

EFFECT OF INTRA - ROW SPACING ON THE PERFORMANCE OF POTATO/SOYBEAN INTERCROP IN JOS PLATEAU AREA

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ABSTRACT

A combination of four soybean intra-row plant spacings (5, 10, 15 and 20cm) and three potato intra-row spacings (30, 40 and 50cm) were used to determine the best plant spacing combination for optimum productivity of potato/soybean intercrop. Soybean was planted in furrows between ridges while potato was planted on ridge crests. The study was carried out in 1993 and 1994.

The results of combined analysis of 1993 and 1994 studies showed that changes in soybean intra-row spacing within 5 - 20cm had no significant effect on the yield of potato tuber.

Similarly, increasing potato plant spacing from 30cm to 50cm did not affect the yield of soybean seed. The lack of responses may be attributed to low plant competition resulting from the planting pattern used. Highest soybean seed and potato tuber yields were obtained at intra-row plant spacing combination of 5cm for soybean and 30cm for potato, and the spacing combination also gave the highest land equivalent ratio and economic returns.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is an important tuber crop in Nigeria. Although about 75% of the annual production of 500,000 tonnes in 1991 came from Jos Plateau (William, 1962; Okonkwo, 1995), potato is also grown in the Mambilla, Biu Plateaux and areas in the country north of latitude 11°N. A minimum temperature of 15°C is required for potato cultivation. In rainy and dry seasons, Jos,

Mambilla and Biu Plateaux satisfy this condition. Most areas north of latitude 11°N satisfy this requirement during the harmattan months (November - February) only.

A survey of the major potato producing areas in Jos Plateau showed that about 85% of the potato grown in rainy season is grown in crop mixture while 90% of the dry season potato is grown as sole crop (Okonkwo *et. al.*, 1995b). Hence, the need for potato based intercrop

studies.

Soybean (*Glycine max* L. Merrill), though widely grown in the middle belt of Nigeria, is a new crop in Jos Plateau. Because of the high protein and amino acid contents (Martin *et. al*, 1976), there are recent efforts by Nigerian Government and Private Organizations to increase the production of this crop for use as protein supplement in livestock feed and human food. Successful and increased production of both potato and soybean crops are especially important for most Nigerians who live on low protein diets. This study determined the plant spacing requirements of potato and soybean grown in a mixture.

MATERIALS AND METHODS

This study was carried out at Kuru, Jos Plateau, Nigeria in 1993 and 1994 to determine the plant spacing requirements of potato/soybean intercrop. Potato cultivar, Diamant, at three within-row plant spacings (30, 40 and 50cm) was intercropped with one soybean cultivar (TGX 995-22E) at four inter-row plant spacings (5, 10, 15 and 20cm). Potato was planted on the crest of ridges spaced one meter apart, while soybean was planted in alternate furrows between the potato ridges in double rows spaced 15cm apart. Soybean was planted two weeks after potato. Sole potato and sole soybean were planted to calculate land equivalent

ratios. Fertilizers were applied at the rates of 100kg each of N and P_2O_5 per hectare, and K_2O at 40kg per hectare. Plot size was 12m² and experimental design was randomized complete block with 4 replications. Weeding was done manually and Ridomil MZ was applied bi-weekly at 2.5kg per hectare to control potato blight (*Phytophthora infestans*). Germination counts were taken 4 weeks after planting, and final stand counts before harvest. After harvest, tubers were graded and weighed. Soybean seed yield was adjusted to 12.5% moisture. Land equivalent ratio was calculated, using the yields from sole and mixed crops. Net returns from the cropping system was also calculated.

RESULTS

Yield of Ungraded Potato Tuber and Tuber Per Square Meter

Yield of ungraded tubers and number per square meter generally declined with increase in intra-row potato plant spacing (Tables 1 and 2). Increasing soybean intra-row spacing from 5cm and 20cm did not significantly ($P = 0.05$) affect the yield of potato tuber or tuber number per square meter. Highest tuber yield of 12.6t/ha was obtained at potato and soybean intra-row

spacing of 30cm and 5cm respectively. Yield of sole potato tuber and tuber number per square meter were 11.85t/ha and 18.62, respectively.

Seed Yield of Soybean

Increasing soybean intra-row spacing from 5cm to 20m significantly reduced the seed yield by 32%. Similar increase in potato intra-row spacing had no significant effect on soybean yield (Table 3). Highest yield of soybean was obtained at soybean intra-row spacing of 5cm.

Soybean Yield Components

Among the yield components studied, number of pods per plant, seeds per pod, weight of pods per plant and weight of seeds per plant were all increased by increases in soybean intra-row spacing (Table 4). Soybean branches per plant was not

significantly ($P = 0.05$) affected by intra-row plant spacing, but there was an increasing trend in branch number per plant with increase in soybean and potato intra-row spacing (Table 4). Highest yields of the soybean yield components studied were obtained at the widest intra-spacing of potato (50cm) and soybean (15-20cm), Table 4.

Table 1: Effect of Potato and Soybean Intra-row Spacing on Ungraded Tuber Yield (t/ha)

Soybean Intra-row spacing (cm)	Potato Intra-row Spacing (cm)			Mean	LSD (0.05)
	30	40	50		
5	12.68	11.03	9.4	11.04	
10	11.52	10.22	10.04	10.59	
15	13.49	10.68	11.12	11.76	1.87
20	12.69	12.11	8.88	11.23	
Mean	12.59	11.01	9.86		
LSD(0.05)		1.61			

Table 2: Effect of Potato and Soybean Intra-row Spacing on Ungraded Tuber Number/m²

Soybean Intra-row spacing (cm)	Potato Intra-row Spacing (cm)			Mean	LSD (0.05)
	30	40	50		
5	19.33	15.41	12.72	15.82	
10	18.88	15.02	14.44	16.14	
15	21.51	15.79	14.41	17.23	3.08
20	20.59	18.25	12.34	17.06	
Mean	20.10	16.11	13.47		
LSD(0.05)		2.67			

Table 3: Effect of Potato and Soybean Intra-row Spacing on Seed Yield of Soybeab (t/ha)

Soybean Intra-row spacing (cm)	Potato Intra-row Spacing (cm)				LSD (0.05)
	30	40	50	Mean	
5	0.92	1.00	0.91	0.94	0.13
10	0.62	0.83	0.86	0.77	
15	0.65	0.62	0.67	0.65	
20	0.62	0.56	0.71	0.63	
Mean	0.70	0.75	0.78		
LSD(0.05)		0.11			

Table 4: Effect of Potato and Soybean Intra-row Spacing on the Yield Components of Soybean

Treatment Combinations (Intra-row Spacing)	No. of Branches per plant	No. of Pods per plant	No. of Seeds per plant	Pod weight per plant (g)	Seed weight per plant (g)
Potato 30cm x Soybean 5cm	1.60a	22.30a	1.74ab	8.83a	6.40a
Potato 30cm x Soybean 10cm	1.75a	19.65a	2.09bc	15.98ab	6.99ab
Potato 30cm x Soybean 15cm	2.15a	35.20ab	1.90bc	13.80ab	9.58b
Potato 30cm x Soybean 20cm	1.80a	30.60ab	2.10bc	14.33a	9.66b
Potato 40cm x Soybean 5cm	1.95a	20.90ab	1.79ab	9.34ab	6.45a
Potato 40cm x Soybean 10cm	2.75a	32.10b	1.80b	14.14ab	9.79b
Potato 40cm x Soybean 15cm	1.75a	30.25b	1.82b	15.03ab	10.47bcd
Potato 40cm x Soybean 20cm	2.55a	33.80b	1.60ab	15.00ab	9.87b
Potato 50cm x Soybean 5cm	2.35a	39.70c	1.54a	13.70ab	9.33b
Potato 50cm x Soybean 10cm	2.00a	38.05c	1.62a	15.46ab	10.58cd
Potato 50cm x Soybean 15cm	2.80a	41.45c	1.96bc	19.99c	13.67d
Potato 50cm x Soybean 20cm	2.55a	42.10c	2.21bc	19.64c	13.22d
Sole Soybean	2.60	27.15	1.74	13.55	9.62

Land Equivalent Ratio and Net Returns

Land equivalent ratio was not significantly affected by potato or soybean intra-row spacing (Table 5). Average LER in the study was 1.79.

Table 6 shows that net returns was affected by changes in potato and soybean yields. Factors which affected potato and soybean yield also affected net returns. Highest net returns was obtained at potato and soybean

spacings of 30cm and 5cm, respectively. Average net return from the potato/ soybean intercrop was ₦56,280.00 per hectare while that from sole potato crop was ₦49,580.00 per hectare.

Table 5: Effect of Potato and Soybean Intra-row Spacing on Land Equivalent Ratio (LER)

Soybean Intra-row spacing (cm)	Potato Intra-row Spacing (cm)			Mean	LSD (0.05)
	30	40	50		
5	2.08	2½ - 3	1.79	1.97	0.29
10	1.65	1.77	1.83	1.75	
15	1.84	1.62	1.73	1.73	
20	1.75	1.64	1.82	1.74	
Mean	1.83	1.77	1.79		
LSD(0.05)		0.24			

Table 6: Effect of Potato and Soybean Intra-row Spacing on Net Income (₦)

Soybean Intra-row spacing (cm)	Potato Intra-row Spacing (cm)			Mean	LSD (0.05)
	30	40	50		
5	71,160	59,240	44,760	58,387	
10	57,080	50,040	49,080	52,067	
15	73,320	50,360	54,680	59,453	10,238
20	66,440	61,800	37,400	55,213	
Mean	67,000	55,360	46,480		
LSD(0.05)		9,846			

DISCUSSION

The effects of potato and soybean intra-row spacings on ungraded tuber yield and tuber number per square meter in this study are consistent with the results of an earlier study on potato planting density which showed that tuber yield increased with increase in plant population up to a limit (Okonkwo and Ifenkwe, 1988). The results however differed from what were earlier reported on potato/maize intercrop studies which showed that increasing the plant population of one component crop depressed the yield of the other crop (Ifenkwe *et. al.*, 1984). In this study soybean was planted in the furrow between two potato ridges as in previous studies. This planting

pattern may have reduced the plant competition between the component crops and thereby minimizing yield reductions of one component crop by the other (Tables 1 - 3).

Yield components of soybean per plant were generally increased by increases in potato and soybean intra-row plant spacings, while soybean seed yield per hectare declined with increase in intra-row spacing. It has been shown that with increase in plant population, soybean branches per plant, pods and seeds per plant decreases while plant height increases (Ozbun, 1982). Our results were consistent with these findings.

Although insignificant, there is an increasing yield trend of soybean seed with increase in potato intra-

row spacing, while potato yield declined with decrease in soybean intra-row plant spacing. This yield relationships may have affected the trend of LER recorded in this study. Average LER of 1.79 obtained shows that there is yield advantage in intercropping potato and soybean.

The net returns from potato/soybean intercrop was controlled by potato yield and prices. With an average yield of 0.73t/ha, soybean contributed very little to the net income from the intercrop. Management of potato/soybean intercrop should therefore be aimed at increasing the

yield of potato if the emphasis is on increasing profit from the intercrop. Based on the yields and net income obtained in this study, intra-row plant spacings of 5cm for soybean and 30cm for potato were found best for profitable potato/soybean intercropping.

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