Pak. J. Agri. Sci.
24(3)183, 1987

SUGARCANE RESPONSES TO NPK APPLICATION AND GEOMETRY OF PLANTING ON A SANDY CLAY LOAM SOIL

M. Shafi Nazir, Bijan Bajelan, G. Ali and R. Ahmad
Department of Agronomy, University of Agriculture, Faisalabad.

ABSTRACT

Sugarcane responses to NPK application at 0-0-0, 150-0-0, 150-150 0, 150-150-150 kg/ha and planting geometry comprising 60, 90, 120 cm apart single, double and triple row strips, respectively with 30 cm space between the rows of each strip were determined on a sandy clay loam soil. Among the three planting patterns, 90 cm apart paired row strip planting system on account of greater number of millable canes per unit area gave the highest cane yield of 128.58 tonnes/ha as against 115.98 and 111.72 tonnes/ha for the 60 cm apart single rows and 120 cm apart triple row planting systems, respectively. As regards NPK rates, cane yield was increased by 20.6 tonnes/ha over the check with the application of 150 kg N alone, while the addition of 150kg P_2O_5/ha alongwith N increased the cane yield further by 6.9 tonnes/ha over N alone as against 7.1 tonnes/ha over NP with the application of 150kg K_2O/ha. The highest cane : top ratio of 12.27 was achieved in case of 90 cm apart paired row strip planting system compared to 9.59 for the 60 cm apart single row planting system. Similarly, the cane:top ratio of 11.30 to 12.54 was recorded in fertilized treatments and the lowest of 7.91 in check plots. Sucrose contents in cane were reduced significantly over the check with the application of N alone, while P and K in combination with N improved the sucrose contents in cane to the level of check.

INTRODUCTION

The major components of sugarcane agro-technology responsible for low cane yield in Pakistan are malnutrition, low plant population and improper method of planting. Since sugarcane crop occupies the land for a long period, it therefore, depletes the soil fertility to the maximum. According to De-Geus

(1967), a crop yielding 30 tonnes of cane takes up from the soil about 68kg N, 29kg P_2O_5 and 136kg K_2O. This shows the magnitude of nutritional requirements of this crop. Another hurdle in the way of increasing cane yield per hectare is the lodging when the crop is heavily fertilized. Under the conventional method of planting sugarcane in 60 cm apart rows, it is not possible to earth up the crop properly and conveniently due to narrow space between the rows as a result of which lodging often takes place. New methods of planting sugarcane in well-spaced multi-row strips have been designed by various workers which not only facilitate interculture and sound earthing up of the crop but also permit easy and free working of the intertillage devices without doing much damage to the plant roots. However, these new methods need to be tested against the conventional one in all respects at different nutritional levels. The present study was, therefore, designed accordingly.

MATERIALS AND METHODS

Studies reported herein were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad, on a sand clay loam soil having on an average 0.056 percent N, 9 ppm available P_2O_5 and 162.5 ppm available K_2O. The fertilizer treatments were 0-0-0, 150-0-0, 150-150-0, 150-150-150 kg NPK/ha, while the planting geometry comprised 60 cm apart single rows, 90 cm apart paired row strips (30/90 cm) and 120 cm apart triple row strips (30/120 cm). The experiment was laid out in a Split Plot Design with three replications and a net plot size measuring 7.20 x 8.40 m. The crop was planted on February 27, 1983 using two budded double setts end to end in the furrows giving rise to a seed rate of 1,19048 setts/ha. The whole of P_2O_5 and K_2O alongwith half of N were applied at the completion of tillering. In all 16 irrigations of 10 hectare centimeters each, were given in addition to about 506 mm rainfall received during the growing period of the crop. All other agronomic operations were normal and uniform for all the treatments. The crop was harvested on March 14, 1984 and data on number of millable canes per unit area, weight per cane, cane yield/ha, and cane:top ratio were recorded, using standared procedures. The sucrose contents in cane were determined by Horn's dry lead acetate method of sugar analysis. The data collected were analysed by using analysis of variance technique and Duncan's New Multiple Range Test at 5% level of probability was employed to test the significance of the mean's differences (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

It is evident from the data that sugarcane planted in the pattern of 90 cm apart double row strips produced significantly more number of millable canes per unit area than that planted in the pattern of 120 cm apart triple row strips but was at par with that planted in the pattern of 60 cm apart single rows (Table 1). Relatively more number of canes per unit area in case of 90 cm apart double row strips compared to single planting system was attributed to better adjustment of space and cane plants within the strip as a result of which the mutual shading among the plants was minimized and circulation of air and light within the strips was encouraged which ultimately promoted the photosynthetic activities of the plants for most of the growing period and thereby increasing the growth and tillering capacity of the cane plants. Almost similar results were reported by Patil *et al.* (1958) and Kanwar and Sharma (1975).

The data on weight per cane indicated non-significant differences among all the planting patterns and fertilizer treatments. The average weight per cane, however, ranged between 1.09 to 1.16 and 1.06 to 1.17 kg for the planting patterns and fertilizer treatments, respectively. These results are quite in line with those reported by Kanwar and Sharma (1975).

On the other hand, due to slow growth rate of the cane plants in check plots, the cane:top ratio was significantly lower than the fertilized plots where growth and development rate of the cane plants was higher. This clearly indicated that harvest index of sugarcane was the lowest in check which was recorded to be 7.91 in terms of cane:top ratio as against 11.30 to 12.54 for the fertilized treatments. Similarly, the cane:top ratio varied significantly under the different planting patterns. The cane:top ratio was significantly the lowest (9.59) in case of 60 cm apart single row planting system and was the highest (12.27) in case of 90 cm apart double row strips where growth and development of the cane plants was better and quick due to better circulation of air and light into the plant canopy because of more space between the strips. Almost similar observations were made by Mali *et al.* (1982).

As regards cane yield per hectare, sugarcane planted in the pattern of 90 cm apart double row strips, on account of higher cane density per unit area, gave significantly higher cane yield per hectare than that planted either in 60 cm apart single rows or 120 cm apart triple row strips. Substantial increase in cane

Table 1. *Effeci of application and planting geometry on yield, yield components and sucrose contents of spring sugarcane*

	Number of millable canes per unit area (7.20x8.40 m)	weight per cane (kg)	Cane yield (tannes/ ha)	Cane:top ratio	Sucrose contents in cane (%)
Planting Geometry					
60 cm apart single rows	634.92ab	1.09NS	116.98b	9.59b	18.80NS
90 cm apart double row strips (30/90 cm)	669.34a	1.16	128.58a	12.27a	18.96
120 cm apart triple row strips (30/120 cm)	589.83b	1.14	111.72b	10.64ab	18.88
NPK rates (kg/ha)					
0-0-0	554.56b	1.06	98.09b	0.91b	19.05a
150-0-0	614.00ad	1.17	108.68a	11.30a	184.6b
150-150-0	676.56a	1.12	125.55a	11.59a	18.85a
150-160-150	680.33a	1.17	132.66a	12.54a	18.85a

NS = Non-significant.

Any two means not sharing a letter differ significantly at 5% level of probability (DMRT).

yield of sugarcane planted in the pattern of 90 cm apart double row strips was also attributed to the minimum mutual shading of cane plants due to better adjustment of the space and plants within the strips as a result of which not only the tillering but also the ecosystem within the immediate vicinity of the plants were improved. This all led to better cane stand per unit area and effective photosynthesis. These findings are in agreement with those of Patil *et al.* (1958), Broadhead and Ashley (1970) and Ramos (1975). Considering fertilizer treatments, highly significant differences were observed among all the treatments. Application of NPK each at the rate of 150 kg/ha although increased the cane yield/ha significantly over the check but was at par with N and NP treatments. This clearly indicated that for a soil having an initial status of 9 ppm available P_2O_5 and 162 ppm available K_2O, the application of P and K alongwith N each at the rate of 160 kg/ha did not help increas the cane yield/ha to a considerable extent but on the other hand improved the cane quality to an appreciable level.

It is evident from the data that sucrose contents in cane tended to be slightly higher in plots planted in the pattern of 90 cm apart double row strips compared to that of 60 cm apart single row or 120 cm apart triple row strip planting systems. However, the differences among them were minor and non-significant. Kanwar and Sharma (1974) reported almost similar results.

Regarding fertilizer treatments, the application of nitrogen alone reduced the sucrose contents in cane significantly over the check, while NP and NPK treatments were at par with the check. The results further indicated that P and K application in combination with N helped in improving and maintaining the sucrose contents in cane to the normal level probable by balancing the processes of sugar synthesis in the cane plants and through normalizing the moisture content in mature cane. Observations made by Din & Singh (1981) are quite in line with these findings.

The ultimate utility and practicability of a planting technology or a fertilizer practice is determined in terms of net economic return per hectare. The data pertaining to economic analysis given in Table 2 indicated that a planting technology of 90 cm apart double row strips gave the highest net income of Rs.25492.00/ha with a BCR of 4.83 as against Rs..22342.00 and Rs. 21277.00 with BCR 4.36 and 4.20 for 60 cm apart single rows and 120 cm apart triple row strip planting systems, respectively.

Table 2. *Economic analysis*

	Grain yield (tonnes/ha)	Gross income (Rs./ha)	Variable cost (Rs./ha)	Total cost (Rs./ha)	Net income (Rs./ha)	Benefit cost ratio (BCR)	Increment benefit cost ratio (IBCR)
A. Planting geometry							
P_1 60 cm apart single rows	115.98	28995.00	6653.00	6653.00	22342.00	4.36	-
P_2 90 cm apart double row strips	128.58	32145.00	6653.00	6653.00	25492.00	4.83	-
P_3 120 cm apart triple row strips	117.72	27930.00	6653.00	6653.00	21277.00	4.20	-
B. NPK rates (kg/ha)							
F_0 0-0-0	98.09	24522.50	6653.00	6653.00	17869.00	3.68	-
F_1 150-0-0	118.68	29670.00	844.78	7498.00	22172.00	3.96	6.09
F_2 150-150-0	125.55	31388.00	1471.44	8125.00	23253.00	3.86	2.74
F_3 160-150-150	132.66	33165.00	1721.44	8376.00	24790.00	3.96	7.10

$$\text{BCR : Benefit cost ratio} = \frac{\text{Gross income}}{\text{Total cost}}$$

$$\text{IBCR : Increment benefit cost ratio} = \frac{\text{Gross income } (F_1\text{-}F_0)}{\text{Total cost } (F_1\text{-}F_0)}$$

As regards fertilizer rates, there was a progressive increase in net income/ha with each successive dose of fertilizer over the check. But the highest incremental benefit cost ratio of 7.10 was recorded in plots fertilized at 150-150-150 kg NPK/ha followed by plots receiving 150 kg N alone recording 6.09 as against the lowest of 2.74 for plots treated with 150-150-0 kg NPK/ha.

REFERENCES

Broadhead, R.D. and T.E. Ashley. 1970. Closer rows for sugarcane. Agri. Res. Wash. 18(8) : 15. (Hort. Abst., 40 : 4982, 1970).

De-Geus, J.G. 1967. Fertilizer Guide for Tropical and Sub-tropical Farming. Centre of Etucle 1, Azote, Zurich.

Dhoble, M.V. and V.S. Khuspe. 1983. Effect of nitrogen, spacing and phosphorus level on sugarcane. J. Maharashtra Agri. Univ. 8(1) : 38-41. (Hort. Abst., 53(11) : 8266, 1983).

Din, J. and R.G. Singh. 1981. Response of sugarcane to application of N, P and K. Indian Sugar. Crop J. 8(1) : 15-17. (Hort. Abst., 52(10) : 7072, 1982).

Kanwar, R.S. and K.K. Sharma. 1975. Effect of inter-row spacing on tiller mortolity, stalk population and yield of sugarcane. (Hort. Abst., 45(10) : 7953.

Mali, S.A., K.R. Pawar and D.N. Borulkr. 1982. Yield contributing characters of three varieties of seasonal sugarcane as influenced by N and P levels. Indian Sugar, 32(2) : 95-104. (Hort. Abst., 63(3) : 2269, 1983).

Patil, S.V., N.B. Trippanavar and N.V. Kulkarni. 1958. Effect of spacing and N application on the yield of sugarcane in Maland tract. Mysore Agri. J. 33 : 67-70. (Hort. Abst., 25(3) : 2912, 1959).

Ramos, M. 1975. Effect of planting distance on sugarcane yield, Puertorico J. Agri. (Univ. of Rico.) 59(2) : 136-153.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. McGraw Hill Book Co. Inc., New York.