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Economics of wide row sugarcane intercropped with aggregatum onion (*Allium cepa* var. aggregatum) under garden land conditions

M. MAHADEVASWAMY AND G. JAMES MARTIN
Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641 001, Tamil Nadu

Abstract: Field experiments were conducted in Tamil Nadu Agricultural Universit Coimbatore during the main season planting of 1999-2000 and 2000-2001 to stud the effect of aggregatum onion intercropping in wide row spaced sugarcane on th total productivity and economic advantage. Intercropping of aggregatum onion di not affect the yield of the base crop of sugarcane. The bulb yield of intercroppe onion varied according to the population density adopted under different row spacing of sugarcane. The yield response of intercrop to the application of NPK fertilizer was significant only at the higher population density. The intercropping of aggregatun onion significantly increased the total productivity (CEY) as well as gross and ne returns as compared to sole crop of sugarcane. Adopting 120 cm wide row spacin for sugarcane and planting high density intercropping of aggregatum onion (1:4 ratio recorded the maximum productivity and economic returns. The total productivity an monetary benefits under 150 cm wide row spaced cane was also superior compare to productivity under normal row spaced (90 cm) cane. The economic incides lik Relative Net Return Index (RNRI) and the Monetary Equivalent Ratio (MER) wer enhanced by 6.4 to 8.2% and 12.3 to 17.0% respectively, indicating the economi efficiency of aggregatum onion intercropping, especially under wide row space cultivation of sugarcane.

Key words : Sugarcane, Spacing, Aggregatum Onion, Intercropping, Productivity.

Introduction

Intercropping systems are preferred because of many advantages like greater resource use efficiency, higher total productivity and increased monetary benefits (Vandermeer, 1989). The slow growth of sugarcane during the initial period coupled with the larger inter row spacing offers vast scope for planting intercrops. Several short duration crops have been tested as intercrops under normal row (80-90 cm) spaced cane (Kannappan *et al.* 1990; Kailasam, 1994). Large scale on-farm trials conducted in farmers' holdings have indicated that the cane productivity was not decreased even at 150 cm row spacing (Nagendran and Palanisamy, 1997). Such wide row spacing can be effectively utilized for raising high density intercrops and for managing them better without much competition effect.

In Tamil Nadu, the multiplier onion (*Allium cepa* var. *aggregatum*) is extensively grown under garden land conditions all through the year. Growing of short duration vegetable crops like aggregatum onion with sugarcane can be very remunerative. Since the sugarcane crop is being planted all through the year in tropical climate, the intercropping of aggregatum onion as intercrop (maturing in about 65 days) serves as a mid season cash flow to the small cane growers apart from increasing the employment opportunities. The present study was conducted to work out the total productivity and economics of sugarcane + onion intercropping system under different row spacings for sugarcane and varied row ratios and population levels for onion with or without fertilizer application to the intercrop.

Materials and Methods

Field experiments were conducted at Eastern Block Farm, Tamil Nadu Agricultural University, Coimbatore during the main season (February planting) of 1999-2000 and 2000-2001 in a split-plot design with three replications. Sugarcane variety 'Co 86032' (mid late) presently a standard commercial variety for the peninsular zone was planted at different row spacings (90, 120 and 150 cm). Sugarcane at wider rows of 120 and 150 cm was planted with 10% and 20%

Table 1. Yield performance of the component crops and their combined productivity as influenced by intercropping systems (pooled data of 2 years)

	Cane yield (t ha^{-1})				Onion yield (kg ha^{-1})				Cane Equivalent yield (t ha^{-1})			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	138.9	140.2	133.0	137.3	-	-	-	-	138.9	140.2	133.0	137.3
S_1	137.5	141.2	133.2	137.3	1992	2808	2436	2412	149.8	158.6	148.3	152.2
S_2	137.2	141.1	133.3	137.2	1810	2633	2252	2231	148.4	157.4	147.2	151.0
S_3	136.0	140.4	132.6	136.3	2876	4667	3946	3829	154.0	167.6	157.2	160.2
S_4	135.5	139.8	132.9	135.9	2597	4042	3575	3404	151.7	165.2	155.5	157.4
Mean	136.9	140.5	133.0		2318	3537	3052		148.5	158.2	148.2	
		SEd	CD (5%)			SEd	CD (5%)			SEd	CD (5%)	
M		1.88	5.22			135.9	377.4			2.04	5.76	
S		3.00	NS			147.2	309.4			2.93	8.12	
M at S		5.00	NS			260.2	NS			5.01	NS	
S at M		5.11	NS			254.5	NS			5.07	NS	

reduced seed rates compared to sugarcane at 90 cm spacing (75,000 setts ha^{-1}). An improved aggregatum onion variety Co4 maturing in about 65 days was planted as intercrop at different row ratios and population levels. The treatment details of the experiment are given below. While sugarcane received a recommended dose of NPK fertilizers (280:75 and 120 kg N, P_2O_5 and K_2O ha^{-1}) the fertilizer application (30:60:30 kg ha^{-1}) to the intercrop of onion was based on the population levels for the respective treatments. The intercrop was harvested at 65-70 days after planting while the main crop of sugarcane was harvested at 12 months. The total cost of cultivation in the intercropping system was worked out based on the cost of inputs used for both the component crops. The yield in the intercropping system was converted into Cane Equivalent Yield (CEY) for better comparison of the different intercropping systems. From the gross returns and the cost of cultivation, net returns and return per rupee invested were calculated. Adjacent to the experimental field, four crops of sole onion were raised (till the harvest of the cane) for working out the economic indices like Relative Net Return Index (RNRI) (Jain and Rao, 1980) and Monetary Equivalent Ratio, MER (Adetiloye and Adekunle, 1989).

Treatment details of the Experiment

A. Main plot treatments

M_1 = 90 cm (75,000 setts ha^{-1})
M_2 = 120 cm (67,500 setts ha^{-1})
M_3 = 150 cm (60,000 setts ha^{-1})

B. Sub-plot treatments (intercropping systems)

S_0 = Sole crop of sugarcane

S_1 = Sugarcane + onion (1:1 ratio in M_1 and 1:2 ratio in M_2 and M_3) with fertilizer application for both the crops

S_2 = Sugarcane + onion (1:1 ratio in M_1 and 1:2 ratio in M_2 and M_3) with fertilizer application for sugarcane only

S_3 = Sugarcane + onion (1:2 ratio in M_1 and 1:4 ratio in M_2 and M_3)

Table 2. Cost of cultivation, gross returns and net returns of sugarcane + aggregatum onion intercropping systems (Rs. 10^{-3} ha^{-1}) (pooled mean of 2 years)

	Cost of cultivation				Gross returns				Net returns			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	57.28	56.46	54.21	55.98	111.1	112.1	106.4	109.9	53.88	55.41	52.25	53.85
S_1	60.89	62.50	58.83	60.74	120.0	127.0	118.8	121.9	59.13	64.55	59.96	61.22
S_2	60.34	61.73	58.25	60.10	118.8	126.1	117.9	120.9	58.51	64.37	59.61	60.83
S_3	64.12	67.63	62.96	64.90	123.2	135.6	125.8	128.2	59.11	68.04	62.87	63.34
S_4	63.06	66.03	61.88	63.65	121.5	132.0	124.5	126.0	58.42	66.04	62.66	62.37
Mean	61.14	62.47	59.23		118.9	126.6	118.7		57.81	63.68	59.46	

Table 3. Economic indices of sugarcane + aggregatum onion intercropping systems (mean of 2 years)

	Returns per rupee invested				Relative net return index				Monetary equivalent ratio			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	1.93	1.97	1.95	1.95	1.00	1.01	0.98	1.00	1.00	1.04	0.97	1.00
S_1	1.96	2.03	2.02	2.00	1.04	1.09	1.05	1.06	1.10	1.20	1.11	1.13
S_2	1.96	2.03	2.01	2.00	1.04	1.09	1.05	1.06	1.08	1.19	1.07	1.12
S_3	1.91	2.00	1.99	1.97	1.04	1.12	1.08	1.08	1.09	1.26	1.17	1.18
S_4	1.92	1.99	2.00	1.97	1.04	1.11	1.07	1.07	1.08	1.23	1.16	1.16
Mean	1.94	2.00	1.99		1.03	1.08	1.05		1.07	1.18	1.10	

with fertilizer application for both the crops

S_4 = Sugarcane + onion (1:2 ratio in M_1 and 1:4 ration in M_2 and M_3) with fertilizer application for sugarcane only

Results and Discussion

Yield performance of component crops and their combined productivity (CEY)

The data on cane yield of sugarcane, bulb yield of onion intercrop and their combined productivity in terms of Cane Equivalent Yield (CEY) are presented in Table 1. Adopting wider row spacing of 120 cm increased the cane yield significantly compared to 90 cm normal row spacing. But further increase in the row spacing of sugarcane to 150 cm wide, recorded significantly lower yield than at 120 cm spacing. However, the cane yield at 150cm was on par with 90 cm normal row spacing. The sustained cane yield even at 150 cm row spacing has been reported under tropical conditions (Prabhakar, 1999). The intercropping of aggregatum onion in the system did not affect the yield of base crop of sugarcane. The mean bulb yield of onion intercrop was the highest under 120 cm wide row spaced cane with intercropping ratio of 1:4 (M2S3) followed by intercropping at 150 cm

wide row spaced sugarcane (M3S3). The response of intercropped onion to the fertilizer application was observed only at higher density of intercrop. Increased planting density of onion from lower population to higher population level increased the mean bulb yield of onion by 44% in normal row spaced (90 cm) cane while the same was increased by 60% at wide row spacings of 120 and 150 cm. This indicates that competition between the components crops was more in 90 cm compared to wide row spaced cane. Intercropping of onion in the system significantly increased the total productivity (CEY) as compared to sole sugarcane. The overall increase in the total productivity was 10.3% and 15.6% under lower and higher population levels of the intercrop, respectively. Increased total productivity by intercropping of onion in sugarcane has been reported by Venkataraman (1977) and Misra (2000).

Economic analysis of the intercropping system

The cost of cultivation, gross returns and the net returns of the intercropping systems are given in Table 2. The intercropping of onion in the system increased the cost of cultivation compared to the sole crop of sugarcane. The increase in the cost varied according to the planting density adopted and fertilizer application to the intercrop in the respective treatments. The cost of cultivation was up by eight and 14 per cent under lower and higher intercropping densities respectively. But at the same time, the intercropping of onion in the system increased the gross as well as the net returns compared to the sole crop of sugarcane. The gross and net returns were highest when onion was intercropped at 1:4 ratio followed by 1:2 ratio adopting 120 cm row spacing for sugarcane, compared to other treatment combinations. The net returns were also found to be higher by intercropping of onion at 1:4 ratio in 150 cm wide spaced cane compared to intercropping (1:2) at 90 cm normal row spaced cane.

The overall increase in net returns was Rs. 7174 ha^{-1} with lower intercrop population and Rs. 9009 ha^{-1} under higher population level of onion intercropping. But increasing the intercrop population level to higher density (S_3 and S_4) from the lower population level (S_1 and S_2) did not proportionate increase the net returns. This is because increase in the yield of the intercrop was not in proportion to the increased density of planting. This was more so when intercropping with high density (1:2) planting was done under normal row spaced cane. Similarly the application of recommended level of NPK to the intercrop did not greatly increase the net returns as the bulb yield of onion between the fertilized and the non-fertilized intercrop was not marked eventhough the difference was significant at higher population level of the intercrops. The cost incurred on the harvesting and processing of the intercrop further reduced the returns from the intercropping systems.

The return per rupee invested was found to be marginally higher under intercropping systems compared to sole sugarcane. This may be due to higher cost incurred on the seed material, planting, harvesting and processing of the intercrop. Further, the cost benefit ratio of the intercropping systems depends upon the selling price of both the component crops. In the present study, while the selling price of sugarcane is fairly stable, the price of the onion intercrop, like any other vegetable crop depends upon the current market price which is subject to seasonal fluctuations. However the Relative Net Return Index (RNRI) and the Monetary Equivalent Index (MER), which are better indicators of monetary advantage of intercropping system were higher in the intercropped situations compared to sole crop situation. The RNRI increased by 6.2 and 13.1% while MER improved by 8.2 and 17.1% respectively under lower and higher intercropping density respectively compared to sole sugarcane. In a study on the effect of vegetable intercropping in maize, Padhi (2001) observed higher RNRI (26% higher) in maize + runner bean intercropping in paired row system with 90 cm between the paired rows.

The study indicated that adopting 120 cm wide row spacing for sugarcane was found optimum to get higher yield of cane as well as intercrop yield of onion. Intercropping of higher density of planting increased the intercrop yield and total productivity of the system compared to the sole sugarcane. Intercropping of onion in the system improved the gross as well as the net returns. The increase in income was

more under wide row spaced sugarcane with higher population levels of the intercrop compared to intercropping of the same under normal row spaced cane. Eventhough the returns per rupee invested did not show marked increase due to intercropping, the economic indices like RNRI and MER increased appreciably indicating the economic efficiency and monetary advantage of onion intercropping especially under wide row system of cane cultivation.

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