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EFFECT OF PLANTING DENSITY & GEOMETRY OF PLANTING ON THE YIELD AND QUALITY OF FIRST AND SECOND AUTUMN RATOON SUGARCANE

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A fresh crop of autumn sugarcane was planted in the patterns of single rows 60 cm apart, double and triple row-strips 90 and 120 cm apart, respectively with a 30 cm space between the rows of each strip, using two budded single and double setts end to end in the furrows giving rise to planting densities of 54450 and 1,08900 setts/ha, respectively. The crop was harvested in the month of November, kept as first ratoon and fertilized at the rate of 150kg N and 75 kg P_2O_5/ha. The first ratoon crop was harvested in the last week of November, kept again as second ratoon and fertilized as before and harvested on November 5, 1984. The results obtained revealed that plots planted at 1,08900 two budded setts/ha placed in the form of double setts end to end in the furrows gave significantly higher yield of stripped cane/ha than those seeded with a single-sett planting density of 54450 setts/ha. Yields averaged 90.69 and 76.69 tonnes of cane/ha, for the first ratoon and 71.09 and 65.16 tonnes/ha for the second ratoon under the two planting densities, respectively. The higher cane yield in case of double sett planting was attributed to significantly higher number of millable canes/ha compared to single sett planting.

As regard planting patterns, double and triple row strip planting system resulted in better ratooning and produced sub-stantially higher cane yield/ha than that of single row planting system in both ratoons. However, the difference between double and triple row strip planting systems was non significant. It was further observed that cane yield of the second ratoon was reduced to the extent of about 20% over the first ratoon crop. The sucrose contents in cane, were not influenced to a measurable extent by the planting patterns and densities of planting.

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INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) has a wide range of ecological tolerance and thus, can be grown successfully in both the tropical and subtropical regions of the world. In Pakistan, it is grown on an area of 0.905 million hectares with a total annual production of 34.50 million tonnes of cane. The national average cane yield is 38.12 tonnes per hectare which is far below the level of production potential of our present recommended cane varieties. These cane varieties have a potential of yielding 184 tonnes per hectare, if modern production technology is applied more carefully and wisely (Hussain, 1981). Amongst the various factors responsible for this high magnitude gap between the actual and potential cane yields per hectare, plant population and its proper adjustment through the field is of prime importance. Sugarcane being a perennial crop is capable of growing as a ratoon for several years if managed properly and looked-after carefully can produce as good yield as that of plant crop Ratoon crop besides saving lot of expenses involved in the form of seed bed preparation and purchasing of planting material matures earlier and gets ready for supply to the sugar mills especially in the beginning of cane crushing season. Although lot of research work seems to have been done in the past on spring ratooning of sugarcane with conventional method of plantation but no systematic research on the ratooning potential and growth behaviour of autumn ratoon crop under the changed geometry of planting and seeding density has been carrried so far in our country. Consequently, the present study was conducted to determine the effect of planting densities and patterns of planting on the ratooning potential and yield behaviour of the first and second autumn ratoon crops of sugarcane under the irrigated conditions obtaining at Faisalabad.

REVIEW OF LITERATURE

Anon. (1966) planted sugarcane @ 33,300, 40,000 and 50,000 setts/ha. and reported that the average of plant and ratoon yields were 50.11, 58.03 and 65.14 tonnes of cane/ha, respectively. Gill and Alam (1967) investigated the effect of planting rates of 20,000, 27,000, 34,000 3-budded setts per hectare on the yield of plant and ratoon crop planted in November. They observed that plant density showed a direct relationship with the rates used. Boyce (1968) stated that there was a linear yield response to decreasing row spacing from 2.18 to 0.87 meter. The cane yield increased at the rate of 5.70 tonnes/ha

(4.5%) for every 0.3 meter decreasing in row width The pregressive increase in cane yield with decreasing row spacing was associated with higher population of thinner and longer stalk. Buren (1972) conducted an experiment to test the correlation between the cane yield and number of stalk and concluded that a planting rate of 69180 setts per hectare appeared to be the optimum for obtaining an appropriate plant stand in order to harvest the maximum cane yield. Plant population beyond this level did not contribute significantly toward the final cane yield. Roach (1977) planted number of cane varieties in single and double rows with several inter-row spacings and found that crop planted in 180 cm apart paired rows with 50 cm space between the rows of a pair gave the highest cane yield/ha. Irvine and Benda (1980) reported that sugarcane planted in the fashion of 183 x 19 cm produced significantly higher yield of biomass, cane and sugar yield per hectare than that planted in the pattern of 183 x 38 and 183 x 76 cm. Ricaud and Cochran (1980) reported that the highest number and yield of millable stalks, sucrose contents, total biomass and fermentable sugar were produced from planting 4 drills, 90 cm wide with plant cane followed by ratoon cane. Shanmugasundaram *et al* (1981) planted three budded setts at 90,000 to 360,000 per hectare and found that a plantig density of 90,000 buds per hectare gave an average cane yields of 101.4 and 80.4 tonnes/ha in case of plant and ratoon crop, respectively while planting density of 360,000 buds per hectare increased the cane yield from 101.4 and 80.4 tonnes/ha to 123 6 and 87.3 tonnes per hectare in case of plant and ratoon crop, respectively. Yang *et al* (1982) found that the fresh crop planted in single and paired rows produced cane yields of 123.1 to 144.6 and 123.0 to 163.0 tonnes/ha while the subsequent ratoon yielded 80.2 to 119.3 and 67.8 to 110.4 tonnes of stripped cane per hectare, respectively.

MATERIALS AND METHODS

Investigations into the effect of planting densities on the growth, yield and quality of first and second autumn ratoon sugarcane planted in different geometrical patterns were carried out at the University of Agriculture, Faisalabad, during the years 1982-84. The plant crop was sown in the patterns of 60 cm apart single rows, 90 cm apart double row strips (30/90 cm) and 120 cm apart triple row strips (30/120 cm) with planting densities of 54, 450 (single sett end to end) and 1,08900 two budded setts/ha (double setts end to end). BL-4

was used as a test variety. The fresh cane crop was planted in the first week of October, 1981, harvested in the third week of November, 1982 and was kept as first ratoon which was harvested on November 25, 1983 and kept as second ratoon for the subsequent year. Both the first and second ratoon were initially fertilized at the rate of 27 kg N + 75 kg P_2O_5/ha with first irrigation in the second week of December, while the remaining dose of 123 kg N/ha was top-dressed in the second week of May and afterward earthing up was done in the end of May. In both the years crop was hoed twice with hand hoe. In all 18 irrigations of 10 hectare centimeter each were given. All other agronomic operations were kept normal and uniform for all the treatments. The first and second ratoon crops were harvested on November 25, 1983 and November 5, 1984, respectively. Standard procedures were followed to record observations on cane length, cane girth and weight per cane by taking a representative sample of 20 canes at random from each plot. Ten out of the 20 sampled canes were taken to the laboratory for sucrose analysis. Sucrose percentage was determined by Horne's Dry Lead Acetate method for sugar analysis. The data collected were statistically analysed using analysis of variance technique and Duncan's New Multiple Range Test at 5% level of probability to test the significance of differences among the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The data pertaining to yield, yield parameters and sucrose contents for both the first and second ratoon crops are presented in Table 1. A perusal of the data revealed that sugarcane planted in 60 cm apart single rows produced significantly lower number of millable canes per unit area than that planted in 90 cm apart double row strips or 120 cm apart triple row strips which were at par with each other. Regarding planting density, plots planted at 1,08900 setts/ha produced significantly more number of millable canes per unit area than that planted at 54450 setts/ha. In case of second ratoon almost similar trend in the results was observed with the exception that the difference between the 60 cm apart single rows and 120 cm apart triple row strips planting system was non-significant. Almost similar results were reported by Ricaud and Cocharan (1980), Gill and Alam (1967), Boyce (1968) and Irvine and Benda (1980) but do not accord with the findings of Buren (1972) who stated that planting rate beyond 69160 setts/ha did not help materially in improving the stand of the ratoon sugarcane.

Table 1. *Effect of planting patterns and densities of planting on the yield, yield components and sucrose contents of the first and second ratoon sugarcane.*

Treatments	No. of millable canes/Unit area (3.60 x 15.00 m)		Cane length (m)		Cane girth (cm)		Weight/Cane (Kg)		Cane Yield/ha (Tonnes)		Sucrose Contents (%)	
A. Planting Patterns	1st. Ratoon	2nd Ratoon	1st. Ratoon	2nd Ratoon	1st. Ratoon	2nd Ratoon	1st. Ratoon	2nd Ratoon	1st. Ratoon	2nd Ratoon	1st. Ratoon	2nd Ratoon
1. 60-cm apart single rows	(1) 446b	(1) 351b	N.S. 2.27	N.S. 2.05	N,S. 2 52	N.S. 2.50	N.S. 0.98	N.S. 0 89	(1) 81.80b	(1) 64.04b	N S. 17.30	N.S. 18.06
2. 90-cm apart paired row strips,	474a	397a	2 33	2.21	2.55	2.38	0.97	1.00	85.78a	71.96a	17.09	17.96
3. 120-cm apart tripple row strips	474a	377ab	2.33	2.16	2.51	2.45	0.99	0.97	86.73a	68.37ab	17.02	17.98
B. Planting densities												
1. 54450 setts/ha	445b	357b	2 30	2.19	2.47	2.41	0.98	0.99	81.10b	65.16b	16.97	17.94
2. 1,08900 setts/ ha.	484a	392a	2.22	2.09	2.58	2.47	0.99	0.98	88.43a	71.09a	17.30	18.07

N.S. = Non-significant.

(1) Means followed by same letter do not differ significantly.

Duncan's New Multiple-Range Test at 5% level of Probability.

As regards cane length and its thickness although there were visible differences in cane length among the various planting patterns and planting densities but statiscally these differences were non-significant for both the ratoon crops. However, the cane length on an average varied from 2.22 to 2.33 and 2.05 to 2.21 meter for the first and second ratoon, respectively. Similarly, cane girth did not vary much under the various planting patterns and densities of planting for both the ratoons and averaged 2.41 to 2.58 and 2.38 to 2.50 cm for first and second ratoon, respectively.

The data on weight per cane showed that the different planting patterns and planting densities did not affect the cane weight to a substantial extent in both the ratoon crops.

However, the average weight per cane varied from 0.97 to 0.99 and 0.97 to 1.00 kg in case of first and second ratoon, respectively. Similar cane weight under all the planting patterns and densitities of planting was attributed to almost uniform cane length and cane girth in both the ratoon crops (Table-1).

The data pertaining to cane yield/ha revealed that plots with a planting density of 1,08900 two budded setts/ha placed in the form of two setts end to end in the furrows produced significantly higher cane yield per hectare than plots with a planting density of 54450 setts/ha placed in the pattern of single sett end to end in the furrows and registered on an average 81.10 and 88.43 tonnes of cane/ha for the first and 64.04 and 71.96 tonnes/ha for the second ratoon, respectively The higher cane yield in case of double setts planting was attributed to considerably higher number of millable canes/ha compared to single sett planting method.

As regards planting geometry, double and tripple row strip planting systems resulted in better ratooning and produced significantly higher cane yield than that of single row planting system in both the ratoons but the difference between the double and triple row strip planting system was non-significant. The higher cane yield in double and triple row strip planting systems was again attributed to substantial increase in the number of millable canes/ha as a result of compact and well adjusted stubbles within the strips which encouraged sprouting and thereby help establishing good stand of the crop. The results further led to the conclusion that the cane yield of second ratoon was reduced to the extent of about 20% over the first ratoon. These results are

supported by the findings of Roach (1977), Shanmugasundarum *et al* (1981) and Yang *et al* (1982).

The sucrose contents in cane were recorded on November 25, 1983 and November 5, 1984 in case of first and second year ratoon, respectively. It is evident from the data given in the table that both the planting patterns and densities of planting did not effect the sucrose contents to a considerable extent in both the years. However, there was a visible increase of 0.86% in sucrose contents of second ratoon cane over the first ratoon which was attributed to comparatively earlier maturity of the second year ratoon crop probably as a result of enhanced period of cane development and sucrose synthesis in cane or due to lesser period of active vegetative growth. The findings of Ricaurd and Cochran (1980) do not accord with these results who reported that sucrose contents were more in cane planted in the pattern of 4 drills 90 cm wide with plant cane followed by ratoon cane.

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