

Effect of nitrogen levels on increased crop production and net profitability of sugarcane ratoon in Uttar Pradesh

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ABSTRACT

A field experiment was conducted on Gangetic alluvial soils of Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during the spring seasons of 2008-09 and 2009-10 respectively to find out suitable nitrogen levels for getting higher and higher growth, yield and economics of first and second ratoon crops of sugarcane. Application of 210 kg N/ha significantly recorded highest percentage of number of tillers/ha (4.16, 5.48%), number of millable canes/ha (1.08, 1.12%), weight of millable cane (6.59, 5.85%), cane length (3.07, 2.59%), number of internodes/cane (8.79, 7.59%), cane girth of top (2.78, 4.52%), middle (2.23, 1.22%) and bottom (1.40, 2.77%) and cane yield (28.44, 33.66%) at 210 kg N/ha and 22.81 and 25.74% at 180 kg N/ha, whereas at highest levels of nitrogen associated with highest yield (176.11, 150.61 t/ha) and biological yield (218.93, 187.64 t/ha) with highest net return (Rs.435842 and Rs.347876/ha) and B/C cost ratio (6.41 and 4.71) than the controlled (50 kg N/ha).

Key words: Nitrogen levels, growth, yield, economics, sugarcane ratoon

Ratoon cropping is the pivot of sugarcane based production system around which cane productivity and economics profitability at farm levels as well as sugar recovery level revolves. Ratooning in sugarcane economizes the cost of cultivation and increases the margin of profit by saving cost of seed cane to the extent of 1/10th of millable canes, saving of about 51 per cent energy and expenditure by eliminating land preparation and planting operation avoiding delayed planting and shortens the crop cycle by 4 to 5 weeks (Lal and Singh 2008). But in ratoon sugarcane, much higher and earlier tillering or sprouting of lateral buds from the stubbles of which develops later into mature cane or stalks. Even though late formed tillers or water shoots utilizes the resources without adding anything to the cane yield and economics. However, late formed tillers/ or shoots utilized the plant and soil resources which could be further utilized by mother tillers for improving the yield and quality of sugarcane. Nitrogen is one of the most important nutrients required in large amounts for its vegetative growth, yield and economics. At the same time higher amounts of nitrogen affected the sprouting, stalk population and produce dense tillers and simultaneously cause higher mortality of tillers because of more competition and greater incidence of late formed tillers or water shoots and helps in converting into strong millable canes. Therefore, the study was undertaken to

assess the performance of different levels of nitrogen for increasing the crop production, economics and net profitability of sugarcane ratoon in Gangetic alluvial soils of Uttar Pradesh.

MATERIALS AND METHODS

The field experiment was carried out during spring seasons of 2008-09 and 2009-10 at Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, (U.P.). The experimental soil was sandy clay loam with pH 7.94, with organic carbon 0.33%, low available N (185.62 kg/ha), low available P (24.45 kg/ha) and medium available K (235.37 kg/ha). This experiment was laid out in a split plot design with three replications. The cane crop was planted in a row spacing of 90 cm apart in an experimental field. The crop was harvested and field was irrigated at the time of ratoon initiation. Thereafter, the field was designed in such a way that our experimental plans have to be accommodated properly. In order to adjust experiment in already existed plant sugarcane field, stubbles of fifth rows were uprooted to make irrigation channels as well as boundary wall for the experimental plots. Similarly, stubbles from the rows of sugarcane plants were also uprooted after a measured length of a plot size so as to bifurcate the plot from one plot to another. Thus, all the uprooted stubbles of canes were shifted to vacant places for gap filling so as to get desired plant population to optimize the yields of ratoon sugarcane. Full dose of P₂O₅ @ 80 kg/ha, K₂O @ 80 kg/ha and 1/3rd of urea as per treatment were applied at the time of ratooning. Rest 2/3rd of urea was top dressed in two equal splits before earthing up in the month of April and May as per treatments.

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Sugarcane ratoon crops were harvested after the completion of 12 month i.e., 15th February or 1st week of March. Various growth parameters viz. number of tillers/ha, height of tillers, LAI, dry matter accumulation and number of millable canes were recorded at standing crop. Similarly yield and yield attributes like cane length, cane diameter, cane weight, green tops yield and cane yield were noted after the harvest of ratoon crop. Economic analysis was done based on the prevailing market price of the inputs and produce i.e. fertilizer N @ Rs. 11.30/kg, P @ Rs. 21.25/kg, K @ Rs. 8.00/kg and cost of sugarcane @ Rs. 2932.50/t (Sugarcane Corporation of India) during 2009-10 as its rate was Rs. 293.25/quintal.

RESULTS AND DISCUSSION

Effect of nitrogen levels on number of tillers, number of millable canes, cane length, weight of millable cane and number of internodes/cane

The number of tillers, number of millable canes, cane length, weight of millable canes and number of internodes/cane improved due to application of nitrogen and highest values were recorded at 210 kg N/ha. The ratoon crop fertilized with 210 kg N/ha recorded significantly higher number of tillers/ha as compared to 180 and 150 kg N/ha. Similarly 180 kg N/ha was also found superior over 150 kg N/ha which produced the lowest number of tillers. These might be due to nitrogen helps in increasing the sprouting of ratoon sugarcane which further converted into number of tillers in increasing order which are supported by the similar findings (Lal and Singh and Lal *et al.* 2008).

The number of millable canes/ha were recorded with the application of 210 kg N/ha which remained at par with 180 kg N/ha where both found superior as compared to 150 kg N/ha which were mainly due to increasing doses of nitrogen helped in proper growth and development of ratoon crops. These results are in agreement with the findings of Ali *et al.* (2000) and Singh (2000).

Higher doses of nitrogen significantly influenced the cane length. The highest cane length was observed with the application of 210 kg N/ha which remained significantly superior over other treatments. However, 150 kg N/ha was found significantly inferior to 180 and 210 kg N/ha with respect to cane length in both first and second ratoon crops. Similar findings were reported to those of Choudhary and Ullah (2001).

Nitrogen fertilization also increased the weight of millable canes significantly up to 210 kg N/ha which was significantly superior over 180 and 150 kg N/ha. This might be due to increasing doses of nitrogen increased the photosynthetic rate, their by accumulating more food materials resulted in increased dry matter which increased the weight of millable canes. Similar trend of effects has also been advocated by Singh (2000).

Application of nitrogen significantly augmented the number of internodes/cane up to highest levels. 210 kg N/ha recorded highest number of internodes which was followed by 180 and 150 kg N/ha. This was due to the fact that continuous uptake of different levels of nitrogen led to proper crop growth and development of crops.

Table 1 Effect of nitrogen levels on number of tillers ('000/ha), number of millable canes/ha, cane length (cm), weight of millable cane (g) and number of internodes/cane of sugarcane ratoon

Treatment	No. of tillers ('000/ha)		No. of millable canes/ha		Cane length (cm)		Weight of millable cane (g)		No. of internodes/cane	
	2008- 09	2009- 10	2008- 09	2009-10	2008-09	2009-10	2008-09	2009-10	2008- 09	2009-10
Nitrogen levels (kg/ha)										
N ₁ - 150	121.64	102.06	105.28	100.56	348.83	294.21	1258.64	1105.56	30.47	28.22
N ₂ - 180	131.81	123.80	111.39	108.44	381.50	314.57	1455.77	1294.44	37.21	35.78
N ₃ - 210	137.54	130.99	112.61	109.67	393.61	322.96	1558.58	1375.00	40.80	38.72
SEm ±	0.33	3.87	1.01	1.38	4.05	2.37	6.74	6.61	0.20	0.19
CD (P = 0.05)	0.96	11.29	2.94	4.03	11.83	6.92	19.67	19.30	0.58	0.56

Table 2 Effect of nitrogen levels on cane girth (cm), cane yield (t/ha), biological yield (t/ha) and harvest index (%) of sugarcane ratoon

Treatment	Girth of cane (cm)						Cane yield		Biological Yield		Harvest Index	
	Top of cane		Middle of cane		Bottom of cane		(t/ha)		(t/ha)		(%)	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Nitrogen levels (kg/ha)												
N ₁ -150	2.23	2.11	2.36	2.24	2.53	2.31	137.11	112.67	169.06	142.94	80.31	78.65
N ₂ -180	2.44	2.32	2.62	2.41	2.80	2.45	168.39	141.67	208.03	176.58	80.25	80.14
N ₃ -210	2.51	2.43	2.68	2.44	2.84	2.52	176.11	150.61	218.93	187.64	80.12	79.86
SEm ±	0.02	0.01	0.01	0.02	0.04	0.03	1.34	0.90	1.28	0.95	0.21	0.24
CD (P = 0.05)	0.06	0.03	0.04	0.07	0.10	0.07	3.90	2.64	3.75	2.76	NS	0.71

Table 3 Effect of nitrogen levels on gross return (Rs/ha), total cost of cultivation (Rs/ha), net return (Rs/ha) and benefit/cost ratio of sugarcane ratoon

Treatment	Gross Return (Rs/ha)		Total cost of cultivation (Rs/ha)		Net return (Rs/ha)		Benefit/Cost ratio	
	2008-09	2009-10	2008-09	2009-10	2008- 09	2009- 10	2008- 09	2009- 10
Nitrogen levels (kg/ha)								
N ₁ - 150	402078	330395	79926	93116	322152	237279	5.03	3.55
N ₂ - 180	493800	415438	80265	93455	413535	321982	6.15	4.44
N ₃ - 210	516446	441667	80604	93794	435842	347873	6.41	4.71

Effect of nitrogen levels on cane diameter, cane yield, Biological yield and Harvest index of ratoon sugarcane

Increasing nitrogen levels from 150 to 210 kg N/ha resulted significant increase in cane diameters of top, middle and bottom and maximum was observed with 210 kg N/ha which were at par with 180 kg N/ha except top of cane diameter in both the years of crops and middle of cane in 2008-09 where 210 kg N/ha was significantly superior over 180 kg N/ha. The values of cane diameter, was due to application of nitrogen and highest values were recorded at 210 kg N/ha. These enhanced cane diameters might have made significant translocation and storage of photosynthate from source to sink which resulted significant improvement in cane diameter with corresponding increase in nitrogen levels. These findings in present study are true to the results obtained by Sharma and Gupta (1991) and Ali *et al.* (2000).

As the nitrogen enhanced the crop growth, protein synthesis and chlorophyll content of leaves. Therefore, the cane yield was significantly influenced by different nitrogen levels and maximum was recorded at highest nitrogen levels (210 kg N/ha). The per cent increase in yield over control were 28.44 and 33.67 recorded at 210 kg N/ha as compared to lower doses of nitrogen which were 22.81% and 25.74% higher yield at 180 kg N/ha than control treatments which might be due to effects of all N together in balanced form reflected increased values of cane yield. Increased cane yield with increase in nitrogen levels was reported by Inoue *et al.* (2009).

The plant fed with higher doses of nitrogen and balanced doses of P and K consequently produced greater green tops yield and trash yield being maximum at highest levels of nitrogen associated with higher biological yield and harvest index but harvest index decreased with increasing the nitrogen levels in 2008-09 while during 2009-10 harvest index increased up to 180 kg N/ha and thereafter it decreased. Similar findings were also reported by Hussain *et al.* (2000) and Ehsanullah and Iqbal (2001).

Effect of nitrogen levels on economics of ratoon sugarcane

There was positive effects on gross return, net return and B/C ratios of each increments of nitrogen application in ratoon sugarcane as higher values were consequently recorded as per nitrogen doses and highest was obtained under higher doses of nitrogen at 210 kg/ha. However, the lower doses of nitrogen

recorded lowest values at 150 kg N/ha which was followed by 180 kg N/ha. In the same way, increasing nitrogen levels has also increased B/C ratios but B/C ratios obtained at 180 and 210 kg N/ha were at par but both are found significantly superior over 150 kg N/ha during both the years of study. However highest B/C ratios were obtained at 210 kg N/ha.

It was concluded that both first and second ratoon crops raised from a single plant cane proved beneficial for farmers when crop was given 210 kg N/ha for better yield and higher net returns along with highest B/C ratio of sugarcane ratoon.

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