African Journal of Biotechnology Vol. 6 (16), pp. 1885-1887, 20 August 2007
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2007 Academic Journals

Short Communication

Intercropping soybean and maize in a derived savanna ecology

J. A. RAJI

Institute of Agricultural Research and Training, Obafemi Awolowo University, P. M. B. 5029, Moor Plantation, Ibadan, Nigeria. E-mail: dr_raji@excite.com.

Accepted 23 April, 2007

Compared to sole soybean, intercropping soybean and maize on flat and ridge reduced yields by 1.0 – 29.1% and 29.4 - 40.2% respectively. In maize, intercropping on flat and ridge reduced yields by 13.2 - 25.2% and 24.8 - 43.5% respectively. Planting sole soybean on ridge enhanced mean yield by 18.6% as compared to the sole crop yield on flat. Conversely, planting sole maize on flat enhanced grain yield by 2.8%. Intercropping soybean and maize on flat resulted in optimum yields. The maximum combined intercrop revenue from maize and soybean was from inter + intra-row planting arrangement on flat. However, it was less than total revenue from sole soybean on ridge by 5.88%.

Key words: Intercropping, flat, ridge, yield, soybean, maize.

INTRODUCTION

Soybean (*Glycine max*) cultivation in Nigeria has assumed a wider scope as a result of its nutritive and economic importance, and the diverse domestic usage. Also, it has been found agronomically compatible with other common arable crops. In the tropics, smallholdings are planted to a mixture of crops. This is because farmers operate under subsistence conditions. Since the introduction of soybean to Nigerian farmers, various attempts have been made to include it in various crop types like cereals and tubers.

Nigeria is the largest producer of soybean in West and Central Africa (Root et al., 1987). However, there is the need to evolve better and simpler planting techniques to enhance yields in peasant farming systems. Such methods must aim at upgrading rather than replacing farmer's approaches to farming and they must also compete favorably with other crops. This is especially important because the bulk of soybean production in Nigeria takes place on flat or on ridges. Intercropping per se has been found to reduce pests and diseases on soybean (AVRDC, 1981 a, b; Van der Goot, 1930). It is therefore the objective of this investigation to assess the performance, grain yields and economic returns from intercropped soybean and the component crop on flat and ridge.

MATERIALS AND METHODS

The experiment was conducted at Ilora Experimental Station of the Institute of Agricultural Research and Training, Obafemi Awolowo University. The station represents the derived savanna zone of south Western Nigeria. Maize variety TZ (E) SR (W) was intercropped with soybean variety TGX 356-02D in a randomized complete block design with soybean as the major crop. There were ten treatments comprising sole soybean on flat and on ridge, sole maize on flat and ridge, inter-row arrangement on flat and on ridge, intra-row arrangement on flat and on ridge, inter + intra-row arrangement on ridge and flat. Plot size was 5 m x 5 m. Five ridges were made per plot for treatments which require such. Each treatment was replicated four times while spacing of 1 m x 1 m and 50 cm x 5 cm was used for maize and soybean, respectively. Planting of both crops was simultaneous. On a ridge, two soybean rows were planted, one at a side, thus making ten rows per plot. However in the inter + intra-row arrangement on ridge, an additional row of soybean was planted on the crest of the ridge, to make 15 rows of soybean. In the intra-row arrangement, maize was planted within only one row of soybean at the side of each ridge. NPK 15 – 15 – 15 fertilizer was applied to maize at 200 kg/ha while 100 kg/ha of single super phosphate was applied to soybean. Both fertilizers were applied at one week after planting. At tarselling, 100 kg/ha of urea was again applied to maize. Herbicide application was carried out at planting, using a mixture of Gramoxone (Paraquat) and Galex at the rate of 7.5 ml/litre of water each. This was followed by two hand weeding before plant harvest. At maturity, five samples per treatment were taken per plot for assessment of yield parame-

Table 1. The effects of intercropping on soybean and maize yields (t/ha).

Treatments	2002			2003			Mean		
	Soybean	Maize	LER	Soybean	Maize	LER	Soybean	Maize	LER
Sole Crop on flat	0.83	2.01		0.89	1.63		0.86	1.82	
Sole Crop on Ridge	0.76	1.40		1.28	2.15		1.02	1.77	
Inter-row arrangement on flat	0.72	1.60	1.70	0.64	1.16	1.4	0.68	1.38	1.6
Inter-row arrangement on Ridge	-	-	-	0.87	1.87	1.5	-	-	-
Intra-row arrangement on flat	0.68	1.45	1.5	0.82	1.71	1.9	0.75	1.58	1.7
Intra-row arrangement on ridge	0.72	1.09	1.2	0.50	1.57	1.1	0.61	1.33	1.2
Inter + Intra-row arrangement on flat	0.67	1.09	1.4	1.03	1.64	2.2	0.85	1.36	1.7
Inter + Intra-row arrangement on ridge	0.68	1.03	1.6	0.75	0.97	1.0	0.72	1.00	1.3
Mean	0.72	1.38		0.85	1.60				
C.V. (%)	23.09	7.25		27.09	25.10				
S.E.	4.1	0.7		4.0	0.7				

ters. The mean seed yield from five plants constitutes the seed weight per plant; plant height was mean measurement from the butt to the apex of five plants; while 100 seed weight was the weight of 100 seeds from each treatment. The remaining plants were bulked for seed yield.

The relative yield estimates were based on de Wit and Van den Bergh (1965) and was defined as

Relative Yield (RY) = O/M

where O is the yield of the species in the mixtures and M is the monoculture yield of the species. The Land Equivalent Ratio (LER) is the sum of the Relative Yields of the component crops i. e.

LER = LER = Rya + Ryb = Oa/Ma + Ob/Mb

where Rya is the relative yield of crop A in the mixture, Ryb is the relative yield of crop B in the mixture; Oa and Ma are the mixture and monoculture yields of soybean while Ob and Mb represent the mixture and monoculture yields of maize. The revenue per acre was based on the prevailing prices at harvest. The comparison of yield parameter on both flat and ridge was based on the average of five plant samples randomly collected from alternate rows in each plot.

RESULTS AND DISCUSSION

Intercropping soybean and maize on flat reduced yields by 13.3 and 20.4%, respectively, when compared to sole crop yields in the first year. Planting sole soybean and sole maize on ridge reduced yields by 8.4% and 30.3% as compared to the flat land in 2002. The intra-row arrangement of soybean and maize on flat reduced yields by 18.1 and 27.8% respectively; on ridge, the reductions were 13.3 and 45.8%.

In 2003, inter + intra-row planting arrangement of soybean on flat enhanced yield by 15.7%. On ridge, soybean yield reduction was 32.0 - 62.9%. However, the intra-row arrangement of maize on flat enhanced maize yield by 4.9% but reduced its yield by 13.0 - 55.0% on ridge.

The yield reduction in soybean caused by the maize intercrop was in agreement with the report of other workers (Singh et al., 1973; Dallal, 1977; Mohta and De, 1980). The yield reductions in intercropped maize agreed with similar findings by Olufajo (1992) and Finlay (1975) but contrasted with reports by other workers (Singh et al., 1973; Whigham and Bharati, 1983) who did not record any reduction in the yield of corn even at 40,000 plant/ha when intercropped with soybean.

Irrespective of land preparation, the Land Equivalent Ratio (LER) indicated advantages in the various intercropping systems (Table 1). In 2002, the LER was maximum in the inter-row arrangement on flat and was maximum in the inter-intra-row arrangement on flat in 2003. However, in 2003, the intra-row arrangement on flat ranked next (LER + 1.9) to the inter + intra-row arrangement on flat (LER = 2.2)

Over the years the mean intra-row arrangement on flat and the combined inter + intra-row arrangement on flat produced the maximum land use efficiency (LER = 1.7). Thus, both planting techniques are recommended to the farmer. However, where the farmer places greater emphasis on soybean production, the inter + intra - row arrangement on flat is optimum because the mean soybean yield was 13.3% higher than in the intra-row arrangement. The additional rows of soybean on the crest of the ridge were not advantageous as the ridge only encouraged high vegetative growth of vines and leaves. The high LER values obtained agree with the results of Whigham and Bharati (1983), Carrangal (1983) who worked on Soybean/maize and rice based farming systems respectively.

In 2003, total revenue from intercropping was higher than in 2002. Income from soybean was generally higher than in maize, irrespective of when planting was on flat or ridge.

The revenue analysis of both crops indicated that sole soybean on flat and ridge gave higher total revenue than for sole maize in flat or ridge. Similarly, intercropped soybean resulted in higher total revenue than intercropped maize. In general, intercropping soybean resulted in reduction of revenue. Highest total revenue from intercrop-

ping was from inter + intra-row planting of soybean on flat. This was $160.00. However it was only 2.8% higher than revenue from sole soybean on flat and 17.5% less than revenue from sole soybean on ridge.

Total revenue from sole maize on flat or ridge was higher than from intercropped maize. However, revenue from sole maize on flat was 5.9% higher than for sole maize on ridge. Also, revenue from sole maize (on flat or ridge) was higher than from intercropped maize. Highest intercrop revenue from maize was from maize arrangement in the intra-row arrangement on flat and was $747.00 (44.1%) less than revenue from sole maize on flat. The combined revenue from intercropping on flat or ridge was however less than total revenue from sole soybean on ridge. However, combined revenue from intercropping using the inter + intra-row arrangement was the highest and was only 5.8% less than the highest revenue from sole soybean on ridge.

The analysis of yield parameter indicated significant differences in maize seed weight/plant, seed size and plant height ($P = 0.05$). Intercropping reduced maize seed weight, seed sizes and plant height on flat and ridge by 3.9 - 23.7% and 18.7 - 25.0% respectively. Intercropping maize on ridge also reduced height by 4.2 - 4.6% while the reduction on flat was insignificant. The seed weight reduction was highest in the inter + intra-row arrangement on flat while the least was the intra-row on flat. The maize seed size (100 seed weight) was reduced by 1.4 - 6.8% and 10.6 - 13.9% due to intercropping on flat and ridge respectively. The observed reduction due to intercropping explains the depressions in mean intercrop seed yield (Table 1). In soybean, seed weight/plant was reduced by 1.0 - 8.3% due to intercropping on flat and ridge respectively. Compared with the sole soybean seed sizes, intercropping on flat reduced seed size by 1.0 - 8.3%. The consequence of this is reduction in intercrop seed yields observed in Table 1. However, on ridge, the seed size increased by 1.6 - 8.0% ($P = 0.05$), implying that although intercropping soybean on ridge reduced seed yields as compared to sole crop, the seeds produced were robust or heavier than on the flat. Except in the intra-row arrangement on ridge, intercropping did not significantly affect soybean heights. The reduction was low (4.2 - 4.6%) on ridge and on flat. Therefore, intercropping has no significant effect on soybean heights.

Since the land use efficiency resulting from intercropping soybean and maize was advantageous, this cropping system should be encouraged in peasant farming. Intercropping both crops is a means of increasing nutrient availability in family diets. Soybean contains lysine which is the amino acid limiting in most diets (Weingartner, 1987) and also has trypotaphan and threomine which in addition to a mixed diet greatly improves the quality of the diet's protein and has been found important in infants, growing children and adults (Weingartner, 1987; Forman and Ziegler, 1979; Scrimshaw and Young, 1979). Maize on the other hand is a staple food consumed after processing into meal or flour (Okoruwa, 1995). However, it is low in protein, calcium, phosphorus and iron but rich in carbohydrate. From the study, a quick method of enhancing rural farm family living condition in terms of revenue generation and their food quality is to intercrop soybean and maize in either the intra-row on flat or the inter + intra - row pattern on flat.

REFERENCES

AVRDC (1981a). Progress report for 1979. Avian Vegetable Research Development Centre (AVRD), Shanhua. Taiwan. p. 107.

AVRDG (1981b). Progress report for 1980. Avian Vegetable Research Development Centre (AVRD), Shanhua. Taiwon. p. 110.

Carrangal VR (1983). Soybean in Rice-based farming system. The International Rice Research Institute (IRRI) Experience. In soybean In Tropical and subtropical cropping systems. Proc. Of a symposium. Tsukuba, Japan. Oct. 1.

Dallal RC (1977). Effect of intercropping of maize and soybean on grain Yield. Trop. Agric., (Trinidad) 54 (2): 189-191

De Wit, Van den Bergh JP (1965). Competition among herbage plants – Netherlands J. Agric. Sci. 13: 212-221.

Forman SJ, Ziagler EE (1979). Soy protein isolates, in infant feeding . In Wikcke HL, Hopkins DT, Waggle DH eds. Soy protein and Human Nutrition, New York, London, Academic Press pp. 79-99.

Mohta NK, De RP (1980). Intercropping maize and sorghum with soybeans. J. Agric. Sc. Camb, 95: 117-122.

Okoruwa AE (1995). Enhancing maize processing and utilization in West and Central Africa. In contributing to food self sufficiency: Maize Research and Development in West and Central Africa. Proc. Reg. Maize Workshop. 29 May – 2 June. IITA Cotonou. Benin Republic pp. 108-119.

Olufajo OO (1992) Response of soybean to intercropping with maize in a Sub-humid Tropical Environment. Tropical Oilseeds J. 1 (1) 27-33.

Root WR, Oyekan PO, Dashiell KE (1987). West and Central Africa: Nigeria sets example for expansion of soybean. In Soybeans for the Tropics Research Production and Utilization. p. 230.

Scrimshaw NS, Young VR (1979). Soy protein in human adult nutrition: Review with new data In Wilcke HL, Hopkins DT, Waggle DH, eds., Soy Protein and Human Nutrition, New York, London Academic Press.

Singh JN, Negi PS, Tripathi SK (1973). Study on the intercropping of soybean with maize and jowar. India J. Agron, 18: 75-78.

Weigartner KE (1987). Processing, Nutrition and Utilization of soybeans. In soybeans for the Tropics. Research, Production and Utilization. (Eds) SR Singh, KO Rechie, KE Dashiell. pp. 149-178.

Whigham DK, Bharati MP (1983) Soybean sole cropping and intercropping in Temperate and Subtropical Environments. In soybean in Tropical and Subtropical Cropping Systems. Proceedings of a symposium Tsukuba, Japan. pp. 137-147.

Van der Goot P (1930). Agronomyzid flies of some native legume Crops in Java. Tropical Vegetable Information Service, AVRD. p. 98 (Translated from Dutch).