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Effect of intercropping maize (*Zea mays*) varieties on autumn-planted sugarcane (*Saccharum officinarum*)

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ABSTRACT

A field experiment was conducted during autumn season of 1988–89 and 1989–90 to screen suitable maize (*Zea mays* L.) variety best suited to intercropping in autumn-planted 'CoS 8315' sugarcane (*Saccharum officinarum* L.) for its effect on growth, yield, quality of cane and subsequently on economic returns. Irrespective of cane alone treatment, significantly higher number of tillers, millable canes and cane yield were recorded under sugarcane + 'Jaunpuri' and 'CD Pool' maize over others. Though all the maize varieties gave higher cane-equivalent yield and net returns except 'Opaque' as compared to sugarcane alone, but amongst them, 'CD Pool' was found to be promising giving highest cane-equivalent yield (123.73 tonnes/ha) and net returns (Rs 26,750/ha). This increase was 24.61% more than the sugarcane alone. Maize variety 'Opaque' as an intercrop reduced the cane yield significantly, resulting in a net loss of returns up to 5.21% compared with sole crop of sugarcane. No significant effect on juice quality parameters were noticed due to intercrops.

Since maize (*Zea mays* L.) is traditionally a rainy-season (July–September) crop and thereby it is not intercropped with autumn-planted sugarcane (*Saccharum officinarum* L.). Its cultivation in winter (October–April) season has started in recent past in certain parts of the country, especially in eastern zone of Uttar Pradesh. The yield levels in winter-season maize are 30–40% higher than those obtained in monsoon or spring season owing to better weed control and input management and less incidence of pest and diseases (Nandal and Agarwal, 1991). However, the technology of growing maize in monsoon season or its intercropping in spring-planted sugarcane (Bhoj and Kapoor, 1970) can also be tried effectively as an intercrop with the autumn-planted sugarcane.

The information on testing of winter maize varieties with autumn-planted sugarcane with respect to yield advantage and remuneration is lacking and needs to be investigated intensively. Hence the present experiment was initiated with a view to study the effect of intercropping of winter maize varieties on yield and remunerative advantage of autumn sugarcane.

MATERIALS AND METHODS

A field experiment was conducted during 1988–89 and 1989–90 at the research farm of G.S. Sugarcane Breeding and Research Institute, Seorahi. The experimental field

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was sandy loam in texture, calcareous in nature, moderately alkaline in reaction (pH 8.3), low in organic carbon, medium in available nitrogen, phosphorus and rich in potassium. The experiment was laid out in randomized block design with 3 replications using sugarcane variety 'CoS 8315'.

The treatments of intercropping 8 winter maize varieties with autumn cane were : T_1, sugarcane alone; T_2, sugarcane + 'Pioneer' maize; T_3, sugarcane + 'Swan' maize; T_4, sugarcane + 'Manjari' maize; T_5, sugarcane + 'CD Pool' maize; T_6, sugarcane + 'Jaunpuri' maize; T_7, sugarcane + 'Ganga 5' maize; T_8, sugarcane + 'Opaque' maize; and T_9, sugarcane + 'WH Starch' maize

Sugarcane was planted in furrows 90 cm apart with the seed of 2-budded setts @ 60/ ha in October during both the years. Intercrops were sown in 1 row between 2 rows of sugarcane just after cane planting and maintained 75% plant population compared to its sole crop. Sugarcane was fertilized with 180 kg N/ha and 60 kg P_2O_5/ha and 90 kg N/ha, 45 kg P_2O_5/ha and 30 kg K_2O/ha to intercrops. Half N and full P_2O_5 were applied at the time of planting and remaining half N was top-dressed at peak-tillering stage at proper moisture, whereas in intercrop, one-third N + full P_2O_5 was applied at the time of sowing and the remaining two-thirds N in 2 equal splits, half at knee-high stage (35 days after planting) and the rest at tasselling stage. All the recommended agronomic practices were followed for raising sugarcane and intercrops.

Data on germination (%), number of tillers, millable canes and yield of intercrops and cane were recorded at their respective harvesting stage. Juice samples were drawn at harvest of sugarcane and analysed for brix, sucrose and pol (%) and further calculated for purity and commercial cane sugar (Spencer and Meade 1955).

Economics of different intercropping systems was worked out at the prevailing market prices during the course of experimentation. Sugarcane crop was harvested 13 months after planting, whereas among intercrops, 'CD Pool' and 'Jaunpuri' varieties of maize were harvested 20 days earlier compared with other maize varieties.

RESULTS AND DISCUSSION

Germination, tillers and millable canes

The variations between germination (%) of cane buds under different treatments were not significant during 1988–89, but significant germination was noticed during 1989–90 due to some treatments except for sugarcane + 'CD Pool' maize. However, mean data on germination (%) did not show major difference (Table 1). It indicates that maize crop caused no adverse effect on germination of cane buds because its plants were very small during the germination phase of sugarcane.

In the first year no significant differences were observed for tillers/ha among different treatments, whereas in second year sugarcane produced significantly more tillers/ha over others but it was at par with sugarcane + 'CD Pool' maize and sugarcane + 'Jaunpuri' maize. This increase in number of tillers on sugarcane alone may be attributed to the absence of any interference to sugarcane plants unlike other treatments, in which maize plants competed with sugarcane and thereby reduced its tiller production. The mean data on number of tillers under sugarcane + 'CD Pool' and sugarcane + 'Jaunpuri' maize intercroppings increased rather progressively over that of other maize varieties intercropped with sugarcane. It indicates their varietal behaviour and beneficial association of intercropping with

Table 1. Growth, yield and quality of autumn sugarcane as affected by intercropping of winter maize varieties

Treatment	Germination (%)			Tillers/ ha ('000)			Millable canes/ha ('000)			Cane yield (t/ha)			Intercrops yield (q/ha)			Juice analysis		
	A	B	Mean	A	B	Mean	A	B	Mean	A	B	Mean	A	B	Mean	Brix (%)	Sucrose (%)	PC
T_1	46.2	45.4	45.8	211	213	212	115	148	132	103.0	105.0	104.0				18.81	15.43	79.5
T_2	45.4	34.0	39.7	171	108	140	87	103	95	82.3	81.6	81.9	48.1	54.1	51.1	17.69	14.8	80.2
T_3	45.9	45.0	45.5	174	166	170	87	112	99	82.8	92.0	87.4	41.6	31.4	36.5	18.23	15.4	79.0
T_4	43.9	37.6	40.8	184	175	180	915	117	106	90.4	79.2	84.8	42.6	48.6	45.6	19.34	16.0	80.6
T_5	42.2	40.8	41.5	188	208	198	96	119	108	92.4	97.2	94.8	50.9	37.5	44.2	19.59	16.3	79.4
T_6	40.6	38.4	39.5	206	209	208	104	9138	121	100.0	103.8	102.0	27.7	17.1	22.4	18.89	15.1	79.0
T_7	44.4	34.3	39.4	169	149	159	88	102	95	82.0	88.9	85.5	45.4	38.0	41.7	17.58	14.6	76.2
T_8	45.6	36.4	41.0	155	206	181	82	122	102	74.0	87.5	80.8	38.8	34.7	36.8	18.74	15.3	78.6
T_9	43.7	37.4	40.6	171	149	160	89	112	101	84.1	86.2	85.2	47.2	44.0	45.6	18.69	15.0	79.6
CD (P = 0.05)		4.8			6		12	14		15.6	5.4		4.9	5.7				

T_1, Sugarcane alone; T_2, sugarcane + Pioneer'; T_3, sugarcane + 'Swan'; T_4, 'sugarcane + 'Manary'; T_5, sugarcane + 'CD Pool'; T_6, sugarcane + 'Jaunpuri; T_7, sugarcane + 'Ganga 5'; T_8, sugarcane + Opaque; and T_9, sugarcane + 'WH Starch' maize

A, 1988--89; B, 1989--90; PC, purity coefficient

sugarcane crop, resulting more tiller production (Table 1).

Tillers and the number of millable canes were significantly higher under the sole sugarcane than under other treatments, but it was at par with sugarcane + 'Jaunpuri' maize during both the years. Reduction in tillers and millable canes population due to different intercrops may be attributed to the fact that shading effect and aggressive nature of maize on sugarcane crop and siphoning of more nutrients, and moisture might have caused for such results. The results confirm the findings Jayabal and Chockalingam (1990). Sugarcane + 'CD Pool' maize intercropping could not attain at par millable canes with sugarcane + 'Jannpuri' maize which might be due to more tiller mortality in former compared with latter. The yield of sugarcane was reduced significantly when maize varieties were intercropped with sugarcane compared with the yield of sole sugarcane crop; but almost at par results were obtained under sugarcane + 'CD Pool' and sugarcane + 'Jaunpuri' maize. Such reduction in sugarcane yield may be attributed to the competition for space and sunlight between cane plants and plants of intercrops. Among different intercrops, sugarcane + 'CD Pool' maize and sugarcane + 'Jaunpuri' maize combinations proved beneficial in terms of cane yield, might be because of lesser competition period and more number of millable canes compared with intercrops. This result is in close confirmity with the findings of Jayabal and Chockalingam (1990).

Different intercrops did not affect juice-quality parameters significantly. Amount of commercial cane sugar calculated followed the same trend as that of cane yield in different treatments and it was highest (10.68 tonnes/ha) in sugarcane alone, followed by sugarcane + 'CD Pool' maize (10.23 tonnes/ha) and sugarcane + 'Jaunpuri' maize (10.12 tonnes/ha) (Table 2).

Table 2. Economics of sugarcane + maize varieties intercropping as a whole

Treatment	Cane-equivalent yield (tonnes/ha)**	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Gain or loss in net returns over alone (%)	Benefit: cost ratio (Rs/ rupee investment	CCS (%)	CCS (tonnes/ ha)*
T_1	104.00	13,893	35,360	21,467		1.61	10.27	10.68
T_2	115.34	15,318	39,216	23,898	+11.32	1.56	9.96	8.16
T_3	111.28	15,318	37,835	22,517	+4.89	1.47	10.42	9.11
T_4	114.64	15,318	38,978	23,660	+10.22	1.54	10.70	9.07
T_5	123.73	15,318	42,068	26,750	+24.61	1.75	10.79	10.23
T_6	116.65	15,318	39,661	24,343	+13.40	1.59	9.92	10.12
T_7	112.80	15,318	38,352	23,034	+7.30	1.50	9.79	8.37
T_8	104.90	15,318	35,666	20,348	−5.21	1.33	10.16	8.89
T_9	115.04	15,318	39,114	23,796	+10.85	1.55	9.87	8.41

T_1, Sugarcane alone; T_2, sugarcane + 'Pioneer'; T_3, sugarcane + 'Swan'; T_4, sugarcane + 'Manary'; T_5, sugarcane + 'CD Pool'; T_6, sugarcane + 'Jaunpuri; T_7, sugarcane + 'Ganga 5'; T_8, sugarcane + Opaque; and T_9, sugarcane + 'WH Starch' maize

** Calculated on the basis of prevailing market prices of sugarcane and grains of maize, *commercial cane sugar on the basis of cane yield and CCS (%) in cane juice

Economics

Intercropping with different varieties of maize in autumn-planted sugarcane was more remunerative except sugarcane + 'Opaque' maize than taking a pure autumn-planted crop of sugarcane. The highest sugarcane-equivalent yield (123.73 tonnes/ha) and net returns (Rs 26,750/ha) were obtained under sugarcane + 'CD Pool' maize. Next in order were sugarcane + 'Jaunpuri' maize and sugarcane + 'Pioneer' maize, whereas lowest performance was recorded with sugarcane + 'Opaque' maize, resulting in a net loss of returns up to 5.21% compared with sole crop of sugarcane.

Thus intercropping of sugarcane + 'CD Pool' maize gave the highest sugarcane-equivalent yield and net returns and proved the most remunerative compared with sole crop.

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