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Integrated nutrient management in late-planted sugarcane (*Saccharum officinarum*)–wheat (*Triticum aestivum*) system in western Uttar Pradesh

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ABSTRACT

A field experiment was conducted on integrated nutrient management in late-planted sugarcane (*Saccharum officinarum* L.)-wheat (*Triticum aestivum* L. emend. Fiori & Paol.) system during 1995–96 to 1998–99 at Modipuram, Meerut, Uttar Pradesh. Significantly higher cane yield (56.11 tonnes/ha) was recorded with 100% NPK ($N_{200}P_{65}K_{55}$) applied on soil-test basis. Substitution of 25% N through pressmud and farmyard (FYM) manure resulted yield at par with 100% NPK applied through chemical fertilizers, while substitution of 25% nitrogen through pressmud, FYM or green-manuring of cowpea in plant crop of sugarcane increased the cane yield of ratoon significantly (97.90 tonnes/ha). Wheat yield was significantly higher with 100% NPK ($N_{120}P_{60}K_{40}$) applied on soil-test basis. Any curtailment of chemical fertilizer reduced the wheat yield remarkably and significantly lower wheat yield (2.70 tonnes/ha) was recorded when 25% N need of wheat was substituted by sugarcane stubbles. Quality parameters such as brix, sucrose and purity showed that application of chemical fertilizer alone reduced the value of these parameters, while combination of both chemical and organic manures improved them. Soil analysis revealed that pH of the soil decreased from initial value (8.20) with the application of fertilizers and the magnitude of decrease was more when organic sources were applied along with chemical fertilizers. Soil organic carbon (%) did not show any remarkable change, while available P_2O_5 and K_2O increased with the combination of chemical fertilizer and organic source, such as pressmud, followed by FYM.

Key words : Integrated nutrient management, Sugarcane–wheat system, Quality parameters, Soil fertility

Sugarcane–wheat is an important cropping system in western Uttar Pradesh. Under this system, sugarcane occupies about 60% area of the total area under sugarcane and considered to be the main source of income of the farmer in the region. The productivity of the system is constrained due to late planting of sugarcane (April to May) and wheat (1 –15 January) in sugarcane–wheat system and inadequate and imbalance fertilizer use. These factors altogether reduce nearly 40% yield of the system. Therefore, present investigation was undertaken to study the effect of organic and inorganic nutrient sources on growth, yield, and quality characters and soil fertility under sugarcane–wheat system.

MATERIALS AND METHODS

A field experiment was conducted on integrated nutrient management in late-planted sugarcane–wheat system during 1995–96 to 1998–99 at Project Directorate for Cropping Systems Research, Modipuram. The experimental soil was sandy loam in texture and had pH 8.2, organic carbon (0.34%) and low in available NPK. In all, 9 treatments, viz. T_1, control ($N_0P_0K_0$); T_2, 100% NPK (200 : 65 : 55) on soil-test basis; T_3, 75% NPK + 25% N (pressmud); T_4, 75% NPK+25% N (FYM); T_5, 75% NPK + 25% N (green-manuring);T_6, 100%NPK (soil-test basis); T_7, 100% NPK (soil-test basis); T_8, 100% NPK (soil-test basis); T_9, 75% NPK in planted sugarcane and its ratoon was taken with recommended package of practices, whereas T_1, control ($N_0P_0K_0$); T_2, 100% NPK (120 : 60 : 50); T_3, 100% NPK (soil test basis); T_4, 100% PNK (soil test basis); T_5, 100% NPK (soil-test basis); T_6, 75% NPK+25% N (pressmud); T_7, 75% NPK+25% N (FYM); T_8, 75% NPK + 25% N (sugarcane stubble) T_9, 75% NPK in wheat crop, were tested in randomized block design with 4 replications. Pressmud applied in the field contains 1.0% N, FYM 0.50% N, cowpea (green-manuring), 0.50% N and sugarcane root stubble 0.50% N. Pressmud, FYM and sugarcane root stubble were applied and mixed in the soil at the time of last ploughing. Green-manuring of cowpea was done 45 days after sowing. These organic manures besides supplying nitrogen, phosphorus and potash also supply secondary and micro-nutrients (Kale, 1981). Sugarcane variety ('COS 767') was planted 60 cm apart during mid-May and harvested in the end of Febru-

ary and ratoon was harvested in the last week of November, whereas wheat variety ('PBW 226') was sown 22 cm apart during the first week of January and was harvested during the first fortnight of May. In sugarcane, 3-budded sets treated with Emisan @ 100 litres water/ha were used. Earthing-up of sugarcne was done in the first fortnight of July. Irrigation and plant-protection measures to sugarcane and wheat crop were used as and when required.

RESUTS AND DISCUSSION

Yield and yield attributes

Yield and yield attributes of sugarcane and wheat were affected significantly due to chemical fertilizers and organic manure (Table 1, 2). Significantly higher planted cane yield (56.11–55.20 tonnes/ha) was recorded with 100% NPK (N_{200} : P_{65} : K_{55}) applied on soil-test basis, while lowest cane yield (32.49–27.10 tonnes/ha) was obtained in the control (no fertilizer). The increase in cane yield due to 100% NPK application was 50.90 to 72.70% over the control. The substitution of N through pressmud and FYM resulted yield at par with 100% NPK applied through chemical fertilizers. However, substitution of 25% N through cowpea (green-manure) reduced the cane yield significantly. It is interesting to note that cane yield in all the treatments of nitrogen substitution did not differ significantly from each other (Gangwar and Sharma, 1997) also reported the similar results. Yield attributes like plant height, internodes/cane, millable canes/m^2 and cane weight (kg) were significantly higher under 100% NPK applied on soil-test basis. Substitution of 25% N through pressmud, FYM or green-manuring of cowpea in plant crop of sugarcane increased the cane yield of ratoon on an average by 7–10 tonnes/ha compared 100% NPK applied through chemical fertilizers on soil-test basis. Among the sources, green-manuring of cowpea resulted in significantly higher cane yield of ratoon over 100% NPK probably owing to marked residual effect of green-manuring of cowpea on ratoon crop. In case of any curtailment in chemical fertilizers on an average reduced the grain yield of wheat by 0.5–0.6 tonne/ha compared with 100% NPK (N_{120} : P_{60} : K_{50}) applied through chemical fertilizer on soil-test basis and significant reduction in the grain yield of wheat was recorded when 25% N need of wheat was substituted by sugarcane root residue. Sources of 25% N substitution did not exhibit significant difference among themselves. Lowest grain yield of wheat was obtained in the treatment where no fertilizer was applied. This significant reduction in the grain yield of wheat was associated with the lower values of yield-attributing characters like spikes/m^2, spike length (cm), grain/spike and 1,000–grain

Table 1. Effect of integrated nutrient supply on the yield of sugarcane–wheat system (tonnes/ha)

Treatment	I crop cycle			II crop cycle		
	Sugarcane	Ratoon	Wheat	Sugarcane	Ratoon	Wheat
T_1	32.49	51.80	1.80	27.10	51.00	2.18
T_2	56.11	88.90	3.38	55.20	72.90	3.68
T_3	54.79	95.60	3.39	52.10	81.40	3.69
T_4	54.20	94.80	3.37	53.80	80.20	3.67
T_5	53.64	97.90	3.35	53.30	83.20	3.65
T_6	56.00	89.20	3.00	54.50	73.10	3.30
T_7	55.90	88.70	2.90	54.30	73.20	3.20
T_8	55.80	89.50	2.70	53.80	72.80	3.10
T_9	46.20	70.60	2.55	47.22	62.00	2.90
CD (P=0.05)	1.92	8.20	0.50	1.80	9.50	0.50

Details of treatments are given under Materials and Methods

Table 2. Effect of integrated nutrient supply on the yield attributes of sugarcane and wheat in sugarcane–wheat system

Treatment	I crop cycle								II crop cycle							
	Planted sugarcane				Wheat				Planted sugarcane				Wheat			
	Plant height (cm)	Internodes/ cane	Millable canes/ m^2	Cane weight (kg)	Spikes/ m^2	Spike length (cm)	Grains/ spike	1,000-grain weight (g)	Plant height (cm)	Internodes/ cane	Millable canes/ m^2	Cane weight (kg)	Spikes/ m^2	Spike length (cm)	Grains/ spike	1,000-grain weight (g)
T_1	130.60	11.97	9.20	0.40	246.0	8.20	28.60	38.20	128.40	12.50	9.40	0.38	324.0	9.20	32.60	40.90
T2	176.30	21.05	12.30	0.50	322.0	9.70	35.20	39.80	173.50	19.30	11.60	0.47	441.0	11.80	48.20	42.10
T_3	168.20	19.12	11.90	0.46	346.0	10.40	35.60	40.10	167.60	21.10	12.30	0.45	445.0	11.40	45.60	42.0
T_4	165.40	18.30	11.70	0.46	334.0	9.80	34.80	40.80	163.80	20.70	12.40	0.45	440.0	11.20	42.80	41.80
T_5	164.6	17.90	11.60	0.45	352.0	10.70	38.20	40.10	164.20	22.10	12.30	0.43	438.0	10.80	40.20	41.80
T_6	175.20	21.90	12.20	0.43	305.0	9.70	32.90	40.40	173.70	19.50	11.70	0.46	405.0	10.60	38.90	41.40
T_7	173.20	20.05	12.10	0.47	318.0	9.50	31.70	40.20	173.40	20.00	11.40	0.45	399.0	10.60	36.70	41.20
T_8	171.10	19.10	11.90	0.46	297.0	9.30	33.10	40.20	171.60	19.80	11.80	0.46	385.0	10.40	36.10	41.20
T_9	163.40	16.40	11.20	0.45	311.0	9.10	31.80	40.0	164.20	20.70	11.90	0.45	378.0	10.20	35.80	41.0
CD (P=0.05)	3.40	1.49	0.53	0.05	0.40	0.41	3.10	NS	3.20	1.62	0.57	0.05	8.40	0.40	3.10	NS

Details of treatments are given under Materials and Methods

weight recorded under this treatment (Gangwar *et al.*, 1994).

Quality parameters

Quality parameters of sugarcane such as brix (%), sucrose (%) and purity (%) affected significantly by integrated nutrient supply (Table 3). Application of 100% NPK through chemical fertilizers alone reduced the quality of juice in terms of brix, sucrose and purity % compared with the control, while combination of both organic and inorganic fertilizers improved these quality characters over 100% NPK. However, higher value of these quality characters were remained under the control where no fertilizer application was made. Because higher doses of N increase the activity of invertase enzyme responsible for the degradation of sugar converting them into reducing sugar (glucose and fructose). These results comfirm those of Singh *et al.* (1986) and Kanwar and Kapur (1987).

Table 3. Effect of integrated nutrient supply on the quality characters of late-planted sugarcane

Treatment	I crop cycle			II crop cycle		
	Brix (%)	Sucrose (%)	Purity (%)	Brix (%)	Sucrose (%)	Purity (%)
T_1	19.53	13.46	86.59	19.50	13.39	86.60
T_2	19.25	11.34	81.25	19.18	11.32	81.20
T_3	19.38	12.25	84.40	19.40	12.22	84.38
T_4	19.44	12.36	84.47	19.41	12.29	84.41
T_5	19.44	12.29	84.45	19.45	12.16	84.40
T_6	19.27	11.26	81.24	19.20	11.23	81.22
T_7	19.27	11.33	81.22	19.22	11.30	81.20
T_8	19.28	11.32	81.18	19.24	11.29	81.20
T_9	19.23	11.31	81.23	19.18	11.27	81.19
CD (P=0.05)	0.08	0.16	0.14	0.07	0.17	0.15

Details of treatments are given under Materials and Methods

Soil fertility

After completing 2 cycles of sugarcane–wheat system, the soil of experimental field was analysed to study the affect of integrated nutrient supply on chemical properties of the soil (Table 4). Application of fertilizers decreased the pH of the soil compared with initial value (8.20) and magnitude of decrease was more when organic sources were applied along with chemical fertilizers and the lowest pH of 7.90 was observed where 25% N was substituted by pressmud. The organic carbon did not change much due to different treatment of fertility, while available P and K

Table 4. Effect of integrated nutrient supply on soil chemical properties after 2 cycle of sugarcane – wheat system

Treatment	Soil chemical properties			
	pH	Organic carbon (%)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Available K_2O (kg/ha)				
T_1	8.15	0.37	7.20	79.40
T_2	8.10	0.38	12.50	92.30
T_3	7.95	0.38	13.20	96.50
T_4	8.02	0.39	12.90	94.20
T_5	8.00	0.39	12.60	93.70
T_6	7.90	0.38	14.20	98.20
T_7	8.00	0.39	13.20	97.40
T_8	8.10	0.39	12.90	97.30
T_9	8.12	0.38	10.50	85.90
Initial	8.20	0.38	8.40	81.50

Details of treatments are given under Materials and Methods

increased up to 14.20 and 98.20 kg/ha over their initial value of 8.40 and 81.50 kg/ha, respectively, in the treatment where 25% N substitution was made by pressmud followed by FYM.

Thus it can be concluded that 75% NPK through chemical fertilizers + 25% nitrogen through pressmud to sugarcane, followed by 100% chemical fertilizer to wheat crop should be applied on soil-test basis for achieving higher yield of late-planted sugarcane–wheat system in western Uttar Pradesh.

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