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Production potential of wide row sugarcane intercropped with aggregatum onion (*Allium cepa*) under different row ratios, fertilizer levels and population densities

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ABSTRACT

A field experiment was conducted during the main season of 1999-2001 at Tamil Nadu Agricultural University, Coimbatore, to study the effect of increasing the row spacing of sugarcane ('Co 86032') to wide rows while intercropping with 'Co 4' aggregatum onion (*Allium cepa* L.) under different row ratios and population levels with or without fertilizer application for the intercrop, on the performance of the component crops and the overall productivity and economics of the sugarcane + aggregatum onion intercropping system. Increasing the row spacing up to 150 cm wide from the normal row spacing of 90 cm did not reduce the cane yields. But 120 cm wide row spacing was found optimum for higher cane and sugar yields. Intercropping of onion increased the total productivity (cane-equivalent yield) and land-use efficiency compared with sole crop of sugarcane. Adopting 120 cm wide rows for sugarcane and intercropping of higher population (333,000) of onion (1:4 ratio) with fertilizer application to both the component crops recorded higher productivity and economical returns. However, the total productivity and economics were also distinctly better in 150 cm wide row sugarcane intercropped with higher population 242,000/ha of onion (1:4 ratio) than intercropping of onion at 1:2 ratio (222,000/ha) in 90 cm row spaced cane. Levels of row spacing or intercropping of onion in the systems did not affect the juice quality of cane.

Key words : Sugarcane, Aggregatum onion, Intercropping, Row ratios, Productivity

Management practices like spacing of cane row, selection of suitable intercrops, row ratios and fertilizer management assume greater importance in minimizing the adverse effect of intercrops on cane yield. Under wide row system of planting, the larger interspace between the sugarcane rows can be effectively utilized by the intercrops for better exploitation of the natural resources. Onion is one of the important

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vegetable and spice crops grown commercially in India. In Tamil Nadu, the multiplier onion belonging to the aggregatum group is largely grown throughout the year without any appreciable differences in day length. Being small statured and early maturing (65–70 days), onion as an intercrop in sugarcane can be not only remunerative but can also meets some dietary requirement of the farm families. With this background, the study was conducted to evaluate the performance of sugarcane under wide row spacings intercropped with aggregatum onion.

MATERIALS AND METHODS

The field experiment was conducted during the main seasons (February planting) of 1999–2000 and 2000–2001 at Tamil Nadu Agricultural University, Eastern Block Farm, Coimbatore, in a split-plot design with 3 replications. The soil was sandy loam to clay loam and calcareous (pH 8.3) in nature with low available N (210 kg/ha), medium P_2O_5 (16.5 kg/ha) and high K_2O (750 kg/ha) status. The main plot treatments consisted of row spacing for sugarcane while the sub-plot consisted of intercropping systems. The mid-late sugarcane variety ('Co 86032') was planted by forming ridges and furrows at different row spacings as per the treatments. The seed bulbs of aggregatum onion ('Co 4') as an intercrop were planted on the sides of the ridges between the sugarcane rows on third day after planting. In case of normal row spacing of 90 cm of sugarcane (M_1), the lower population of onion (S_1, S_2) adopted was 111,000 plants/ha (1:1 ratio) and higher population (S_3, S_4) was 222,000 plants/ha (1:2). Similarly, in 120 cm (M_2) spaced sugarcane, the lower population of onion (1:2 ratio) was 166,500 plant/ha while the higher population (1:4 ratio) level was 333,000 plants/ha. In case of 150 cm (M_3) row spacing of sugarcane, it was 121,300 plants/ha and 242,600 plants/ha at lower (1:2) and higher (1:4) population levels respectively. While sugarcane received the recommended level of fertilizer (275,75 and 120 kg/ha of N, P_2O_5 and K_2O), the fertilizer application (30:60:30 kg/ha) to the intercrop of onion (S_1 and S_3) was based on the population level adopted in the respective treatments. The intercrop was raised with normal plant protection and cultural practices. The intercrop was harvested at 65–70 days while the main crop of sugarcane was harvested at 12 months of age.

RESULTS AND DISCUSSION

Cane yield parameters and sugar yield

Increasing the row spacing to 120 and 150 cm wide rows, significantly reduced the millable cane population, but favourably influenced the yield parameters like cane length, cane diameter and single cane weight (Table 1). The juice quality (CCS %) was not affected by the row spacings adopted for sugarcane. Row spacing of 120 cm was found optimum for higher cane and sugar yields. Further increase in the row spacing to 150 cm wide caused significant reduction in the cane yield compared to that of 120 cm, but was on a par with 90 cm normal row. Similar trends were noticed for sugar yield also. Ali *et al.* (1999) found that the cane yield were

Table 1. Effect of row spacing for sugarcane and sugarcane + onion intercropping systems on cane yield attributes, quality, cane and sugar yield

Treatment	No. of millable canes ('000/ha)		Single cane weight (kg)		Cane length (cm)		Commercial cane sugar (%)		Cane yield (tonnes/ ha)*	Sugar yield (tonnes/ ha)*
	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001		
Row spacing (sugarcane)										
M_1 (90 cm)	140.8	128.9	1.116	1.007	208.7	201.3	13.53	13.46	137.0	18.4
M_2 (120 cm)	130.6	116.4	1.222	1.124	222.6	210.7	13.43	13.46	140.2	18.9
M_3 (150 cm)	117.3	102.2	1.286	1.201	221.3	213.3	13.10	13.44	133.0	17.6
CD (P=0.05)	6.04	12.2	0.03	0.05	11.60	7.00	NS	NS	5.46	0.87
Sugarcane + onion intercropping										
S_0 Sole cane	130.4	116.9	1.206	1.107	216.3	207.9	13.31	13.42	137.3	18.3
S_1 1:1 in M_1 and 1:2 in M_2 and M_3 (with recommended NPK for both crops)	130.0	116.5	1.207	1.116	218.4	208.1	13.37	13.45	137.3	18.4
S_2 1:1 in M_1 and 1:2 in M_2 and M_3 (with recommended NPK for cane)	129.6	116.0	1.213	1.106	218.3	209.8	13.34	13.46	137.1	18.3
S_3 1:2 in M_1 and 1:4 in M_2 and M_3 (with recommended NPK for both crops)	129.0	114.3	1.207	1.107	216.8	207.7	13.38	13.45	136.1	18.2
S_4 1:2 in M_1 and 1:4 in M_2 and M_3 (with recommended NPK for cane)	128.9	114.1	1.206	1.119	217.8	207.4	13.34	13.50	136.0	18.2
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Interactions not significant;
*Pooled data of 2 years

Table 2. Performance of intercropped aggregatum onion (kg/ha) under different row spacings of sugarcane and population density of onion (pooled mean of 2 years)

	Sugarcane + onion intercropping systems				
Row spacing	S_1	S_2	S_3	S_4	Mean
M_1	1,980	1,810	2,876	2,597	2,315
M_2	2,808	2,633	4,667	4,042	3,537
M_3	2,434	2,268	3,946	3,576	3,056
Mean	2,407	2,237	3,829	3,405	
CD					
Row spacing			377.4		
Intercropping system			310.5		
Interaction			NS		

Details of row spacings are given in text

similar at both the spacings of 100 or 120 cm in 'CP 70-1547' sugarcane. The cane or sugar yields also did not differ between 90 and 150 cm spaced 'Co 86032' sugarcane (Parbhakar, 1999). The intercropping of aggregatum onion under different population levels or row ratios with or without fertilizer application for the intercrop did not cause any adverse effect on the cane or sugar yield. The results confirm the findings of Zohry (1999).

Bulb yield of intercropped aggregatum onion

Significantly higher bulb yield of onion

was recorded when intercropped in 120 cm row spaced cane compared to normal row spacing of 90 cm or wide row of 150 cm (Table 2). This is owing to the higher population of onion (up to 75% of the sole onion) that could be accommodated under 120 cm row compared to 90 cm (55%) normal row or 150 cm (56%) wider row spacing. However, the performance of onion under 150 cm wide row spacing was better than 90 cm spacing due to higher bulb weight of onion plants as well as relatively higher population. The response of the intercrop to the fertilizer application could be observed only at higher population levels of onion. This may be due to competition for light, moisture and nutrient between the component crop of onion and sugarcane at higher population density of intercrop. Lower row ratio and population density (1:1 in M_1 and 1:2 in M_2 and M_3) recorded lower fresh bulb yield than higher row ratios and population density (1:2 in M_1 and 1:4 in M_2 and M_3) of the intercrop. The increase in the bulb yield due to increased density of intercrop was 43.9% in M_1 and 60.0 and 60.5% in M_2 and M_3 treatments respectively. The interaction effects were found not significant.

Total productivity (cane-equivalent yield)

In terms of total productivity cane-equivalent yield, intercropping of aggregetum onion in sugarcane recorded significantly higher productivity than the sole crop of cane (Table 3). The increase in the productivity was 10.4% and 15.6% under lower and higher population density of the intercrop respectively. Intercropping of onion with higher population (1:4) in 120 cm wide spaced sugarcane with fertilizer application for both the component crops in the system recorded the maximum cane-equivalent yield (CEY), followed by the same row arrangement without application of fertilizers for the intercrop. This was due to not only increased cane yield but also due to higher bulb yield of the intercropped onion at this level of row spacing. Venkataraman (1977) also reported increased productivity by intercropping of onion as reflected by CEY. Intercropping of higher population level of onion at 1:4 ratio in 150 cm wide spaced cane with or without fertilizer application for the intercrop was also found to be distinctly superior than intecropping of the same (1:2) under 90 cm normal row in terms of overall productivity, though the sole crop yield of sugarcane was relatively less at 150 cm spacing. The interaction was not significant.

Land-use efficiency and monetary advantage

The land-use efficiency was greatly enhanced by intercropping of aggregatum onion in sugarcane compared with sole cane, as reflected by higher LER, ATER and AHER (Table 4). The land-use efficiency was higher under 120 cm and 150 cm wide row spaced cane than 90 cm normal row indicating that the land was best utilized in wide row cultivation of sugarcane while intercropping with aggregatum onion. The LER values increased by 34.7% (under low density of intercropping) and 53.0% (under higher density of intercropping). Similarly, intercropping of onion in the system significantly increased the monetary advantage. Singh *et al.* (1999)

Table 3. Total productivity (CEY) (tonnes/ha) as influenced by various sugarcane + onion intercropping systems (pooled mean of 2 year)

	Sugarcane + onion intercropping system					
Row spacing	S_0	S_1	S_2	S_3	S_4	Mean
M_1	138.9	149.9	148.5	153.9	151.7	148.5
M_2	140.3	158.7	157.4	169.5	165.0	158.2
M_3	133.1	148.4	147.2	157.2	155.6	148.3
Mean	137.4	152.3	151.0	160.2	157.4	
CD for						
Row spacing	5.67					
Intercropping system	6.03					
Interaction	NS					

Details of row spacings one given in text

Table 4. Effect of row spacings and sugarcane + onion intercropping systems on resource-use efficiency and economics (pooled mean of 2 years)

Treatment	Land-equivalent ratio (LER)	Area-time equivalent ratio (ATER)	Area-harvest equivalency ratio (AHER)	Relative net return index (RNRI)	Benefit : cost ratio
Row spacing					
M_1	1.25	1.03	1.06	1.03	1.94
M_2	1.42	1.08	1.13	1.09	2.00
M_3	1.31	1.02	1.06	1.05	1.99
CD (P=0.05)	0.063	0.037	0.039	0.034	0.040
Sugarcane + onion intercropping					
S_0	0.98	0.98	0.98	1.00	1.95
S_1	1.33	1.05	1.09	1.06	2.01
S_2	1.30	1.04	1.08	1.06	2.01
S_3	1.53	1.08	1.15	1.09	1.97
S_4	1.47	1.07	1.13	1.08	1.97
CD (P=0.05)	0.053	0.041	0.041	0.033	0.038

Details of treatments are given in Table 1

observed higher land-use efficiency and net returns by intercropping of sugarcane with spice crops like garlic compared to monocropped cane. However, within intercropping systems, benefit : cost ratio did not vary much due to the population density of the intercrop or due to the application of fertilizers to the intercrop in the system. This was due to the fact that though there was increased bulb yield at increased row ratios or population density of the intercrop, the yield increment was not in proportionate to the cost of inputs incurred on bulb yield, cost of planting and harvesting of the intercropped onion.

The study indicates that cane yields were

not reduced by increasing the row spacing of sugarcane to 120 or 150 cm wide rows. However, 120 cm row spacing was found optimum for higher cane and sugar yields. Further, the total productivity and land-use efficiency can be greatly enhanced by intercropping with higher population (1:4 ratio) of aggergatum onion in the wide row planting systems of sugarcane without any adverse effect on the cane yield or the cane juice quality.

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