Research Article

Evaluation of Different Planting Technique in Ratoon Sugarcane under Semi-Arid Conditions

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Abstract | Effect of different planting patterns on the productivity of first ratoon of sugarcane genotype SPSG-394 was determined under field condition throughout the year 2017-18. Planting patterns under study comprised 100 cm spaced 30 cm wide single row ditches, 100 cm spaced 60 cm wide double row ditches, 100 cm spaced 90 cm wide triple row ditches, 100 cm spaced 100 x 100 cm, pits, 90 cm spaced single rows and 90 cm spaced double row strips. The quadruplicated experiment already laid out according to RCBD for the plant crop, used for this study. The sugarcane was sown on September 8 2015, and in late February, 2017 it was harvested. Consequent ratoon was the test crop. The latter was harvested on 16th of February, 2018. Observation on different qualitative and quantitative traits of crop were recorded by using standard procedure. Highest number of millable cane m^2 (10.35) was recorded for sugarcane planted in 100 cm spaced and 90 cm wide triple against the lowest of 8.55 cane m^2 for that planted in 100 cm spaced and 30 cm wide single row ditches. The highest stripped cane yield was obtained from sugarcane planted in 100 cm spaced 60 cm wide double row ditches (75.03 t ha^{-1}) while the lowest from that planted in 90 cm spaced single rows. Planting pattern did not significantly impact on sucrose % of cane juice that however range between 20.56 and 20.03%. The highest harvest index of 79.21% was recorded for sugarcane planted in 100cm spaced 30 cm wide single row ditches.

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Introduction

Sugarcane *(Saccharum Officinarum L.)* is a prominent member of the large family of grasses. Basically it is cultivated in tropics but its cultivation has been extended to subtropical regions between altitude 30^0 N and 35^0 S. In subtropical region of Pakistan, sugarcane is being grown successfully only under irrigated conditions. Sugarcane has a central role in country economy due to its cash crop in nature. It plays vital role in economic uplift of grower as well as country. It provides basic raw material for domestic

industry. Being a perennial crop, sugarcane is capable of growing successfully as ratoon crop for several years if managed properly and looked after carefully. At farmer's field the ratoon sugarcane yield has always been less than that of plant crop (Ullah *et al*., 2016; Raza *et al*., 2016).

Main reason for low cane yield in Pakistan is low soil fertility, suboptimal plant population density, poor management and inappropriate plating method for efficient utilization of natural resources (Anjum *et al*., 2015). It is well established that fertilization has a key role in sustaining crop productivity (Ullah *et al*., 2019; Zhang *et al*., 2019; Ullah *et al*., 2020a, b) however appropriate plant method also played an important role particularly in sugarcane. Conventional method of planting sugarcane in 60 cm spaced single row limits domestic cane production to considerable extent (Shafi *et al*., 1990).

The newly developed methods have been reported to different production positional. Crop planted in 60cm wide ditches with double row have been reported to give the maximum cane yield (Mahmood, 1997). As there are limited literature on the performance of ratoon sugarcane crop at newly developed plantation techniques, this study was designed to investigate the effect of different planting patterns on ratooning ability and production positional of the sugarcane genotypes SPSG-394 as first spring ratoon crop under the agro-ecological condition of Faisalabad.

Materials and Methods

The proposed study was established at the Agronomic Research area, University of Agriculture, Faisalabad during 2017-18. The experiment was undertaken according to randomized complete block design for the plant crop that kept as ratoon for study. The net plot size was variable for each treatment. However, a uniform area from each experiment unit was harvested for recording the data. The treatment comprised the following six planting patterns. T1: 100 cm spaced 30 cm single row ditches and T2: 100 cm spaced and 60 cm wide double row ditches T3:100 cm spaced 90 cm wide triple row ditches and T4:100 cm spaced and 100 x 100 cm pits, T5: 90 cm spaced double row strips (30/90 cm), T6:90 cm spaced single rows. Sugarcane genotype SPSG-394 was sown as plant crop. The plant crop was harvested at the end of February 2017and was kept as ratoon for the present study. After harvesting the plant crop trash was removed from field and weeds were controlled by manual hoeing in order to encourage sprouting of stubbles of the plant crop. Fertilizer was applied @220-110-110kg N, P_2O_5, K_2O ha^{-1} in the form of urea ,TSP and SOP .Whole of the phosphorous, potash and half of nitrogen applied after sprouting of plant crop. The nitrogen which was left was applied at tillering stage (30 days after the first application of fertilizer). Total of 16 irrigations, each of 10 cm, were given to crop. Beside of 604.7mm rainfall received during growth period of crop. The crop was harvested on 16th of February 2018. The following observation were recorded at the time of crop harvest.1: Number of millable canes m^{-2}, cane length in meter, cane diameter in cm, number of inter node per cane, internodes length cm, weight per stripped cane kg, tops weight (t h^{-1}), Trash weight (t ha^{-1}), stripped cane yield (t ha^{-1}), sucrose content %, commercial cane sugar % and harvest index%. Data collected were subjected to Fisher's analysis of variance technique and the treatment means were compared by using the LSD test at 0.05 probability level (Steel and Torrie, 1984).

Results and Discussion

The number of mill able cane m^{-2} is the major yield component which play key role in formulating the final cane yield ha^{-1}. The statically analysis of data reveal that there was highly significant difference in number of mill able cane among the different planting pattern. The highest number of mill able cane m^{-2} was recorded in crop grown in T1 (10.35) which was however statically equal that planted T3 (10.31) and T2 (10.28a). On contrary the lowest number of mill able cane m^{-2} (8.55b) was produced by crop raised in T1 and T6 (8.7). Differential effect of different planting pattern on the number of mill able cane m^{-2} might be attributed to the varying germination count and till ring. Earlier studies also confirmed same results (Nazir *et al*., 1988). The data regarding the cane length are given in Table 1. The result shows that significant difference in cane length among different planting pattern. The T3 show maximum cane length (2.11a) and minimum cane length were produced by T6. The maximum cane length in T3 owing to enhanced utilization of nutrients and water for development of cane because of adequate availability of growth resources in this planting techniques. These finding are agreement with (Anjum *et al*., 2015). Cane diameter is another

important yield contributing component of sugarcane .it is effected by the environment to which the plant is exposed during it growth period. The results presented in Table 1 clearly indicated that a distinct difference was found among the various planting pattern but these difference were not large enough to reach the level of significance however, on an average the cane diameter ranged between 2.00cm to 2.11cm. These results concur with finding of (Randhawa *et al*., 1993), demonstrated that different row spacing had no significant effect on cane diameter. The number of internodes with inter nodal length determine the cane length which ultimately contribute towards the final cane yield ha^{-1} the data given in Table 1 indicate that there were significant difference among the different planting technique. Sugarcane planted in T6 show greatest number of internodes (19.57) but did not differ significantly from that planted in T6 (19.54) and T3 (18.74) Internodes per cane. On contrary the lowest number of internodes per cane (17.27) were recorded from T5 which was however statically equal to that in T4 (17.92) and T2 (18.35). Similar result has been reported by (Bashir, 1995), showed that sowing pattern had a significant effect on number of internodes. Intermodal length has significant effect on sugarcane yield. The data presented in Table 1 indicate that planting technique had highly significant effect on intermodal length. The maximum intermodal length (11.34) was recorded in T4 which in turn statically equal to T3 and T2. In contrary the shortest inter node (10.08cm) was produced by the sugarcane planted in T6. Longer internodes in pit plantation as well as in double and triple row ditches then other treatment might be due to accelerated growth rate because of less light penetration in to crop canopy and more availability of water and its efficient utilization by the crop in the former three planting technique as both shades/ darkness (Afghan, 1996) and adequate water supply (Bashir, 1995) promote stem elongation. The individual cane biomass has a direct bearing on the final cane yield and is function of combined effect of thickness of cane. The data presented in Table 6 indicate that there were significant difference among the various planting pattern the maximum cane weight was observed in T2 (0.75) and in contrast the lowest weight per stripped cane was obtain in T6 (0.58kg) similar result have also been reported by (Anjum *et al*., 2015). The data regarding tops weight t $ha^{-1}$are presented in Table 1 there was highly significant difference among the various treatment under study. Maximum weight of the top (15.91 t ha^{-1}) was obtained in T4. On contrary the lowest top weight (9.51 t ha^{-1}) was recorded in T1. The data regarding trash weight per ha^{-1} as influenced by different planting pattern are given in Table 1. The maximum trash weight was recorded in T3 (8.14) which were at par with T4 (8.12). On contrary the lowest trash weight (4.97 t ha^{-1}) was recorded from T5 similar result have been reported by (Ullah *et al*., 2016) strip cane yield per hectare is a function of the interplay of various yield parameters. The data on strip cane yield presented in Table 1. There were highly significant differences among the different planting pattern the sugarcane planted T2 (75.03) Produced the highest striped cane yield but statically equal to that in T4 (73.09 t ha^{-1}). On contrary the lowest yield was obtain T6 (46.7 t ha^{-1}) above result concur with the finding of (Ullah *et al*., 2016). The highest striped cane yield in case of T2 was attributed to greater number of mill able cane and relatively higher cane weight. Once cane is matured its quality are mainly evaluated by sugarcane juice sucrose content. The sucrose content in cane juice presented in Table 1. Although there were visible differences among different planting pattern but these differences were not large enough to reach the level of significance however sucrose content range between 20.56-20.03%.

Table 1: *Treatments.*

Treatment	MC m^{-2}	CL (m)	CD (cm)	INPC	IL (cm)	CW (kg)	WT (t ha^{-1})	TW t ha^{-1}	SCY t ha^{-1}	SC (%)	CCS (%)	HI (%)
T1	8.55b	2.02ab	2.08^{NS}	19.54a	10.20b	0.66c	9.51d	4.99c	52.55c	20.50^{NS}	15.63^{NS}	79.21a
T2	10.28a	2.05ab	2.11	18.35bc	11.26a	0.75a	13.58b	7.21b	75.03a	20.35	15.82	78.27ab
T3	10.35a	2.11a	2.04	18.74ab	11.32a	0.68bc	14.03b	8.14a	65.54b	20.56	15.93	74.69d
T4	10.31a	2.03ab	2.11	17.92bc	11.34a	0.73ab	15.91a	8.12a	73.09a	20.23	15.49	75.27cd
T5	8.81b	1.99bc	2.00	17.27c	10.14b	0.63cd	10.61c	4.68c	50.98cd	20.3	15.35	76.93bc
T6	8.70b	1.90c	2.00	19.57a	10.08b	0.58d	9.81cd	4.97c	46.70d	20.52	17.85	75.92cd

Note: *MC: Mill able Cane; CL: Cane Length; CD: Cane Diameter; INPC: No. of internodes per cane; IL: Intermodal length's= Cane weight; WT: Weight of tops; TW: Trashs Weight; SCY: Stripped cane yield; SC: Sucrose content; CCS: Commercial cane sugar; HI: Harvest index.*

These finding are in consistent with the finding of (Singh *et al*., 1987). The data regarding the commercial cane sugar percentage are presented in Table 1. Planting technique had non-significant effect on C.C.S %. However, the C.C.S percentage varied from 15.35 to 15.93. The non significant differences among all the planting patterns were probably attributed to the uniform cane maturity in all treatment. These finding are similar to those of (Ullah *et al*., 2016) clearly established their findings that row spacing failed to impact cane quality. Harvest index express the efficiency of the crop for production of its economic parts. There were highly significant differences in harvest index among various planting technique. Harvest index was maximum (79.21%) when sugarcane was planted in T1and statically equal to T2 (78.27%). On contrary the lowest harvest index was recorded (74.69%) T3 did not differ from crop raised inT6 and T4.

Novelty Statement

To the best of our knowledge this is the first study conducted on Ratoon Sugarcane under semi-arid condition.

Author's Contribution

Muhammad Mohsin Raza: Conceived the idea.
Hera Gul: Wrote abstract
Malik Muhammad Yousaf: Planned methodology
Sami Ullah and Rao Wali Muhammad: Did SPSS analysis.
Ghulam Sabir Hussain: Concluded the research.
Mumtaz Hussain: Provided technical input at every step.
Jahangir Shah: Overall management of the article.
Bashir Ahmad: Collected the data.
Ijaz Ahmad: Wrote results and discussion.
Muhammad Zeshan: Wrote introduction and managed references.

Conflict of interest

The authors have declared no conflict of interest.

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