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Production potential of spring sugarcane as influenced by intercropping of dual-purpose legumes under *tarai* conditions of Uttarakhand

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ABSTRACT

A field experiment was conducted during 2000–02 at the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, to study the effect of dual-purpose legume intercropping with spring sugarcane under different NPK levels. All intercrops, except *Sesbania* reduced the cane yield significantly. The reduction in cane yield was 14.0, 8.9 and 11.4% with cowpea [*Vigna unguiculata* (L.) Walp.], mungbean (*Vigna radiata*) and urdbean (*Vigna mungo*) intercropping respectively. Sugarcane intercropped with *Sesbania* (GM) yielded similar to that of sole sugarcane. Different fertility levels did not show significant effect on cane yield. Sugarcane + cowpea gave 17.2, 15.8, 19.0 and 26.5% higher mean cane-equivalent yield (118.4 tonnes/ha) than sole sugarcane, sugarcane + mungbean, sugarcane + urdbean and sugarcane + *Sesbania* intercropping respectively. A dose of 100% of recommended NPK resulted in 5.0% higher cane-equivalent yield than 75% dose and was on a par with 125% of NPK dose. Sugarcane + cowpea also gave the highest net return of Rs 57,772 compared to Rs 41,449 with urdbean and Rs 48,330 with sole sugarcane. Respective benefit : cost raio was 2.06, 1.78 and 2.01. A dose of 125% of the recommended NPK gave highest monetary return and benefit : cost ratio with maintaining the residual soil-fertility status after harvest of sugarcane.

Key words : Sugarcane, Legume intercropping, NPK levels, Yield, Economics

Intercropping in spring sugarcane with legume is quite a common practice and has been recognized as potential system to enhance the productivity of sugarcane-based cropping systems. Non-legume intercrops deplete more soil nutrient and bring economic reduction in sugarcane yield. Hence there is a need for better management and the selection of suitable intercrop for local conditions necessitate for harnessing maximum benefits and sustaining soil health. Intercropping in sugarcane is localized, depending on soil environment and market demands. However, a meagre information is available on nutrient management in spring sugarcane-based intercropping systems. Keeping these points in view, the present study was carried out to find out appropriate intercrops under different fertilizer levels in spring sugarcane.

MATERIALS AND METHODS

The field experiment was conducted during 2000–02 to find out suitability of legume intercropping with spring-planed cane under different NPK levels at the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The soil was silty clay loam, rich in organic carbon, medium in available phosphorus and potassium and neutral in soil reaction. Treatments comprising 15 combinations, i.e. 5 cropping systems, viz. sole sugarcane, sugarcane + cowpea, sugarcane + mungbean, sugarcane + urdbean and sugarcane + *Sesbania*; and 3 fertility levels, viz. 75, 100 and 125% of recommended N: P_2O_5:K_2O (150:80:60 kg/ha), were tested in randomized block design with 3 replications. Sugarcane crop (cv. 'Co Pant 90223)' was planted in the first week of March during both the years. Two rows of cowpea '(Pusa Komal)', mungbean ('Pant Mung 2)' and urdbean (Pant Urd 19)' and 3 rows of *Sesbania* '(Local)' were sown just after planting of sugarcane between 2 rows. All the intercrops in association with sugarcane were grown with the recommended package of pracices. Cowpea was grown for vegetable purpose, whereas mungbean and urdbean for grain. *Sesbania* grown for green-manure purpose, was turned up with manual hoeing at 50 days after sowing and irrigation was applied just after its incorporation. Rest of the intercrops straw was incorporated after complete picking

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of the mature pods. Sugarcane was fertilized as per treatments, whereas intercrops were fertilized on their population ratio in sole as well as intercropping system. Results based on pooled data are presented.

RESULTS AND DISCUSSION

Cropping system

Intercropping did not influence germination (%) at 45 days after planting. Cane yield and their attributes were influenced significantly by cropping systems (Table 1). All the intercrops, except *Sesbania,* led to significant reduction in cane yield, being 14.0, 8.9 and 11.4% with cowpea, mungbean and urdbean as intercrops respectively. Reduction in cane yield might be due to shading effect of intercrops on sugarcane at initial stage. Panwar *et al.* (1990) also observed similar effect. Number of millable canes also followed similar trend, being highest in sole sugarcane (101,000/ha) which declined by 13.9, 7.9 and 10.9% with cowpea, mungbean and urdbean intercropping respectively. Reduction in number of millable canes led to less shoot production under intercropping conditions (Table 1). The heaviest cane (1,150 g) produced under sugarcane + *Sesbania* intercropping, which was mainly attributed to taller and thicker cane. Commercial cane sugar, a product of sucrose content and cane yield, exhibited a trend similar to that of cane yield having maximum of 11.5 tonnes/ha with sole sugarcane. Sugar yield was reduced by 14.8, 8.7 and 13% with cowpea, mungbean and urdbean, respectively, grown as intercrops.

Sugarcane + cowpea inercropping gave the highest cane-equivalent yield (CEY) of 118.4 tonnes/ha, being significantly higher by 17.2,15.8, 19.0 and 26.5%, than sole sugarcane and sugarcane intercropped with mungbean, urdbean and *Sesbania* respectively (Table 2). This might be owing to additional yield obtained from cowpea and attractive price of their pods in market. Our results corroborate the findings of Islam *et al.* (1990).

Intercropping of sugarcane + cowpea also gave significantly higher net return Rs 57,772 and benefit : cost ratio of 1.06 compared with Rs 48,330 and 2.01 with sole sugarcane.

Sole sugarcane removed significantly higher amount of N (196.6 kg/ha), P (18.7 kg/ha) and K (317 kg/ha), which might be attributed to cumulative effect of the highest biomass production under this treatment. Respective values of NPK uptake with sugarcane + cowpea was 174.5, 17.8 and 260 kg/ha respectively. *Sesbania* grown as intercrop in sugarcane for green manure gave the highest sustainability to residual soil NPK status over its initial soil test levels (Table 2). In sugarcane + *Sesbania* intercropping at harvest of sugarcane, the highest residual fertility of N (192 kg/ha), P (20.2 kg/ha) and K (305 kg/ha) was observed compared with 186, 19.8 and 298 kg/ha of its initial soil-test values. Such increases in soil-fertility status was mainly because of addition of nutrients through green-manuring *Sesbania* incorporation in sugarcane field. Bezbaruah and Thakuria (1996) also reported similar results in cereal–legume intercropping systems.

Nutrient management

Germination, cane yield, cane weight, and juice quality did not vary due to nutrient doses. However, a dose of 100% of recommended NPK resulted in higher shoot height and number of millable canes which were significantly higher by 5.3 and 6.6% than 75% recommended dose of the fertilizer.

Table 1. Effect of cropping systems and nitrogen, phosphorus and potassium levels on growth, yield and quality of spring sugarcane

Treatment	Germination (%)	Shoot height (cm)		Number of millable canes ('000/ha)	Cane weight (g)	Cane yield (tonnes/ ha)	Juice surcose (%)	Commercial cane sugar yield (tonnes/ha)
		HI	MT					
Cropping system								
Sole sugarcane	37.4	105	150	101	1,100	101.0	19.2	11.5
Sugarcane + cowpea	36.3	99	134	87	1,118	86.8	18.9	09.8
Sugarcane + mungbean	38.0	97	127	93	1,054	92.0	19.0	10.5
Sugarcane + urdbean	35.2	94	125	90	1,118	89.5	18.8	10.0
Sugarcane + *Sesbania*	34.8	95	140	96	1,150	93.6	18.7	10.7
CD (P=0.05)	NS	8	10	7	45	7.5	NS	0.9
N:P_2O_5:K_2O (150:80:60 kg/ha) % of recommended								
75	35.1	94	133	91	1,100	90.6	19.0	10.3
100	37.6	102	138	95	1,110	94.9	18.8	10.6
125	36.3	98	134	94	1,116	92.4	18.9	10.6
CD (P=0.05)	NS	6	7	4	NS	NS	NS	NS

HI, At harvest of intercrops stage; MT, maximum tillering stage

Table 2. Effect of cropping systems and nitrogen, phosphorus and potassium levels on cane-equivalent yield, monetary return, nutrient uptake (kg/ha) and residual soil fertility in spring sugarcane-based intercropping systems

Treatment	Cane-equivalent yield (tonnes/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Benefit : cost ratio	Nutrient uptake (kg/ha)			Residual soil fertility (kg/ha)		
					N	P	K	N	P	K
Cropping system										
Sole sugarcane	101.0	95,950	48,330	2.01	196.6	18.7	317	163	16.2	270
Sugarcane + cowpea	118.4 (100)	112,480	57,772	2.06	174.5	17.8	260	188	18.8	268
Sugarcane + mungbean	102.2 (4.4)	97,090	43,528	1.81	184.0	14.4	285	174	17.6	256
Sugarcane + urdbean	99.5 (3.8)	94,525	41,449	1.78	181.0	13.2	280	179	17.2	260
Sugarcane + *Sesbania*	93.6	88,920	41,688	1.88	185.8	17.4	292	192	20.2	305
CD (P=0.05)	8.6		9,050	0.12	11.2	4.0	24	11	3.4	35
$N:P_2O_5:K_2O$ (150:80:60 kg/ha) % of recommended										
75	99.0	94,050	43,750	1.87	173.0	14.1	276	166	15.8	255
100	104.0	98,800	47,400	1.92	188.0	16.8	287	184	18.2	269
125	106.0	100,700	48,560	1.93	192.2	18.0	298	188	19.8	291
CD (P=0.05)	5.0		4,800	NS	7.8	2.3	16	7	2.0	22

Values in parentheses are of intercrops yield (q/ha); sugarcane price Rs 950/tonne, cowpea Rs 300/q, mungbean Rs 2,200/q, urdbean Rs 2,500/q; Initial soil test values 186, 19.18 and 298 kg/ha of N, P and K respectively

Nutrient doses had significant effect on cane-equivalent yield and economics (Table 2). Cane-equivalent yield and returns/ha exhibited an increasing trend with increasing levels of NPK up to the highest levels. A dose of 125% of recommended NPK resulted in 7.0 tonnes/ha more cane-equivalent yield than 75% dose. Such increase in cane-equivalent yield might be owing to under higher fertility condition, sugarcane compensate the shading effect in respect of the good yield of the intercrops. Similar opinion was also given by Singh *et al.* (2002).

When fertilized with 125% of recommended dose, sugarcane crop removed highest amount of N (192.2 kg/ha), P (18.0 kg/ha) and K (298 kg/ha) which were significantly higher by 11.0, 27.7 and 8.0% over 75% recommended NPK dose. Residual soil fertility followed the same trend as that of nutrient uptake. These results are in close conformity with those of Raju *et al.* (1997).

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