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Determination of Optimum Level of Nitrogen and its Effects on Yield and Quality of Ratoon Sugarcane

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Abstract: the results showed that nitrogen levels influence significantly the yield and yield components like the number of millable cane at harvest, cane length, cane diameter and weight per stripped cane. However, nitrogen did not influence significantly the yield and yield components like number of internodes per cane, internodal length and quality parameters like sucrose contents and commercial cane sugar showed non significant response to nitrogen. The highest stripped cane yield of 108.43 t ha⁻¹ was obtained with 200 kg N ha⁻¹.

Key words: Level, nitrogen, quality, sugarcane, yield

Introduction

Nitrogen is an important plant nutrient, and it increases the yield of sugarcane, and also play important role in many physiological processes of plants. Sugar cane have high yielding potential. The average stripped cane yield of 50.3 t ha⁻¹ in Pakistan is far below than the major sugar cane growing countries of the world (Anonymous, 1998). Further cost of cultivation of sugar cane in Pakistan is high. The law of diminishing returns may be used in deciding the most profitable level of any like fertilizer. The most profitable level of any input depends upon marginal product and the prices of input or change in the technology affecting the values of marginal product (Sharma and Sharma, 1981).

In the literature there is lot of controversy over the application of nitrogen. Many authors respond positive effect of N on sugarcane yield and quality. However, there are number of authors (Jayabal and Chockalingam, 1990) reported that application of 250 kg N + 32 kg P₂O₅ ha⁻¹ significantly improved the sucrose content of cane juice. At present Punjab Agriculture Department is recommending N at the rate of 200 kg ha⁻¹. In order to solve the controversy the following study was conducted.

Materials and Methods

This study was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad. The experiment was laid out in a Randomized Complete Block Design with four replications. The net plot size was 3.6 x 10 m. Sugar cane variety SPSG-394 was used for this study. Nitrogen treatments included in this study were 0, 100, 150, 200 and 250 kg ha⁻¹. The N and P₂O₅ and 1/3 N were applied at sowing and remaining doses of N were applied at 1st and 2nd irrigation. All other agronomic practices were kept normal and uniform for all treatments. Data collected were statistically analyzed by analysis of variance technique at 5% level of probability (Steel and Torrie, 1981). The law of diminishing return was used to determine the optimum level of nitrogen by equating the inverse price ratio with marginal product (Sharma and Sharma, 1981).

Results and Discussion

Stripped cane yield: Significant results were obtained in case of stripped cane yield. Maximum stripped cane yield of 108.43 t ha⁻¹ was obtained from the plots given N @ 200 kg t ha⁻¹ but significantly differ from control treatment (Table 1).

Table 1: Effects of levels of nitrogen on sugarcane yield and yield components

| | Treatments N t ha ⁻¹ | | | | |
|--|---------------------------------|---------|---------|---------|---------|
| | 0 | 100 | 150 | 200 | 250 |
| Stripped cane yield t ha ⁻¹ | | | | | |
| No. of millable cane | 84.50cd | 86.74b | 89.94a | 108.4ab | 98.39b |
| Canes at harvest (m ⁻²) | 14.93c | 15.60b | 15.91ab | 17.01a | 16.33ab |
| Cane length (m) | 1.91b | 2.20a | 2.24a | 2.35a | 2.32a |
| No. of internodes/cane | 15.40NS | 17.48NS | 17.80NS | 18.23NS | 17.88NS |
| Internodal length (cm) | 10.96NS | 11.12NS | 11.40NS | 11.85NS | 11.07NS |
| Cane diameter/cm | 5.93NS | 5.01NS | 5.13NS | 5.25NS | 5.30NS |
| Weight per stripped cane(kg) | 0.51c | 0.62abc | 0.59bc | 0.72a | 0.65ab |

NS = Non significant

Table 2: Average marginal product and inverse price ratio at different levels of nitrogen application

| N applied (kg ha ⁻¹) | Yield obtained (kg ha ⁻¹) | Total product due to N | Average product | Marginal product | Inverse price ratio |
|----------------------------------|---------------------------------------|------------------------|-----------------|------------------|---------------------|
| 0 | 84500 | - | - | - | 14.73 |
| 100 | 86760 | 2260 | 22.60 | 22.60 | 14.73 |
| 150 | 89940 | 3180 | 63.60 | 9.20 | 14.72 |
| 200 | 108430 | 18490 | 369.80 | 306.2 | 14.73 |
| 250 | 98390 | 10040 | 200.80 | -169.00 | 14.73 |

Price of sugarcane (kg⁻¹) = 0.95

Price of fertilizer (kg⁻¹) = 14

Chudhry and Ullah: Optimizaton of N in sugarcane

Table 3: Effect of levels of nitrogen on sugarcane quality

| | Treatment N t ha ⁻¹ | | | | |
|---------------------------|--------------------------------|-------|-------|-------|-------|
| | 0 | 100 | 150 | 200 | 250 |
| Sucrose contents (%) | 15.25 | 15.50 | 15.61 | 15.78 | 15.67 |
| Commercial cane sugar (%) | 12.36 | 12.65 | 12.97 | 13.24 | 13.20 |

These results are supported by Pannecrselvam *et al.* (1991), Banger *et al.* (1992) and Makodem (1998). This may be due to initial low nitrogen level in soil or different types of soil in which these experiments were conducted.

Optimum level: Optimum level of nitrogen was determined by equating the inverse price ratio with marginal product (Table 2) which indicated that it was profitable to apply 200 kg N t ha⁻¹ because inverse price ratio and marginal product did not match with each other. It indicated that futher experiments should be conducted in which nitorgen should be applied below 250 kg ha⁻¹ to known the optimum range of nitrogen. As the results showed that application of nitrogen has significant effect on the sugarcane yield.

Yield components: The number of millable cane was affected by different level of nitrogen (Table 1). The results are in agreement with Ali (1999).

Cane length responde to nitrogen. These results are in agreement with Hussain *et al.* (1991). Cane diameter was not influenced by different levels of nitrogen (Table 1). Similarly number of internodes and internodal length was not significantly influenced by different levels of nitrogen (Table 1). These results are also agreement with Banger *et al.* (1992) and Ali (1999).

Quality parameters: Maximum sucrose contents and C.C.S. were obtained as 15.78 and 13.24\$ from the treatments 200 kg N ha⁻¹ respectively. The results was not significantly different (Table 3). These results are in agreement with Ingawala *et al.* (1992) and Kapoor *et al.* (1993). The present

recommendation of Punjab Agriculture Department at the rate of 200 kg N ha⁻¹ need further investigation.

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