

Productivity of Intercropped Plantain-Soybean in Southwestern Nigeria

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ABSTRACT

False Horn plantain planted at 1600 plants/ha was intercropped with soybean densities of 83200-208000 plants/ha for two consecutive seasons. Weed cover was decreased by 45% on intercropped plots. Seed yield of intercropped soybean was reduced by 47% when introduced at the plantain vegetative phase. Intercropping at the plantain flowering stage did not significantly affect soyseed yield of intercropped soybeans. Plantain growth and bunch weight were not significantly influenced by intercropping with soybeans. The land equivalent ratio for the intercrops with soybean densities of 83200, 124800, 166400 and 208000 plants/ha were 1.34, 1.79, 1.73 and 1.84 respectively. These results indicate that mixed plantain-soybean cropping is very productive, especially with high soybean densities.

KEYWORDS

Plantains, soybeans, Nigeria, mixed cropping, planting density, plant production.

Productivité de l'association bananier plantain-soja dans le sud-ouest du Nigéria.

RÉSUMÉ

Des bananiers plantains Faux Corne ont été plantés à raison de 1600 plants/ha en culture associée avec du soja (densités : 83200 à 208000 plants/ha) pendant deux saisons consécutives. La densité de mauvaises herbes dans les parcelles intercalaires a diminué de 45 %. Lorsque le soja a été planté pendant la phase végétative des bananiers, sa production de graines a été réduite de 47 %. En revanche, lorsque son introduction a été faite à la floraison des plantains il n'y a pas eu d'effet significatif sur la production de graines. La croissance et le poids des régimes de bananes ne sont pas influencés de manière significative par la présence du soja. Les rapports de production par unité de terrain ("Land Equivalent Ratio") des cultures associées varient de 1,34 à 1,84 selon les densités de plantation du soja. Ces valeurs indiquent que l'association plantain-soja est très productive spécialement quand la densité de plantation du soja est élevée.

MOTS CLÉS

Banane plantain, soja, Nigéria, culture en mélange, densité de plantation, production végétale.

Productividad de la asociación plátano-soja en el sudoeste de Nigeria.

RESUMEN

El plátano Falso Cuerno fue sembrado a razón de 1600 plantas/ha en asociación con soja (densidad : 83200 a 208000 plantas/ha) durante dos ciclos consecutivos. La presencia de malas hierbas en las parcelas en asocio disminuyó un 45 %. La producción de granos de soja disminuyó un 47 % cuando el cultivo fue introducido en la fase vegetativa del plátano. En contraste, la producción de granos de soja no disminuyó cuando esta fue introducida al momento de la floración en los plátanos. El crecimiento y el peso de los racimos en el plátano no fueron influenciados significativamente por la presencia de la soja. El valor de producción por unidad de terreno en el asocio de los cultivos varió de 1,34 a 1,84 según las densidades de plantación en la soja. Estos valores indican que la asociación plátano-soja es bastante productiva, especialmente cuando la densidad de plantación en la soja es alta.

PALABRAS CLAVES

Plátano, soja, Nigeria, cultivo mixte, densidad de plantación, producción vegetal.

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•••• introduction

Plantain (*Musa* AAB) is a staple foodcrop of the wet lowlands of western Africa (OKIY, 1960; KARIKARI and AGYEPONG, 1983). It is usually grown as a shade crop in cocoa and coffee plantations, or intercropped with other foodcrops such as maize, cassava, cocoyam and assorted vegetables (OBIEFUNA *et al.*, 1991; LACHENAUD, 1987; YAO, 1988; OLAKODUN, 1990).

Although mixed plantain-legume crops are hardly featured in western African systems, they are prominent in farming systems of the bimodal highlands of eastern and central Africa, and are reputed to be sustainable.

The steady human population growth in the wet lowlands of western Africa marks the need for better farming systems that combine high productivity with sustainability.

Although plantain-foodcrop and plantain-treecrop systems are highly productive (DEVOS and WILSON, 1979; YAO, 1988), such systems probably cannot remain sustainable without regular applications of organic manure.

Since organic manure supplies from traditional sources are often limited, it is necessary to design systems with in-built mechanisms to assure sustainability and high productivity.

Some tropical grain legumes are reported to contribute to the nitrogen economy of subsequent crops (DE *et al.*, 1983). HALLIDAY (1982) considered that introducing legumes into cropping systems could help stabilize cereal grain productivity.

The present study was aimed at attaining high stable plantain productivity when intercropped with grain-legumes.

Soybean (*Glycine max* L. Merr.) was selected to be intercropped with plantain since it is a multipurpose legume with a ready market, thus making it attractive for farmers (AJAYI-OBE, 1992). Productivity results obtained during the first two seasons of the study are presented.

•••• materials and methods

The study was conducted on the experimental site at the National Horticultural Research Institute, Ibadan (Nigeria), in the rain forest zone. The soil at the site was sandy clay loam (Table 1). False Horn cv Agbagba plantain suckers, spaced at 2.5 × 2.5 m, were planted in July 1989 and 1990, intercropped with four populations of soybeans cv TGX 536-02D. In 1989, the soybean intercrop was introduced one week after planting the plantain suckers; in 1990, it was introduced at the plantain flowering stage.

The four soybean populations were planted at 83 200, 124 800, 166 400 and 208 000 plants/ha. This was achieved by planting, between the rows of plantain, 2 rows of soybeans 1 m apart, 3 rows 0.8 m apart, 4 rows 0.6 m apart and 5 rows 0.5 m apart, respectively. Intra-row spacing was 0.1 m. As controls, a plantain monocrop and a monocrop of each of the four soybean populations were grown. Treatments were set up according to a randomized complete block design with three replications. Plantain received 710 kg/ha NPK 15-15-15 and 80 kg/ha muriate of potash.

Soybeans received 50 kg/ha NPK 15-15-15 in the first season and 120 kg/ha NPK 15-15-15 plus 24 kg/ha single super phosphate in the second season. Plantain leaf area was estimated using the model $Y = 0.65X - 0.22$ ($r = 0.97$) developed by AIYELAAGBE (1991): X = mid rib length (m), Y = lamina area (m²). Weed density on the plots was assessed according to dry weight of weeds collected with two throws of a 1 m² wooden quadrat at the soybean flowering stage.

Plantain was harvested at the mature green fruit stage, while soybeans were harvested at the brown pod stage. The land equivalent ratio (LER) was calculated by pooling yields of plantain parent plants for the two years of the study and those of soybean for the same period. Cash advantage due to intercropping (CAI) was calculated as the difference between revenues obtained from the

plantain monocrop and revenues from the mixed plantain-soybean crops. Prices used were based on 1992 market values in Ibadan. Plantain averaged 7.00 N/kg, while soybean averaged 5.00 N/kg. One Naira (N) was equivalent to \$0.06 during the study period. Rainfall data for the study period are given in Table 2.

●●●● results

vegetative growth

In both trials intercropping did not significantly affect plantain growth (Table 3) or any of the soybean growth parameters, except for total dry matter yield in the 1989 trial. Planting density did not significantly influence vegetative growth in soybeans.

weed density

Intercropping plantain significantly reduced weed cover on the plots by 45%. Soybean planting rates of 124800-208000 plants/ha provided much better weed control than the rate of 83200 plants/ha (Table 4).

crop yields

Intercropping did not have a significant effect on plantain bunch weight. However, intercropping significantly decreased soybean yields by 47% in the 1989 trial, but not in the 1990 trial. When the results for both years were pooled, intercropping with plantain reduced soybean yields by 19%. Planting density did not significantly influence soybean seed yield in the 1989 trial, but it significantly increased seed yield in the 1990 trial (Table 5).

productivity of mixed crops

Land equivalent ratios (LER) for the mixed plantain-soybean crops increased as the soybean populations in the mixture increased (Table 6). There were no clear trends for cash advantage due to intercropping (CAI), but values were highest for plantain intercropped with soybeans at 208000 plants/ha.

Table 1
Characteristics of soil used.

Sand (%)	Silt (%)	Clay (%)	OM (%)	Particle size distribution					
				Total N (%)	AVP (ppm)	K (meq /100g)	Ca (meq /100g)	Mg (meq /100g)	Ech Acidity
66	14	20	3.49	0.13	1.79	0.31	1.80	0.94	0.20

Table 2
Rainfall distribution at study site (mm).

Year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
1989	0.0	20.6	56.9	202.7	267.8	159.5	168.8	168.8	157.7	146.1	0.6	0.0
1990	20.3	29.3	5.6	187.1	175.7	114.4	220.2	65.4	206.0	197.6	43.1	33.0

Table 3
Growth and yield response of plantain to intercropping with different soybean populations.

	Soybean population/ha				
	0	83 200	124 800	166 400	208 000
Plant height (m)	1.72	1.70	1.98	1.74	1.69
Canopy diameter (m)	2.43	2.46	3.05	2.61	2.17
Leaf number	10	10	11	10.7	10
Leaf area (m ²)	7.52	6.18	12.0	7.33	6.31
Fruit weight (t/ha)	12.9	11.9	12.7	10.4	14.4

Table 4
Effect of soybean population and intercropping soybeans with plantain on weed density on plots (dry weight g/m²).

Cropping system	Soybean population/ha				Pooled mean (cropping system)
	83 200	124 800	166 400	208 000	
Monocropping	26.0	12.0	12.0	4.0	13.5
Intercropping	21.3	3.7	2.3	2.7	7.5
Pooled mean (population)	23.7	7.9	7.2	3.4	

LSD : least significant difference between means.

LSD (p = 0.05) for comparing effect of cropping system = 5.6.

LSD (p = 0.05) for comparing effect of soybean population = 7.9.

Table 5
Effects of intercropping plantain with different soybean populations on soybean seed yield (t/ha).

Cropping system	Soybean population/ha				Pooled mean (cropping system)
	83 200	124 800	166 400	208 000	
1989					
Monocropped	1.85	1.30	1.00	2.06	1.55
Intercropped	0.60	0.75	1.14	0.81	0.83
Pooled mean (population)	1.23	1.03	1.07	1.44	
1990					
Monocropped	0.75	0.95	1.83	1.73	1.32
Intercropped	0.50	1.08	1.50	3.05	1.5
Pooled mean (population)	0.63	1.02	1.67	2.39	
Total for 1989 & 1990	1.86	2.05	2.74	3.83	

LSD : least significant difference between means.
LSD (p = 0.05) for comparing effect of intercropping in 1989 = 0.04.
LSD (p = 0.05) for comparing effect of soybean population in 1990 = 0.57.

Table 6
Productivity indices of mixed plantain-soybean crops.

Cropping system	Soybean population/ha			
	83 200	124 800	166 400	208 000
Plantain yield (t/ha)*	11.9	12.7	10.4	14.4
Soybean yield (t/ha)**	1.1	1.83	2.64	3.86
LER	1.34	1.79	1.73	1.84
CAI (N/ha)	-1 470	7 750	-43 000	29 800

LER : land equivalent ratio.
CAI : cash advantage due to intercropping.
N = Naira, N 1.00 = \$0.06
* Yield of plantain monocrop = 12.9 t/ha
** Grain yields of intercropped soybeans pooled for the 1989 and 1990 seasons.

•••• discussion

The absence of significant effects of intercropping on plantain growth and yield is in agreement with prior results of other investigators (DEVOS and WILSON, 1979; RAO and EDMUNDS, 1984; RODRIGUES and MORALES, 1988). The fact that there were no significant decreases in plantain yields

suggests that populations of intercropped soybeans were sub-optimal, thus available growth resources could support both crops.

Yield decreases in intercropped soybeans were due to shading effects of the large plantain leaves, hindering light transmission to the floor, thus reducing photosynthesis and pod set in the soybean plants. OLUFAJO (1992) observed similar yield decreases in mixed soybean-maize crops. During the second season, the absence of significant yield reductions in intercropped soybean was the result of better light transmission to the floor level. This was due to the decreased plantain leaf area following leaf senescence and black Sigatoka infection which necessitated some leaf pruning.

The LER results indicated that the plantain-soybean combination is beneficial. The trends suggest that the productivity of these mixed crops could be further increased by planting at higher soybean densities than in the present study. The results on the revenue aspects of the mixed crops were inconclusive since there were no clear CAI trends.

•••• conclusion

Plantain planted at the recommended spacing of 2.5 x 2.5 m can be intercropped with soybeans up to 208 000 plants/ha without any significant plantain yield loss. The added advantages of good weed control and modest soybean yields should make the combination attractive to farmers. ●

•••••••••• acknowledgement

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