INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2007/09–1–167–169
http://www.fspublishers.org

Agronomic Performance and Juice Quality of Autumn Planted Sugarcane (*Saccharum officinarum* L.) as Affected by Flat, Ditch and Pit Planting Under Different Spatial Arrangements

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ABSTRACT

An experiment to determine the effect of different planting patterns on the yield potential and juice quality of autumn planted sugarcane was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad. The planting patterns comprised 100 cm spaced single rows with 30 cm wide ditches, 100 cm spaced double rows with 60 cm wide ditches, 100 cm spaced triple rows with 90 cm wide ditches, 100 cm spaced 100 x 100 cm pits, 90 cm spaced single rows and 90 cm spaced double-row strips. The experiment was laid out in a randomized complete block design with four replications. The results revealed that sugarcane planted in 100 cm spaced double rows with 60 cm wide ditches on account of relatively greater number of stripped canes m^{-2} and higher weight per stripped cane gave significantly the highest stripped cane yield of 134.81 t ha^{-1}, which was statistically equal to that produced by 100 cm spaced 100 x 100 cm pits planting (132.50 t ha^{-2}). The lowest cane yield of 105.95 t ha^{-2} was recorded for sugarcane planted in 90 cm spaced single row. Similarly sucrose contents in cane juice were the highest (18.68%) in sugarcane planted in 90 cm spaced double-row strips followed by that planted in 90 cm spaced single rows (18.63%) against the lowest 18.44% in that planted in 100 cm spaced triple rows with 90 cm wide ditches.

Key Words: Sugarcane; Planting pattern; Sucrose content; Cane yield

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is an important sugar and economically valuable crop of our country. It plays a significant role in the economic up-lift of the country and provides raw material for sugar industry. Molasses are used for the manufacture of alcohol, etc., which are exported to earn foreign exchange and bagasse is used in chipboard industry. At present sugarcane is grown on an area of 0.947 million hectares with total cane production of 48.04 million tones giving an average yield of 45.316 t ha^{-1}, which is much lower even than the yield potential of existing recommended cultivars (Economic Survey of Pakistan, 2004–05). Among many reasons for low cane yield at farmer's field, use of conventional methods of planting associated with low plant population is considered to be of primary importance.

Recently a new technology of planting sugarcane in ditches and pits of variable size has been developed, which has not only explored the possibility of increasing plant population per unit area, but also making efficient utilization of water and applied nutrients. According to Nazir (1990) sugarcane planted in 90 cm spaced 90 x 90 cm pits in a diagonal fashion gave the highest cane yield of 235.14 t ha^{-1} as against 133.17, 154.74, 155.93, 170.92 176.29 and 221.67 t ha^{-1} for that planted in 90 cm spaced double-row strips, 90 cm spaced 100 x 100 cm pits, 100 cm spaced 100 x 100 cm pits, 70 cm spaced 100 x 100 cm pits, 90 cm spaced 90 x 90 cm pits and 50 cm spaced 100 x 100 cm pits, respectively. Singh and Singh (1993) planted five cultivars at a row spacing of 60, 75 and 90 cm and found that cane yield of 76.5 t/ha at 75 cm row spacing was greater than 71.10 and 63.4 t/ha at 60 and 90 cm row spacing, which was higher than 64.3 and 57.9 t/ha at 60 and 90 cm row spacing for the ratoon crop, respectively. By contrast, Sundara and Reddy (1994) planted sugarcane in ridges or furrows, ring or pits and trenches. They obtained cane yield of 65.4, 81.9 and 77.2 t/ha, respectively. However, trench planting (25 cm deep U-shaped furrows) gave significantly higher net return than the other two planting methods. Similarly Gill (1995) reported that pit planting of sugarcane was superior to flat planting. Autumn sugarcane when planted in 100 cm spaced 100 x 100 cm pits gave 57.17 to 112.98 and 59.37 to 94.69% higher stripped cane and sugar yield, respectively than flat planting. Keeping all this in view the present study was planned to determine the productive potential and juice quality of autumn sugarcane planted on flat, ditches and in pits under different spatial arrangements in irrigated environments at Faisalabad.

MATERIALS AND METHODS

The study was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad on a sandy clay loam soil during the year 1995 - 96. The experiment was laid out in a randomized complete block design with four replications. The crop was planted in autumn season Sugarcane variety. SPSG-394 was used as a medium of the trial. A basal dose of 170 - 85 - 85 kg NPK ha^{-1} was used for all treatments. Ditches were made 30 cm deep, while pits were dug to a depth of 60 cm and then refilled to the level of 45 cm with the same soil along with well rotten 5 kg F.Y.M per pit. Each pit was planted with 30 two-budded setts. The planting patterns comprised 100 cm spaced single rows with 30 cm wide ditch, 100 cm spaced double rows with 60 cm wide ditch, 100 cm spaced triple-rows with 90 cm wide ditches, 100 cm spaced 100 x 100 cm pits, 90 cm spaced single rows and 90 cm spaced double-row strips. Observations on number of millable canes/unit area at harvest, cane length, cane diameter, weight per stripped cane, stripped cane yield and sucrose contents in cane juice and harvest index were recorded using standard procedures.

Sucrose percentage was determined by Horn's dry lead acetate method of sugar analysis using saccharimeter. The data obtained were analyzed statistically using Fisher's analysis of variance technique and the treatments' means were compared by using LSD test at $p \leq 0.05$ (Steel & Torrie, 1984).

The number of millable canes m^{-2} is the major yield component, which plays an important role in formulating the final cane yield per hectare. The data presented in Table I revealed that there were significant differences among the various planting patterns under study. The highest number of millable canes m^{-2} (10.96) was recorded for 100 cm spaced triple-rows with 90 cm wide ditch planting, which was statistically equal to that planted in 100 cm spaced 100 x 100 cm pits (10.88). However, these treatments were significantly better than rest of the planting treatments, which in turn differed significantly from one another. The lowest number of 9.40 canes m^{-2} was recorded for 90 cm spaced single rows, which was statistically equal to 90 cm spaced double-row strip planting (9.63 m^{-2}) against 9.77 and 10.43 for 100 cm spaced single-row and double-row ditches, respectively. The higher number of millable canes m^{-2} in case of 100 cm spaced triple-row ditches was attributed to higher germination and better tillering. Variable number of canes per unit area at different spatial arrangements has also been reported by Mahmood *et al.* (2005).

The length of a cane is directly related to the final cane yield per hectare. The data on cane length indicated that there were significant differences among the different planting techniques under study. Although sugarcane planted in 100 cm spaced 90 cm wide triple-row ditches produced significantly longer canes (3.01 m) but was at par with 100 cm spaced double-row or single-row ditches and 100 cm spaced 100 x 100 cm pit planting systems. Significantly the smallest canes were obtained from the treatment 90 cm spaced single-rows followed by 90 cm spaced double-row strip planting. The highest cane length in 100 cm spaced triple–row ditch planting might be ascribed to better utilization of the water and nutrients towards growth and development of canes, because of favorable eco-system in this planting technique. These findings are in agreement with those of Nazir *et al.* (1988). The thickness of the cane is another important yield component of sugarcane. The data on cane diameter presented in Table I revealed that there was significant variation among the various planting techniques. Sugarcane planted in 100 cm spaced 100 x 100 cm pits produced significantly thicker canes (2.24 cm) than rest of the treatments. The maximum cane diameter (2.24 cm) was recorded in plots planted in the pattern of 100 cm spaced 100 x 100 cm pits against the lowest of 2.15 cm in case of 100 cm spaced 90 cm wide triple-row ditch planting system. This was probably due to variable number of canes m^{-2}. The weight of an individual cane has a direct bearing on the final cane yield per hectare and is a function of the combined effect of length and thickness of the cane. The data presented in Table I indicated that there were highly significant differences among the various planting treatments under study. Sugar cane planted in 100 cm spaced 60 cm wide double-row ditches although produced significantly heavier cane than 100 cm spaced triple-row ditches, 90 cm spaced single rows and 90 cm spaced double-row strip planting patterns but was on a par with 100 cm spaced 100 x 100 cm pits and 100 cm spaced 30 cm wide single row ditch planting patterns. Almost similar results were reported by Rhandhawa *et al.* (1993).

The final yield per hectare is a function of integrated interplay of the various yield parameters. The data on cane yield per hectare showed highly significant variation among different planting patterns under study. Sugarcane planted in 100 cm spaced 60 cm wide double-row ditches on account of relatively more number of canes per m^{-2} and higher weight per stripped cane gave significantly the highest stripped cane yield of 134.81 t ha^{-1}, which was statistically equal to that produced by 100 cm spaced 100 x 100 cm pits planting 132.50 t ha^{-1}. However, both these treatments were statistically better than the rest of the planting treatments, which in turn differed significantly from one another. The lowest cane yield of 105.95 t ha^{-1} was recorded for 90 cm spaced single-rows planting against 118.21, 122.47 and 127.35 in case of 90 cm spaced double-row strips, 100 cm spaced single-row ditch and 100 cm spaced triple-row ditch planting, respectively. Significant variation in cane yield under different planting techniques, were also reported by Yadav (1992) and Mahmood *et al.* (2005).

Cane maturity and its quality is mainly determined by sucrose contents in cane juice. The data on sucrose contents in cane juice indicated that there were highly significant differences among the different planting patterns under study. Sucrose contents in cane juice were the highest (18.68%) in sugarcane planted in 90 cm spaced double-row strips and was closely followed by that planted in 90 cm spaced single-row (18.63%) against the lowest of 18.44% in case of 100 cm spaced triple-row ditch planting. Almost similar findings were reported by Nazir and Jabbar (2002),

Table I. Agronomic traits and juice quality of autumn planted sugarcane as affected by different planting patterns

Planting patterns	No of millable canes m^{-2}	Cane length (m)	Cane diameter (cm)	Weight per Cane (kg)	Striped Cane Yield (t ha^{-1})	Sucrose Content in Cane Juice (%)	Harvest index (%)
P1	9.77 c	2.96 abc	2.20 b	1.29 ab	122.47 c	18.56 c	81.77 ab
P2	10.43 b	3.00 a	2.18 bc	1.32 a	134.81 a	18.52 cd	82.17 a
P3	10.96 a	3.01 a	2.15 c	1.19 c	127.35 b	18.44 e	81.07 ab
P4	10.88 a	2.99 ab	2.24 a	1.30 ab	132.50 a	18.49 d	81.91 ab
P5	9.40 d	2.92 c	2.19 b	1.15 c	105.95 e	18.63 b	79.09 c
P6	9.63 cd	2.93 bc	2.18 bc	1.26 b	118.21 d	18.68 a	80.70 b

P1= 100-cm spaced single rows with 30 cm wide ditches; P2= 100-cm spaced double rows with 60 cm wide ditches
P3= 100-cm spaced triple rows with 90 cm wide ditches; P4=100-cm spaced 100x100-cm pits; P5=90-cm spaced single rows
P6= 90-cm spaced double row strips

and Gill (1995).

Harvest index also expresses the production efficiency of a crop. There were highly significant differences among the various planting techniques under study. The harvest index was the maximum (82.17%), when sugarcane was planted in 100 cm spaced double-row ditches, which was statistically equal to that planted in 100 cm spaced triple-row ditches (81.07), 100 cm spaced 100 x 100 cm pits and 100 cm spaced single-row ditches. Significantly the lowest harvest (79.09%) was recorded for sugarcane planted in 90 cm spaced double-row strips.

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(Received 29 December 2005; Accepted 10 November 2006)