

## Effect of Nitrogen on Growth, Yield and Sucrose Content of Sugarcane

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### ABSTRACT

A field experiment was carried out to determine the nitrogen requirement of sugarcane at Sugarcane Research and Training Institute (SRTI), Jaipurhat Sugar Mills (JSM) farm and Kaliachapra Sugar Mills (KCSM) farm, Kishoreganj, during the cropping season of 1986-87 and to study the effect of nitrogen on different growth parameters of sugarcane. Nitrogen at 160 kg ha<sup>-1</sup> produced significantly higher number of tillers, millable canes and higher yield of canes and sugar in all locations. Nitrogen application increased cane yield by 20.45 and 10% at SRTI, JSM and KCSM respectively. Nitrogen rate of 160 kg ha<sup>-1</sup> also gave the highest economic return in all locations.

### INTRODUCTION

Sugarcane is a long duration exhaustive crop. A sound fertilization practices is very essential for its growth and development, ICAR (1980) reported that 70 tons cane removes 85-110 kg N ha<sup>-1</sup>. Therefore, additional nitrogen is required for proper growth and development and to supplement losses of N from Soil through leaching, denitrification, volatilization etc. The rate of N application varies from place to place on the basis of soil fertility, productivity and agro-climatic condition (Singh & Singh, 1972). Boramanikar and Borole (1983) obtained highest result from timely application of 250 kg N ha<sup>-1</sup>. On the Other hand Chowdhury *et al.*, (1982) found that highest yield of cane was obtained with 125 kg N ha<sup>-1</sup>.

The recommended dose of nitrogen fertilizer application for sugarcane is 125 kg N ha<sup>-1</sup> (Ali, 1974). Whereas experiments at JSM shows the highest yield of cane at 200 kg N ha<sup>-1</sup> (Rahman and Khalequzzaman, 1981). In the above situations, a series of field studies were undertaken with the various doses of nitrogen to find out the optimum dose of nitrogen for sugarcane.

### MATERIALS AND METHODS

The field experiment was conducted at three locations such as Sugarcane Research and Training Institute (SRTI) farm, Ishurdi, Jaipurhat Sugar Mills (JSM) farm and Kaliachapra Sugar Mills (KCSM) farm, Kishoreganj during the cropping season of 1986-87. Soils of SRTI, JSM and KCSM represent Ganges River Flood plain, Tista Flood plain and old Brahmaputra Flood plain, respectively. Soil samples were collected before set up of experiments to determine the nutrient status. Results of chemical analyses of soils samples collected are presented in the Table 1.

Sugarcane variety Isd-16 was used as test crop at SRTI, whereas, Isd-2/54 was used at JSM and KCSM. In all experiments the treatments were distributed in a randomized complete block design with four replications. Three eyed assorted setts

were planted in the trenches. The nitrogen (N) treatments were 0, 80, 120, 160, 200 and 240 kg N ha<sup>-1</sup> from Urea. Recommended doses of P, K and S fertilizers were applied @ 125 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, 110 kg K<sub>2</sub>O ha<sup>-1</sup> and 30 kg S ha<sup>-1</sup> for SRTI and JSM, and @ 85 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, 110 kg K<sub>2</sub>O ha<sup>-1</sup> and 30 kg S ha<sup>-1</sup> for KCSM. Full doses of P, S and half of N and K were applied in trenches at the time of plantation and rest half of N and K were applied after 120-160 days of plantation as top dressing.

Soil texture was determined by hydrometer method, organic carbon by wet oxidation method, pH by a glass electrode pH meter and total nitrogen by kjeldahl NaHCO<sub>3</sub> extract, exchangeable K (NH<sub>4</sub> OAC extractable) was determined by flame photometer and available S on NH<sub>4</sub> OAC extract was determined by turbidimetric method (Black, 1965).

## RESULTS AND DISCUSSION

Results obtained on different field experiments are presented in the Table 2. From the table it is observed that nitrogen fertilizer has no effect on percent germination in any location. But the maximum doses, which might have caused injury on sugarcane buds, reduced germination percentage. Maximum number of tillers and millable canes were obtained where nitrogen @ 160 kg ha<sup>-1</sup> was applied in all locations. The number of millable cane were found less than the number of tillers due to tillers mortality. A similar observation was made by Rahman *et al.* (1989) and Anon. (1985)

The result also showed linear response to increasing levels of N upto 160 kg N ha<sup>-1</sup>. Further increase of N application (200 and 240 kg N ha<sup>-1</sup>) did not increase the yield of cane. This might be due to lodging as well as insect infestation of cane to the higher doses of nitrogen application. The highest yield of cane and sugar were obtained where 160 kg N ha<sup>-1</sup> was applied. The percent increase in cane yield over control were 20%, 45% and 10% at SRTI, JSM and KCSM respectively. The variation in the response of cane yield might be due to cane varieties, as well as soil fertility variations. Nitrogen fertilizer has no significant positive influence on percent recovery and sugar yield at KCSM through the highest sugar yield was recorded in 160 kg N ha<sup>-1</sup> treatment. At SRTI and JSM, percent recovery of sugar were not statistically significant but total production of sugar was significantly higher in 160 kg N ha<sup>-1</sup> than any in other treatment. Similar results were obtained by Rahman and Khalequzzaman (1981).

**Table 1. Initial soil analysis.**

| Locations | Texture    | pH  | Organic carbon (%) | Total N (%) | Available P (ppm) | Exchangeable K (me%) |
|-----------|------------|-----|--------------------|-------------|-------------------|----------------------|
| SRTI      | Loam       | 7.6 | 0.69               | 0.06        | 13                | 0.14                 |
| JSM       | Sandy loam | 5.8 | 1.04               | 0.05        | 20                | 0.13                 |
| KCSM      | Loam       | 5.9 | 0.82               | 0.06        | 12                | 0.07                 |

**Table 2. Effect of different levels of Nitrogen on yield and related parameters of sugarcane at different locations.**

| Location | Treatments<br>(kg ha <sup>-1</sup> ) | Germination (%) | No. of tiller ha <sup>-1</sup><br>(‘000’) | No. of millable cane ha <sup>-1</sup><br>(‘000’) | Yield of cane (TCH) | Recovery (%) | Yield of sugar (TSH) |
|----------|--------------------------------------|-----------------|-------------------------------------------|--------------------------------------------------|---------------------|--------------|----------------------|
| SRTI     | No                                   | 30.8 ab*        | 70.9 b                                    | 64.6 ab                                          | 55.0 ab             | 9.4 ab       | 5.2 b                |
|          | N <sub>80</sub>                      | 33.1 a          | 85.2 b                                    | 65.5 ab                                          | 51.0 b              | 9.9 ab       | 5.1 b                |
|          | N <sub>120</sub>                     | 22.3 a          | 80.7 b                                    | 59.4 b                                           | 59.9 ab             | 9.6 ab       | 5.5 b                |
|          | N <sub>160</sub>                     | 33.3 a          | 98.9 b                                    | 69.2 a                                           | 66.6 a              | 10.4 a       | 6.9 a                |
|          | N <sub>160</sub>                     | 33.2 a          | 73.2 b                                    | 64.3 ab                                          | 52.7 b              | 9.4 ab       | 4.9 b                |
|          | N <sub>240</sub>                     | 25.6 b          | 71.1 b                                    | 63.0 ab                                          | 52.0 ab             | 8.9 b        | 5.0 b                |
| JSM      | No                                   | 41.4 ab         | 63.3 c                                    | 60.7 c                                           | 37.2 d              | 9.3 ab       | 3.5 d                |
|          | N <sub>80</sub>                      | 42.2 a          | 84.2 b                                    | 81.3 b                                           | 45.0 c              | 9.3 ab       | 4.2 c                |
|          | N <sub>120</sub>                     | 42.2 a          | 85.2 b                                    | 83.3 ab                                          | 51.3 ab             | 9.3 ab       | 4.8 b                |
|          | N <sub>160</sub>                     | 42.6 a          | 95.2 a                                    | 89.5 a                                           | 54.0 a              | 9.9 a        | 5.4 A                |
|          | N <sub>200</sub>                     | 39.4 b          | 86.9 b                                    | 84.7 ab                                          | 51.2 ab             | 8.8 b        | 4.5 c                |
|          | N <sub>240</sub>                     | 41.1 ab         | 91.8 a                                    | 83.3 ab                                          | 48.6 bc             | 9.6 a        | 4.7 b                |
| KCSM     | No                                   | 29.8 a          | 78.1 b                                    | 70.3 b                                           | 49.9 abc            | 6.5 a        | 3.2 ab               |
|          | N <sub>80</sub>                      | 28.3 a          | 72.5 c                                    | 70.8 b                                           | 46.9 bc             | 6.6 a        | 3.1 ab               |
|          | N <sub>160</sub>                     | 30.3 a          | 90.3 b                                    | 83.3 ab                                          | 55.9 ab             | 6.3 a        | 3.5 a                |
|          | N <sub>160</sub>                     | 30.3 a          | 95.5 a                                    | 85.8 ab                                          | 59.3 abc            | 6.7 a        | 4.0 a                |
|          | N <sub>200</sub>                     | 29.3 a          | 85.1 ab                                   | 76.4 a                                           | 53.0 a              | 6.4 a        | 3.4 a                |
|          | N <sub>240</sub>                     | 20.3 a          | 79.9 b                                    | 64.2 b                                           | 44.6 c              | 6.2 a        | 2.8 b                |

\* Figures accompanied by same letters (s) in a column are not significantly different at 5% level of probability as per DNMR test.

**Table 3. Cost analysis.**

| Location | Treatment<br>(Kg N ha <sup>-1</sup> ) | Cost of Nitrogen fertilizer (Tk) | Yield of Cane (TCH) | Cane Yield increase over control (ton) | Net Income (Tk.) | Net benefit (Tk ha <sup>-1</sup> ) |
|----------|---------------------------------------|----------------------------------|---------------------|----------------------------------------|------------------|------------------------------------|
| SRTI     | No                                    | —                                | 55.0                | —                                      | —                | —                                  |
|          | N <sub>80</sub>                       | 900                              | 51.0                | -4.0                                   | -3859.6          | -4759.6                            |
|          | N <sub>120</sub>                      | 1350                             | 57.9                | 2.9                                    | 2820.1           | 1470.1                             |
|          | N <sub>160</sub>                      | 1800                             | 66.6                | 11.6                                   | 11126.5          | 9326.5                             |
|          | N <sub>200</sub>                      | 2250                             | 52.7                | 2.3                                    | 2204.1           | -45.0                              |
|          | N <sub>240</sub>                      | 2700                             | 52.0                | 3.0                                    | 2858.6           | 158.6                              |
| JSM      | No                                    | —                                | 37.2                | —                                      | —                | —                                  |
|          | N <sub>80</sub>                       | 900                              | 45.0                | 7.8                                    | 7469.0           | 6569.0                             |
|          | N <sub>120</sub>                      | 1350                             | 51.3                | 14.1                                   | 13532.8          | 12182.8                            |
|          | N <sub>160</sub>                      | 1800                             | 54.0                | 16.8                                   | 16141.1          | 14341.1                            |
|          | N <sub>200</sub>                      | 2250                             | 51.2                | 13.9                                   | 13407.6          | 11157.6                            |
|          | N <sub>240</sub>                      | 2700                             | 48.5                | 11.3                                   | 10914.8          | 8214.8                             |
| KCSM     | No                                    | —                                | 49.9                | —                                      | —                | —                                  |
|          | N <sub>80</sub>                       | 900                              | 46.9                | 3.0                                    | 2868.3           | -3768.3                            |
|          | N <sub>120</sub>                      | 1350                             | 55.9                | 6.0                                    | 5813.5           | 4463.5                             |
|          | N <sub>160</sub>                      | 1800                             | 59.3                | 9.5                                    | 9095.6           | 7295.6                             |
|          | N <sub>200</sub>                      | 2250                             | 53.0                | 3.2                                    | 3012.6           | 762.6                              |
|          | N <sub>240</sub>                      | 2700                             | 44.6                | -5.3                                   | -5072.4          | -7772.4                            |



**Economics of fertilizer use :**

The economic analysis on the yield of cane was done and is shown in the Table 3. The highest net return was obtained at 160 kg N ha<sup>-1</sup>, respective of locations. At SRTI and SCSM 80 kg N ha<sup>-1</sup> did not bring any benefit because of low yield of cane. Similarly the treatments 200 kg N ha<sup>-1</sup> at SRTI and 240 kg N ha<sup>-1</sup> at KCSM failed to produce any economic benefit due to higher cost of fertilizer compared to yield increase.

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