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Effect of N Fertilization and Insecticides on the Incidence of Shoot and Top Borer, Yield and Quality of Ratoon Sugarcane

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ABSTRACT

Field experiments were conducted at Sugarcane Research Institute farm, Pusa, Bihar, India in calcierthents soil to study the effect of nitrogen (75, 150 and 225 kg ha^{-1}) and insecticides (gamma HCH 6G, phorate 10G and carbofuran 3G all of them @ 1 kg a.i ha^{-1}, neem cake blending of urea 1:4) on the growth, incidence of shoot and top borer, yield and quality of ratoon sugarcane. Application of N significantly influenced the production of tiller, millable cane, yield of ratoon cane, though 150 and 225 kg N ha^{-1} were statistically at par to each other. N-fertilization did not cause significant variation on the incidence of shoot and top borer, though all the insecticides were equally effective and significantly superior to untreated in controlling incidence of pests and ultimately the yield. Application of N and insecticides did not affect significant variation in sucrose percent juice.

Key words: Nitrogen fertilization, insecticides, shoot and top borer, ratoon, sugarcane.

INTRODUCTION

Inadequate nitrogen fertilization is a major handicap in the yield potential of ratoon sugarcane. The crop is less efficient in utilizing applied nitrogen than plant crop of sugarcane, hence, higher dose of N has to be applied in ratoon cane than plant cane to make up the exhaustion caused by the preceding crop and to sustain good yield. Appropriate dose of N fertilizer is the basic need in view of the fact that its requirement for good growth and sucrose percent in juice after a certain level starts declining (Rana and Saini, 1989). Insecticides are recommended for effective control of sugarcane insect pests. Beneficial effects of insecticides in increasing the efficiency of nitrogen application and thereby increasing the cane yield have been reported under different agro-climatic conditions. Since, systematic information on these aspects in ratoon sugarcane is lacking, this experiment was conducted to find out the optimum N dose and suitable insecticide to improve the productivity of ratoon sugarcane.

MATERIALS AND METHODS

The field experiment was conducted at Sugarcane Research Institute farm, Pusa, Bihar, India during spring cropping season of 1994-95 to 1996-97. The soil of experimental plot was sandy loam with 32.4% free calcium carbonate, 0.42% organic carbon, 151.6 kg ha^{-1} available N, 22.50 kg ha^{-1} available phosphate and 128.2 kg ha^{-1} available K having pH 8.3. The treatments were levels of nitrogen 75, 150 and 225 kg N ha^{-1} in main plot and insecticides gamma HCH 6G, phorate 10G and carbofuran 3G all of them @ 1 kg

a.i./ha^{-1}, neem cake blending of urea 1:4 and the untreated control in sub-plot making altogether fifteen treatment combinations which were replicated three times in a split plot design. Plant crop of sugarcane (variety BO 110) was harvested in the last week of February and then recommended agronomical practices were followed in all the plots. Full dose of phosphate 50 kg ha^{-1}, potassium 60 kg ha^{-1} and half of N as per treatments were applied three weeks after stubble shaving (end of March). Neem cake blending of urea 1:4 was thoroughly mixed with 1% neem oil which was applied at the time of basal application of N as per treatment. Soil application of insecticides as per treatments were done after the basal application of nutrients and it was immediately covered by the soil. The remaining half of N as per treatments was top dressed in two equal splits after second irrigation and at the time of earthing up (first week of July). The percent incidence of shoot borer was calculated during the third week of March and first week of June and that of top borer (second generation) during the first week of July. The ratoon crop was harvested in the last week of January. Whole cane samples were taken at the time of harvest and analysed for total N and juice quality (Meade and Chen, 1977) and thereby N uptake and commercial cane sugar were calculated.

RESULTS AND DISCISSION

Effect of Nitrogen

Nitrogen nutrition brought positive impact on initial shoot population (Table 1). The increase in tiller production by the application of 150 and 225 kg N ha^{-1} over 75 kg N ha^{-1} was to the extent of 20.7 and 10.4 percent respectively, further all the N levels differed significantly among themselves. Jafri and Alam (1981) and Thakur et al. (1988) have reported similar results. Nitrogen resulted in significant improvement in plant height and girth development, though 225 and 150 kg N ha^{-1} were statistically similar and significantly superior to 75 kg N ha^{-1} in influencing height and girth of ratoon cane plant. This might be due to accelerated growth rate in plant system resulting in greater accumulation and storage. Elongation of the plant and girth development are very complex chemical and physiological phenomenon occuring in the meristem of the plant, where the highest concentration of N occurs.

Nitrogen fertilization did not affect signifgicant variation either in shoot borer incidence as well as top borer incidence (Table 1). Improvement in growth characters due to N fertilization resulted positive increase in millable canes ha^{-1}, though 150 and 225 kg N ha^{-1} were statistically similar and both of them were significantly superior to 75 kg N ha^{-1} (Table 2). Nitrogen by its combination in various metabolic activities and better growth of ratoon cane plants as evidenced by significant increase in height, girth and millable canes ha^{-1} resulted in higher ratoon cane yield. The increase in ratoon cane yield by the application of 225 and 150 kg N ha^{-1} over 75 kg N ha^{-1} were to the extent of 27.2 and 17.8 percent respectively. Many workers (Thakur et al. 1988 and Rana and Saini, 1989) have reported similar results. Although sucrose percentage in juice was not significantly influenced by N fertilization, commercial cane sugar was more at higher N level owing to increase in ratoon cane yield. However, 150 and 225 kg N ha^{-1} were statistically similar in influencing the commercial cane sugar (Table 1). Nitrogen uptake was also significantly more at higher N levels, however, the difference between 150 and 225 kg N ha^{-1} was not significant.

Effect of insecticides

Application of insecticides brought significant variation in initial shoot population dead heart basis and pre-monsoon tiller count (Table 1). Pre-monsoon tiller production by the application of different insecticides was 4.7 to 11.8 percent higher over untreated (control). Insecticide carbofuran 3G produced maximum plant height (216 cm) though statistically similar to phorate 10G (200 cm) and gamma HCH 6G (199 cm) and significantly superior to neem cake blending of urea 1:4 (196 cm) and untreated control (193 cm). These beneficial effects of insecticides might be due to effective control of insect pests during various growth phases of ratoon canes. There was favourable response of insecticides on girth of ratoon cane and individual cane weight, however, it was not significant.

Insecticides did not significantly influence on the incidence of initial shoot borer recorded during the third week of March. This might be due to low natural incidence of shoot borer during initial stage of crop growth. At later stages of crop growth insecticides were significantly effective in minimising the percent incidence of shoot borer and top borer (second generation) (Table 1). Although all the insecticides were equally effective in minimising the percentage incidence phorate 10G gave the best result in controlling shoot borer followed by carbofuran 3G and gamma HCH 6G was the best in controlling top borer followed by phorate 10 G.

Table 1. Effect of nitrogen fertilization and insecticides on morphological characters and incidence of shoot and top borer in ratoon sugarcane (Pooled data of 1994-95 to 1996-97).

Treatments	Initial shoot population '000' ha^{-1} (Third week of April)	Pre-monsoon tillers (early June) '000' ha^{-1}	Final plant height (cm)	Shoot borer (% incidence)		Top borer (% incidence)
				Last week of March	1st week of June	1st week of July (2nd gen.)
N-Levels (kg ha^{-1})						
75	45.16	137.42	183	4.30 (11.66)*	13.80 (22.25)	9.42 (16.68
150	50.60	151.65	202	3.58 (10.65)	13.28 (21.75)	8.24 (16.38)
225	60.12	165.48	210	5.10 (13.02)	14.38 (22.45)	8.26 (16.41)
CD (P=0.05)	7.08	11.15	18	NS	NS	NS
Insecticides :						
Untreated control	45.97	136.65	193	3.51(10.68)	22.21(27.61)	12.15 (21.12)
Gamma HCH 6 G 1 kg a.i ha^{-1}	51.47	157.41	199	3.72 (10.88)	11.48 (22.01)	5.48 (12.98)
Phorate 10 G 1 kg a.i ha^{-1}	53.24	161.28	200	4.98(12.68)	10.51 (18.71)	6.30 (14.42)
Carbofuran 3G 1 kg a.i ha^{-1}	55.48	163.92	212	4.91 (12.56)	10.90 (20.08)	8.12 (16.03)
Neem cake blending of urea (1:4)	52.37	150.48	196	4.24 (11.75)	14.11 (22.00)	11.25 (19.72)
CD (P=0.05)	5.84	10.10	14	NS	2.52	2.04

*Figures in parentheses are original values and transformed in $\sqrt{x + \frac{1}{2}}$

Insecticides brought positive variation in millable cane ha^{-1} among them carbofuran 3G produced the maximum millable canes followed in order by phorate 10G and gamma HCH 6G. All of them were significantly superior to neem cake blending urea 1:4 and untreated control.

Thus, due to effective control of shoot and top borer at the different growth phases of ratoon sugarcane by the insecticides brought significant improvement in tiller production, height and millable canes ha^{-1} which ultimately reflected in higher yield of ratoon cane. The magnitude of increase in yield by insecticides carbofuran 3G, phorate 10G, gamma HCH 6G and neem cake blending of urea over untreated control was to the extent of 19.6, 16.2, 11.3 and 3.7 percent respectively. Gupta *et al.* (1985) and Biswas *et al.* (1994) have reported similar results. Application of insecticides significantly improved the growth hormones (auxin) in growth phases of ratoon cane and consequently reduced the insect pest damage probably due to recovery of plants more rapidly. Sucrose percent in juice was not significantly influenced by the insecticides. However, commercial cane sugar ha^{-1} was significantly higher in the insecticide applied plots due to positive improvement in cane yield. Nitrogen uptake (kg ha^{-1}) was maximum by carbofuran 3G followed in order by phorate 10G, gamma HCH 6G, neem cake blending of urea and untreated control and all of them differed significantly among themselves (Table 2). This might be due to varied translocation of nitrogen by different insecticides in growth phases of ratoon crop.

Table 2. Yield attributing characters, cane and commercial sugar yield (t ha-1) and N uptake (kg ha-1) as affected by N-levels and insecticides on ratoon sugarcane (Three years pooled data of 1994-95 to 1996-97).

Treatments	Millable canes ('000 ha^{-1})	Cane girth (mm)	Per cane weight (g)	Cane yield (t ha^{-1})	Sucrose % juice (t ha^{-1})	Commercial cane sugar	N-Uptake (kg ha^{-1})
N-levels (kg ha^{-1})							
75	90.12	19.4	657	59.11	17.11	6.98	139.65
150	102.67	20.0	579	69.63	16.90	8.12	174.96
225	108.08	20.1	696	75.16	16.73	8.55	188.84
CD (P=0.05)	10.71	0.5	NS	7.31	NS	0.94	10.04
Insecticides							
Untreated control	91.24	19.4	674	61.47	16.91	7.07	145.22
Gamma HCH 1 kg a.i ha^{-1}	100.98	19.8	678	68.39	16.82	7.85	169.27
Phorate 1 kg a.i ha^{-1}	105.17	19.9	686	71.40	16.95	8.26	179.40
Carbofuran 1 kg a.i ha^{-1}	105.88	20.1	693	73.37	17.11	8.56	187.09
Neem cake blending of urea 1 4	95.60	19.6	682	65.20	16.76	7.45	156.48
CD (P=0.05)	6.94	NS	NS	4.02	NS	0.64	8.62

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