YIELD RESPONSE OF SUGAR CANE TO DIFFERENT RATES OF ORGANIC MATTER, NITROGEN AND PHOSPHORUS IN EAST PAKISTAN

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INTRODUCTION

Sugar cane is one of the most important commercial crops of Pakistan and plays a vital role in the agricultural economy of the farmers. The total area under sugarcane in Pakistan is 1.03 million acres of which 0.3 million acres are in East Pakistan. The average yield of cane is 14 tons per acre per year (which is very low compared to the other countries of the world). At present there are nine sugar mills in East Pakistan having a total capacity of producing over 80,000 tons of white sugar annually. Of the total cane produced in the country only 20 percent goes to the factory, while about 70 percent is converted into crude sugar called “gur”. Pakistan Sugar Commission (1959) estimated the requirement of white sugar at 7 pounds per capita; at this rate the annual requirement comes to 150 thousand tons, of which 70 thousand tons are in deficit. Expansion of the sugar industry has drawn the keen attention of the government and the East Pakistan Industrial Development Corporation has planned to set up more sugar mills in this province in the near future.

Increased yields of cane and sugar have been obtained from applications of organic manure, nitrogen, phosphate and potash to most of the soils in East Pakistan. The amounts of these fertilizers applied to the soil for a one-year sugar cane crop are based primarily on the fertilizer trial experiments.

This paper deals with the response of sugarcane to the rates of organic matter, nitrogen, phosphorus, and their different combinations at Dacca for plant cane crop.

METHODS AND MATERIALS

The experiment was planted on Tejgaon clay soil, at the East Pakistan Agricultural Coellege Experiment Station. The soil of the experimental station is characterised by the low availability of major nutrients, high phosphate fixing capacity. The soil at the experimental site had a pH 5.2, 1.65% of organic matter, 0.104% of nitroben and 0.086% of total phosphorus.

The experiment was conducted in 1962-63 with a variety Co. 527 and a plant crop of 12 months was harvested.

A 3 x 3 factorial experiment was laid out in a split plot design replicated three times with three different levels of organic matter as farmyard manure, nitrogen as urea, and phosphorus as triple superphosphate. Phosphorus was the mainplot treatment and nitrogen and organic matter were the subplot treatments.
The various fertilizer treatments used per acre are given below:

(i) **Organic matter treatments**
   - Mo- control
   - M1- 16,000 lbs. of F.Y.M.
   - M2- 24,000 lbs. of F.Y.M.

(ii) **Nitrogen treatments**
   - No- control
   - N1- 120 lbs. N
   - N2- 180 lbs. N

(iii) **Phosphorus treatments**
   - Po- control
   - P1- 80 lbs. P₂O₅
   - P2- 120 lbs. P₂O₅

In the main treatments of N and P the entire amounts of nitrogen and phosphorus were applied from fertilizers. But in all the M x N, M x P and M x N x P combinations, the amount of N and P₂O₅ present in F.Y.M. was estimated and the rest was applied from fertilizers. F.Y.M. and T.S.P. were applied before planting in the furrow along with a blanket application of 120 lbs. of K₂O as muriate of potash. Split-application of urea was done as top-dressing.

At harvest, the number of millable cane per plot was counted and weight of millable cane per plot was measured. Brix and sucrose were determined from the expressed juice of the randomly selected stalks.

**RESULTS AND DISCUSSION**

**Yield of cane per acre**

**Nitrogen** – Nitrogen fertilization significantly increased the cane yield over the control. Maximum yield of cane was obtained from 120 lbs. of nitrogen per acre (Table 1). Nitrogen also increased the number of millable canes at harvest.

The relationship between cane tonnage and the level of nitrogen is:

\[ Y = 48.62 + 4.456 - 1.23 N \]

Y being the yield in tons of cane per acre and N the rate of nitrogen in units, applied to soil per acre (1 unit = 60 lbs. N).

**Organic matter** – The response of sugarcane to F.Y.M. application was statistically significant. The use of 16000 lbs. of F.Y.M. per acre gave the highest response which was superior to the highest rate of F.Y.M. at 5 percent level.

The relationship between cane yield and the rate of F.Y.M. is:

\[ Y = 47.68 + 6.07 M - 1.63 M² \]

Y being the yield in tons of cane per acre and M the level of F.Y.M. in units, added to soil per acre (1 unit = 8000 lbs. F.Y.M.).

Organic matter application does not only increase the total yield by supplying nitrogen but also acts as a soil improver. Its application is beneficial in improving the soil fertility in general and particularly organic matter content and the physical condition of a soil. The availability of P and K are increased and higher nitrate-nitrogen in the soil is maintained as found by Rege**44, Patel et al.**39, Samuels and
TABLE 1
RESPONSE OF CANE TO DIFFERENT LEVELS OF ORGANIC MATTER, NITROGEN AND PHOSPHORUS

<table>
<thead>
<tr>
<th>Pounds per acre</th>
<th>T.C.A.</th>
<th>Brix</th>
<th>Sucrose (Pol) %</th>
<th>T.S.A.</th>
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Landrate and Patwardhan et al. Decline in yield due to the highest rate of F.Y.M. might have caused the deficiency of some nutrients which affected the growth of cane plants adversely.

Phosphorus – There was no significant response of sugarcane to the application of phosphatic fertilizer. But phosphorus tended to increase the yield of cane (Table 1). Karim also could not get any significant response of sugarcane to 80 lbs. of P₂O₅ in this experimental station. The plots which received no phosphate fertilizer tillered badly and resulted in a significant decrease in the number of millable canes at harvest.

Nitrogen + organic matter – The interaction of nitrogen and organic matter significantly increased the cane yield. Best responses were obtained from the combinations of 120 lbs. of N and 16000 lbs. of F.Y.M. and 180 lbs. N and 16000 lbs. F.Y.M. (Table 2). It may be inferred that both F.Y.M. and urea as the sources of nitrogen when applied in combination were more efficient for the nitrogen nutrition of the crop. The higher rates of nitrogen beyond that optimum level applied from urea is not utilized by the plant which is lost due to leaching in absence of sufficient organic matter in the soil. When quick and slow acting sources of nitrogen are used the response

TABLE 2
RESPONSE OF CANE TO THE INTERACTION OF ORGANIC MATTER NITROGEN

<table>
<thead>
<tr>
<th>Pounds per acre</th>
<th>Nitrogen</th>
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<th>Brix</th>
<th>Sucrose (Pol) %</th>
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TABLE 3
RESPONSE OF CANE TO THE INTERACTION OF NITROGEN PHOSPHORUS

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<th>Pounds per acre</th>
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TABLE 4
RESPONSE OF CANE TO THE INTERACTION OF ORGANIC MATTER NITROGEN PHOSPHORUS

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<td>n.s.</td>
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</table>

in yield was more pronounced up to the optimum level by steady supply of nitrogen throughout the active growth period of the cane plant.

Nitrogen + Phosphorus – Yield of cane was increased significantly by N+P interaction (Table 3). The combination of 120 lbs. N and 180 lbs. P₂O₅ gave the highest response yielding 54.1 tons of cane per acre. Increasing rates of P with either 120 or 180 lbs. of nitrogen from urea decreased the cane tonnage. Khanna et al., and Raheja also found similar results with N+P interaction.
Organic matter + nitrogen + phosphorus – Table 4 shows that the triple interaction of M+N+P significantly increased the yield of cane per acre. The combination of 16,000 lbs. of F.Y.M., 180 lbs. of total nitrogen and 120 lbs. of total P₂O₅ resulted in 59.52 tons of cane per acre which was the highest of all the 27 treatments (Table 4). The total quantity of nitrogen applied in this combination was 62 lbs. from F.Y.M. and 118 lbs. from urea and total P₂O₅ was 45 lbs. from F.Y.M. and 75 lbs. from triple superphosphate. In this combination of MNP, there were adequate amounts and proportions of organic matter, nitrogen and phosphorus which might have enhanced balanced uptake of the nutrients applied. The highest level of nitrogen (180 lbs. N from both sources) which was the most responsive for sugar cane could, therefore, act efficiently only when the level of P was sufficient. Due to the low organic matter content of the experimental soil, 180 lbs. N from urea alone could not be properly utilized by sugar cane in the absence of adequate organic matter supply which could regulate the steady supply of nitrogen resulting in higher uptake of N. Similar results were reported by Das12, Latif28 and Karim26.

Brix

No significant response was found from any of the main treatments. Nitrogen fertilization tended to reduce the Brix while organic matter application slightly increased it. The effect of P was also insignificantly negative. There was no significant effect on Brix percent from either first or second order interaction of MNP.

Sucrose percent cane

Nitrogen – Nitrogen fertilization produced an insignificant negative influence on the sucrose content over the control. In as much as nitrogen was not needed to increase the cane yield, the application of nitrogen might be expected to reduce the sucrose percent of sugar cane. Agarwala4, Borden19, Mohan Rao and Narashimham31 and Samuels and Landreau49 observed that nitrogen application tended to reduce sucrose content when there was no increase in cane yield due to the nitrogen application.

Organic matter – The action of organic matter on the sucrose percent cane was also not significant. The application of farmyard manure tended to increase the sucrose content.

Phosphorus – There was a significant decrease in sucrose content by the use of phosphate fertilizer. The effect of 120 lbs. of P₂O₅ was found to be apparently superior to the lower level. The possible explanation of such an adverse effect of P on sucrose content may be due to higher reducing sugar and lower juice sucrose content. Tandon and Bhoy44, Arakeri et al.4, and Samuels et al.49 also found some negative responses in sucrose content by the use of phosphates. Clements11 also could not get any significant response due to application of P₂O₅ up to 400 lbs. per acre. Sucrose content was not significantly influenced by any of the interactions of MNP.

Acknowledgements

Thanks are due to Dr. Fariduddin Ahmed, Mr. Akbar Hossain and Mr. M. A. Quddus who made all the facilities available to carry out this investigation. Sincere gratitude is also expressed to Mr. A. S. M. Kamaluddin, for his advice and help in this study and Dr. S. M. Hasanuzzaman for his suggestions in statistical analysis and interpretation.
A field experiment was conducted in 1962-63 at the East Pakistan Agricultural College Experiment Station, fertilized with different levels of nitrogen, organic matter and phosphorus and their different combinations to study the response of sugar cane variety Co. 527.

Nitrogen produced a significant increase in cane yield. Cane tonnage was maximum (53.00 tons per acre) with 120 lbs. of nitrogen from urea beyond which the yield decreased.

Organic matter application resulted in a significantly increased cane yield. Application of 16000 lbs. of F.Y.M. per acre gave the highest yield (53.40 tons) and the cane yield was decreasing beyond this rate.

The application of phosphate had no marked effect on cane yield. Both interactions of nitrogen-organic matter and nitrogen-phosphorus significantly increased the cane yield. Application of 16000 lbs. of F.Y.M. in combination with 120 lbs. or 80 lbs. of total nitrogen produced the highest yields among the nitrogen and organic matter combinations. A combination of 120 lbs. of nitrogen with either 80 lbs. or 120 lbs. of P₂O₅ gave the best result.

The response in cane yield due to 16000 lbs. of F.Y.M. in combination with 180 lbs. of total nitrogen and 120 lbs. of total P₂O₅ along with 120 lbs. of K₂O was highest (59.92 tons per acre) in this experiment.

No significant effect on Brix was observed in this experiment. The application of 80 lbs. of P₂O₅ lowered the juice sucrose percent. Nitrogen beyond the optimum level tended to depress sucrose content in cane while organic matter slightly increased it. No interaction was significant.

The application of 120 lbs. N from urea increased the sugar yield per acre. Farmyard manure also increased the yield of sugar per acre. Highest yield of sugar was obtained from the triple interaction that produced the highest cane tonnage.

REFERENCES

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