to lower yields. Also, the reduction in seed yield could be attributed to the presence of higher number of empty, immature or poorly filled pods.

The interaction effect of cropping system and fertilizer rate was not significant in the yield components assessed (number of pods per plant, weight of seeds per plant, 100-seed weight) and grain yield in both seasons. Averaged over the two cropping seasons, the lowest number of pods per plant (31.88), seed weight per plant (3.44 g) and 100-seed weight (6.96 g) were obtained in intercropping at zero level of N: P: K fertilizer application while the highest values (78.98), (11.00 g) and (12.49 g), respectively were obtained under sole cropping at 300 kg/ha NPK fertilizer. The others fell between these values.

Considering the yield values obtained in soybean, fertilizer used for the crop in the mixture could not be optimized by applying 300 kg NPK/ha, which was the highest rate used in the study.

Maize yield

In 2002 and 2003, 100-seed weight was not affected by intercropping while number of grains per cob and grain yield were significantly ($P < 0.05$) affected by intercropping in both cropping seasons (Table 2). Maize yield and yield components (number of grains per cob and 100 grain weight) increased with increased application of NPK fertilizer in both seasons. Maize yields in the two cropping seasons were generally low due to low level of N-content in the soil as well as thick cloud cover, which interfered with the photosynthetic efficiency of the crop, which is a C_4 – plant characterised by high efficiency of light utilization (Uzo, 1983). Higher yield components of maize were recorded under sole cropping compared to intercropping indicating that crops in sole plots suffered less from competition. The implication of this finding from the study was that the nutrient requirements of soybean and maize in the intercropping system were higher than the nutrient need of either crop as sole crop. Baker (1979) also reported that the nutrient needs of the intercropping component crops were always higher than for each crop parameters measured. The number of grains per cob, 100 grain weight and grain yield increased with incremental rate of NPK fertilizer application in both cropping seasons. The number of grains per cob increased by 21, 48.5 and 57.5% in 2002 and by 32.5, 43.8 and 107.5% in 2003 with 100, 200 and 300 kg NPK/ha fertilizer applications, respectively over the control treatment. The corresponding values for increase in 100 grain weight were 7.4, 14.5 and 24.3% (2002) and 11.0, 14.8 and 16.3% (2003). Similarly, grain yield increased by 36.0, 50.2 and 71.9% in 2002 and 54.0, 62.0 and 84.2% with 100, 200 and 300 kg NPK/ha fertilizer applications, respectively over the control treatment. The increase in grain yield was due to the positive effect of fertilizer applications on the yield components (number of grains per cob and 100-grain weight). The interaction effects of cropping system and fertilizer rate on yield and yield components of maize were not significant in both years.

Assessment of the productivity of the mixture

The land equivalent ratio, area x time equivalent ratio, competition coefficient, monetary equivalent ratio and gross return were used to assess the productivity of the component crops in the intercrop (Table 3). In 2002 and 2003, intercropping resulted in yield advantage; the total land equivalent ratio (LER) was between 1.31 and 1.68 (2002) and 1.58 and 1.79 (2003) showing 31 % to 68 % (2002) and 58 % to 77 % (2003) yield advantages due to intercropping compared to sole crop of both soybean and maize. The highest LER was obtained in soybean and maize intercrop that received the highest fertilizer rate in the study (300 kg NPK/ha) in the two cropping seasons.

Table 1: Effect of cropping system and NPK fertilizer rate on yield and yield components of soybean in soybean/maize intercropping system in 2002 and 2003 cropping seasons.

	Number of pods per plant		Weight of seeds per plant (g)		100 seed wt (g)		* Grain yield (kg/ha)	
	2002	2003	2002	2003	2002	2003	2002	2003
Cropping system								
Sole soybean	54.67	67.14	8.65	7.24	8.06	9.99	521.76	601.80
Intercropped soybean	47.04	56.83	7.02	5.88	7.79	9.41	353.52	441.56
$FLSD_{0.05}$	3.557	4.240	1.333	1.876	ns	ns	35.86	33.12
NPK fertilizer rate (kg /ha)								
0	29.38	42.24	3.88	4.44	6.47	8.12	261.18	387.93
100	46.61	58.18	6.89	7.65	7.32	10.17	513.78	589.43
200	57.95	67.36	9.72	8.25	10.81	11.14	560.41	668.54
300	69.49	80.15	10.85	5.90	7.10	9.38	415.19	440.83
$FLSD_{0.05}$	5.030	5.997	1.886	2.653	2.202	2.104	50.71	46.84

* Grain yield at 13% moisture content

Table 2: Effect of cropping system and NPK fertilizer rate on yield and yield components of maize in soybean/maize intercropping system in 2002 and 2003 cropping seasons.

	Number of grains per cob		100 grain wt (g)		* Grain yield (kg/ha)	
	2002	2003	2002	2003	2002	2003
Cropping system						
Sole soybean	238.50	246.90	18.88	19.43	786.83	623.85
Intercropped soybean	212.50	224.60	17.53	17.83	684.53	561.75
FLSD $_{0.05}$	9.6	11.5	ns	ns	16.7	13.8
NPK fertilizer rate (kg /ha)						
0	165.15	152.60	16.25	16.85	527.27	394.90
100	200.35	202.20	17.45	18.70	716.90	608.65
200	245.35	271.60	18.60	19.35	792.00	640.05
300	290.15	316.60	20.20	19.60	906.55	727.60
FLSD $_{0.05}$	19.2	17.8	1.1	1.2	33.4	27.6

*Grain yield at 13% moisture content

On the basis of ATER, yield advantages accrued from intercropping soybean with maize, hence, in 2002 ATER increased with increase in NPK fertilizer rate up to 300 kg/ha. Similar trend was obtained in 2003. These productivity results (LER and ATER) support the findings by Allen and Our (1983) and Okpara (2000) in maize-cowpea intercrops, which showed yield advantages in the systems. The LER and ATER obtained in their respective intercropping studies indicated a greater productivity per unit area of land for the mixtures than when either of the two crops was grown separately. In 2002 and 2003, competition coefficient (C) favoured maize when compared with the soybean component probably because of more competitive ability of maize - a taller and C_4 plant with higher efficiency of light utilization (Palaniappan, 1985) than soybean – a C_3 plant growing under maize canopy and with less efficient light utilization. Assessing the monetary equivalent ratio (MER) (Adetiloye, 1989), the results showed that in either of the two years, incremental application of NPK fertilizer increased partial monetary equivalent ratio (PMER) of soybean up to the highest fertilizer rate applied in the mixture. Also, there was increased partial monetary equivalent ratio by maize with increased rate of NPK fertilizer within the range used in this study. However, the highest total monetary equivalent ratios (1.68 in 2002) and (1.87 in 2003) were obtained under 300 kg/ha NPK fertilizer, which was the highest rate.

In terms of the gross monetary returns (GRM), the mean obtained from intercropping soybean with maize was greater than that from sole soybean by 19 and 14 % in 2002 and 2003, respectively and greater than that from sole maize by 47 and 64 % in 2002 and 2003, respectively. Hedge and Reddy (1987) obtained the highest gross returns from the optimum mixtures of pigeon pea and sorghum than from their monocrops. Averaged over the two cropping seasons, the highest gross monetary return value was obtained under 300 kg/ha NPK fertilizer rate in soybean-maize intercrop (₦79, 941.25). This implies that yield and monetary returns of soybean and maize mixture were not optimized at the highest fertilizer rate used in the study.

CONCLUSION

The results of this study showed that soybean and maize could be intercropped. Based on yield and productivity advantage, especially optimum gross returns obtained from the intercropping situation fertilizer use for the component crops could not be optimized by applying 300 kg/ha NPK, which was the highest rate used in the study. This implies that yield increase should be expected beyond this level. Hence, the effect of different rates of NPK fertilizer on the growth, performance and yield of soybean and maize intercrop deserve further investigation using higher fertilizer rates.

Table 3: Effect of cropping system and NPK fertilizer rate on land equivalent ratio (LER), area x time equivalent ratio (ATER), competition coefficient (C), monetary equivalent ratio (MER) and gross monetary return (GMR) of soybean (S) and maize (M) in soybean/maize intercropping system in 2002 cropping season.

Cropping system x NPK fertilizer rate (kg/ha)	Land equivalent ratio			ATER	Competition coefficient		Monetary equivalent ratio			[5]Gross monetary return (₦/ha)		
	[1]Partial		[2]Total		[3]Partial				[3]Total	Partial		Total
	S	M			S	M	S	M		S	M	
Sole soybean x 0	-	-	-	-	-	-	-	-	-	25192.80	-	25192.00
Sole soybean x 100	-	-	-	-	-	-	-	-	-	48731.20	-	48731.20
Sole soybean x 200	-	-	-	-	-	-	-	-	-	52578.40	-	52578.40
Sole soybean x 300	-	-	-	-	-	-	-	-	-	56460.80	-	56460.80
Sole maize x 0	-	-	-	-	-	-	-	-	-	-	22303.05	22303.05
Sole maize x 100	-	-	-	-	-	-	-	-	-	-	26400.50	26400.50
Sole maize x 200	-	-	-	-	-	-	-	-	-	-	28742.00	28742.00
Sole maize x 300	-	-	-	-	-	-	-	-	-	-	32711.00	32711.00
Soybean/maize x 0	0.66	0.65	1.31	1.31	0.50	0.50	0.29	0.45	0.74	16596.00	14605.50	31201.50
Soybean/maize x 100	0.69	0.90	1.59	1.59	0.43	0.57	0.59	0.73	1.32	33472.80	23782.50	57255.30
Soybean/maize x 200	0.71	0.93	1.64	1.64	0.43	0.57	0.66	0.82	1.48	37086.40	26698.00	63784.40
Soybean/maize x 300	0.74	0.94	1.68	1.68	0.44	0.56	0.74	0.94	1.68	41969.60	30747.50	72712.10

[1]Partial LER for soybean and maize were obtained by diving each intercrop yield by its corresponding sole crop yield.
[2]Total LER = Sum of the partial LERs from the two component crops in the intercropping system.
[3]Partial MER for soybean and maize were obtained by diving each intercrop MER by its corresponding sole crop MER.
[4]Total MER = Sum of the partial MERs from the two component crops in the intercropping system.
[5]Soybean and maize were at the prevailing market prices of ₦ 80/kg and ₦ 35/kg, respectively at the time of harvest in 2002.
1 US Dollar = ₦120.50 (Nigerian Naira) in 2002

Table 4: Effect of cropping system and NPK fertilizer rate on land equivalent ratio (LER), area x time equivalent ratio (ATER), competition coefficient (C), monetary equivalent ratio (MER) and gross monetary return (GMR) of soybean (S) and maize (M) in soybean/maize intercropping system in 2003 cropping season.

Cropping system x NPK fertilizer rate (kg/ha)	Land equivalent ratio			ATER	Competition coefficient		Monetary equivalent ratio			[5]Gross monetary return (₦/ha)		
	[1]Partial		[2]Total		[3]Partial					Partial		
	S	M			S	M	S	M	[3]Total	S	M	Total
Sole soybean x 0	-	-	-	-	-	-	-	-	-	40597.20	-	40597.20
Sole soybean x 100	-	-	-	-	-	-	-	-	-	60534.90	-	60534.90
Sole soybean x 200	-	-	-	-	-	-	-	-	-	68284.80	-	68284.80
Sole soybean x 300	-	-	-	-	-	-	-	-	-	68832.00	-	68832.00
Sole maize x 0	-	-	-	-	-	-	-	-	-	-	16948.00	16948.00
Sole maize x 100	-	-	-	-	-	-	-	-	-	-	25900.00	25900.00
Sole maize x 200	-	-	-	-	-	-	-	-	-	-	26808.00	26808.00
Sole maize x 300	-	-	-	-	-	-	-	-	-	-	30160.00	30160.00
Soybean/maize x 0	0.72	0.86	1.58	1.58	0.46	0.54	0.45	0.49	0.94	29230.20	14644.00	43874.20
Soybean/maize x 100	0.75	0.88	1.63	1.63	0.46	0.54	0.73	0.76	1.49	45561.60	22792.00	68353.80
Soybean/maize x 200	0.76	0.91	1.67	1.67	0.46	0.54	0.82	0.81	1.63	52142.40	24396.00	76538.40
Soybean/maize x 300	0.86	0.93	1.79	1.79	0.48	0.52	0.94	0/93	1.87	59117.40	28048.00	87165.40

[1]Partial LER for soybean and maize were obtained by diving each intercrop yield by its corresponding sole crop yield.
[2]Total LER = Sum of the partial LERs from the two component crops in the intercropping system.
[3]Partial MER for soybean and maize were obtained by diving each intercrop MER by its corresponding sole crop MER.
[4]Total MER = Sum of the partial MERs from the two component crops in the intercropping system.
[5]Soybean and maize were at the prevailing market prices of ₦ 90/kg and ₦ 40/kg, respectively at the time of harvest in 2003.
1 US dollar = ₦128.50 (Nigerian Naira) in 2003.

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