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RESEARCH ARTICLE

Response of sugarcane genotypes to varying planting environments under two distinct agroclimatic zones of Punjab, India

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Abstract

Sugarcane, an important sugar producing crop provides raw materials for sugar industries hence, creates employment for the human population. In India, sugarcane planting has large sowing window starting from autumn (October-November) to spring season (February- March/April). To determine the optimum planting time of sugarcane cultivars, a field experiment was conducted during 2017-18 at two diverse locations (Faridkot and Gurdaspur) of Punjab, in split plot design having three planting dates (February 25th, March 25thand April 25th) in main plots and four sugarcane cultivars (CoPb 91, CoJ 88, Co 0118 and Co 0238) in sub-plots with 3 replications. Results described that the sugarcane crop planted on February 25 produced more tillers that resulted in maximum millable canes (*i.e*., 113.8 '000 / ha at Faridkot and 107.3 '000 / ha at Gurdaspur, respectively). At both sites, maximum cane yield of 128.4 and 136.3 t / ha was recorded under the February 25 planted crop, which was 15.5 and 18.4 % more than March 25 and 31.2 and 36.9% higher than the April 25 planted crop, respectively. At both locations, the higher cane yield (128.4 and 136.3 t / ha) under February 25 planted crop might be attributed to improved yield parameters such as more millable canes (113.8 and 107.3'000/ha), higher single cane weight (1.2 and 1.4kg) and better quality attributes *viz.,* extraction (55.9 and 56.1%), brix (18.5 and 18.6%), sucrose (16.5 and 16.8%), purity (89.3 and 90.5%) and commercial cane sugar (11.5 and 11.8%). Stable sugarcane yield of Co 0238 was obtained in agro climatic zone II, while CoJ 88 was very uniform in agro climatic zone IV, so these varieties can be selected for cultivation in respective agro climatic zones of Punjab. Therefore, variety CoJ 88 is suitable for Faridkot and Co 0238 for Gurdaspur. In contrast, Co 0118 showed very inconsistent performance at both regions.

Keywords: Cultivar; Date of planting; Faridkot; Gurdaspur; Sugarcane

Introduction

Sugarcane is the important cash crop of India and the world, being cultivated from 8°-32°N surrounding both the tropics and subtropics. In India, sugarcane is grown in two distinct agro climatic regions, namely the tropics (Maharashtra, Karnataka, Gujarat and Tamil Nadu) and the subtropics (Uttar Pradesh, Punjab, Haryana and Bihar). Approximately, 7.5% of the Indian rural population has been engaged in sugarcane cultivation (Solomon 2016). Being the second largest agro-industry after textiles, the sugar industry supports 6 million farmers' families (Verma 2015) and largely contributes to economic development of India (Ahmed and Rahman 2014). Being a long duration crop, sugarcane passes through all the distinguished seasons throughout the year therefore, it requires different sets of climatic conditions during its prolonged life cycle. Sugarcane major phenological stages viz. establishment and formative stage (tillering), elongation and peak growth, ripening and maturity, respectively, coincide with summer, monsoon and winter season. Hence, at various phenological stages, sugarcane growth and development are largely affected by the temporal as well as spatial changeability of the weather.

The genial temperature of sugarcane is 20-30°C for germination, 30-35°C for tillering and 20°C for active growth stage (Fageria et al. 2010). A high temperature reduces sugar accumulation through aggravated photorespiration and increased evapotranspiration (Marin et al. 2013). Similarly, under elevated temperatures, sucrose conversion into fructose and glucose is accelerated, causing poor sucrose content because, sugar accumulation in cane stalks is faster under lower air temperatures. Varietal response to weather variations varies among the cultivars. Using the DSSAT-CANEGRO model, Singh et al. (2021) reported that in Punjab climate change may decline the cane yield of sugarcane cultivars CoJ 88 and Co 0238 by 7.8 and 9.9 % respectively, whereas cultivar CoPb 91 can tolerate the high temperature to some extent. Due to high competition for fiber and food, there is little scope to enhance the sugarcane area to meet the probable requirement for sugar in India. So, to meet the rising demand for sugar and its products, it is essential to boost the productivity of sugarcane. During 2020-21, Punjab produced 7.5 million metric tonnes sugarcane from 0.9 million ha area with 838 q/ha average cane yield and the average sugar recovery was 9.0 per cent (Anonymous 2022). These differences in production of sugarcane may be owing to discrete management as well as environmental factors. Though the agro-climatic environments of Punjab have the potential to increase the sugarcane production but, the spatial and temporal variability in the weather parameters frequently caused reduction in sugar and cane yields in various regions of the state. In this regard, Samui et al. (2013) opined that among Indian states, low sugarcane yields are primarily due to intense conditions of weather and the high frequency of prolonged dry spells even during the monsoon season. In south-western region of Punjab, Singh et al. (2019) have compared different cropping systems for raising the output of sugarcane and wheat crops. Their results explained that furrow irrigated raised bed (FIRB) system may be useful for obtaining high productivity and net returns, as both the crops can be sown timely and give better yields.

To acquire a healthy crop of sugarcane, appropriate planting time for selected genotypes is one such principal factor determining the potential productivity of any area. The late planted sugarcane crop takes less time for physiological growth and reduction in the production of sugarcane. From February - March the sugarcane crop can be properly grown in North India, but for gaining higher yield; identification of the optimum planting dates, fitting well in soil and weather conditions is of paramount importance. On the other hand, sugarcane crop planted in summer emerges rapidly but, it is extremely susceptible to mortality of shoots that leads to fewer millable canes. Because, sugarcane planted in April/May experience higher temperature stress, that shortens the tillering period resulting, in decline in productivity than the February planted crop (Pandey and Shukla 2003). Singels and Smith (2002) recorded only 40% germination at 67 days after planting in 28th May planted sugarcane crop and Verma et. al. (1996) recorded 25-62% tiller mortality in sugarcane planted under diverse planting seasons which was highest in summer, followed by autumn or spring sugarcane. Mishra et al. (2016) recommended that by changing sugarcane planting from February to March or April, relevant cane yield declined by 4.0 and 11.1 per cent from cane yield mean (92.3 t/ha) of sugarcane crop planted in February. They also suggested that the yield of cane could be higher by 8.1% only with sugarcane planting in March than in April. Hence, choice of appropriate planting time is the important component for determining the yield potential of sugarcane. Keeping this in view, the current study was emphasized to estimate the response of sugarcane varieties with different dates of planting in two distinct agro-climatic zones of Punjab, India.

Materials and Methods

This experiment was performed at two diverse locations, one at Punjab Agricultural University (PAU), Regional Research Station (RRS), Faridkot (lat 30°40'N; long 74°44'E; alt 200m above msl) which falls in the western plain zone (agro-climatic zone-IV) of Punjab, and another at PAU, RRS, Gurdaspur (lat 32°40'N, long 75°40'E and alt 241m above msl) that lies underneath the north portion of the state representing undulating plain-zone (agroclimatic zone II) of Punjab. During 2017-18 at both locations, the field trials were carried out using split plot design with three dates of planting (February 25, March 25 and April 25) in main plot and four varieties of sugarcane (CoPb 91, CoJ 88, Co 0118 and Co 0238) in sub-plot replicated thrice. Harvesting the crop was completed by the end of January, 2018. The soil of the experimental area was sandy-loam and silt-loam at Faridkot and Gurdaspur, respectively. Standard agronomic practices were adopted following package and practices for crops of Punjab Kharif 2017 (https://www.pau.edu/content/pf/pp_rabi.pdf) at both locations.

Daily weather data of both locations were recorded from the Agrometeorological observatory established near the experimental fields at PAU, RRS, Faridkot and PAU, RRS, Gurdaspur. Different growth, yield and quality attributes, including no. of tillers, no. of millable canes (NMC), single cane weight, cane yield, extraction percent, brix percent, sucrose content, purity percent and commercial cane sugar (CCS) content were recorded at both locations. The tiller population was counted at 90 and 120 days after planting (DAP) from two rows. The NMC of each plot was manually counted from four rows before harvesting. Similarly, the weight of five individual canes has been recorded at harvest to get mean single cane weight. Randomly selected five canes from each plot were used to determine the quality parameters and juice extraction. The cane samples were cut into pieces and weighed. Then, juice was extracted by crushing of stalks in the mechanical crusher and juice weight was recorded. Extraction percent was calculated from cane sample weight and juice weight. Extracted juice was used for further analysis of quality parameters. Brix percentage known as total solids was determined with the help of a hydrometer and brix reading was corrected at 20°C. The sucrose content was determined from the uncorrected brix and corresponding pol reading (Gupta 1977; Meade and Chen 1977). Likewise, the purity percentage in juice was calculated by following Satisha et al. (1996) and the percentage as well as mass of CCS in cane was computed by following the formula (Gupta 1977; Meade and chen 1977).

$$\text{Purity (\%)} = \frac{\text{Sucrose percentage in juice}}{\text{Brix percentage in juice}} \text{ x } 100$$

$$\text{CCS (\%)} = [0.292 \text{ x } S] \text{ x } \frac{0.035 \text{ x } P{-}1}{P} \text{ x } 1$$

Where , S = Sucrose (%) in the juice and
P = Purity (%) in the juice.

CCS (t / ha) = [Yield* CCS (%)]/100

Results and Discussion

Variations in weather conditions

The daily data of meteorological parameters of both locations converted into standard meteorological week (SMW) (Fig.1) scales revealed that weekly maximum temperature ranged from 15.7 (4st SMW) to 43.0°C (16th SMW) at Faridkot and 16.0 (4th SMW) to 42.7°C (22th

SMW) at Gurdaspur. On the other hand, weekly minimum temperature varied from 4.5 (2nd SMW) to 28.7°C (32th SMW) and 4.6 (2nd SMW) to 26.2°C (26th SMW) at respective locations. At both locations, maximum weekly rainfall of 96.1 and 156.4 mm occurred on 36th and 31st SMW, respectively. Maximum evaporation of 76.4 mm was recorded in the 23rd SMW at Faridkot and 48.8 mm during the 24th SMW at Gurdaspur. Similarly, relative humidity ranged from 12 (16th SMW) to 95% (45th SMW) at Faridkot and from 39 in the 22nd SMW to 95% in the 1st SMW at Gurdaspur. Maximum sunshine duration was 9.3 (16th SMW) and 9.7 hours (16th SMW) at Faridkot and Gurdaspur, respectively.

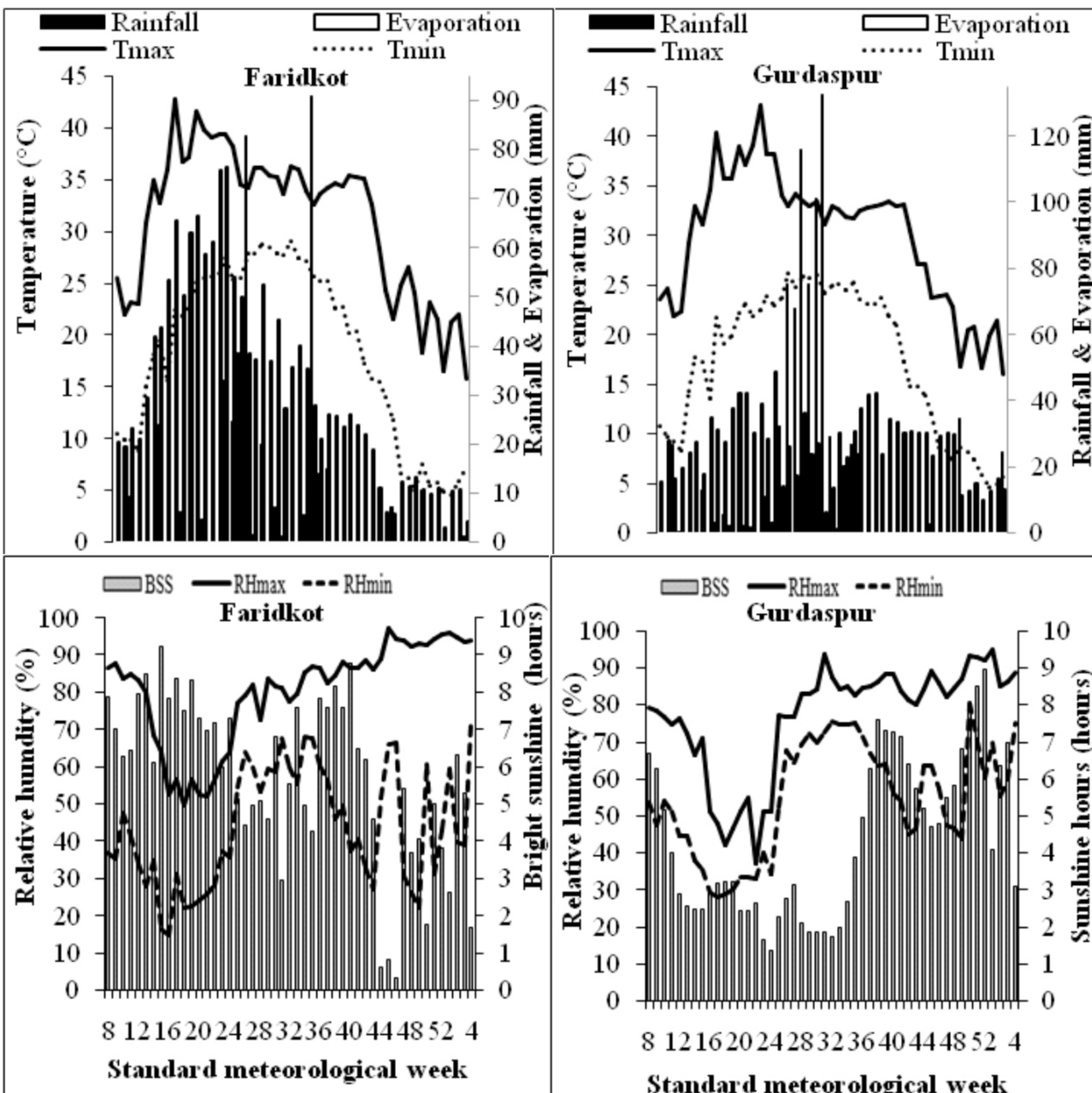

Figure 1. Weekly weather conditions at Faridkot and Gurdaspur during 2017-18

Number of tillers

The tiller population increased up to 120 days after planting and after that; declined until 150 days after planting (Table 1). A decrease in the tiller count may possibly be the mortality of newly emerged shoots because of high competition for air, nutrients, light and moisture. The population of tillers in late to early crop differed from 110.4 to 154.1 '000/ha at 120 DAP and 107.3 to 140.3 '000/ha at 150 days after planting and 102.18 to 129.76 '000/ha and 97.68 to 117.67 '000/ha at Faridkot and Gurdaspur, respectively for particular intervals. Early sugarcane planting (February 25th) results in the production of higher tillers than delayed and late crop planted. Initially, tiller mortality was minimal in mid-planted crops but between the periods of 150 days after planting to harvest, 19.08% mortality of tillers was noted at Faridkot. As far as the planting time of sugarcane is concerned, Verma et al. (1996) reported 25 to 62% tiller mortality in the summer season planted sugarcane. In addition, Singh et al. (2017) opined that summer planted crops faced high thermal stress at the tillering stage, which resulted in maximum tiller mortality than other periods planted sugarcane. Among different varieties at 120 days after planting, CoJ 88 recorded significantly, highest no. of the tillers (145.3 '000/ha) however, at 150 days after planting, no. of tillers of CoJ 88 (136.2'000/ha) was on par with Co 0238 at Faridkot station. While at Gurdaspur, CoJ 88 produced a consistently higher number of tillers at both the intermissions (i.e. 120 and 150 days after planting). Interaction among different dates of planting and varieties remained non-significant except for Gurdaspur at 120 DAP (Table 1).

The number of millable canes (113.8'000/ha) under early sown (February 25th) crop was on par (107.2 '000/ha) with the March 25th sown crop but then again, significantly higher (90.7 '000/ha) than the April 25th crop planted at Faridkot (Table 2). On the other hand, at Gurdaspur, NMC was 107.3, 97.0 and 86.8'000/ha for crops planted at various dates. The tiller population was comparatively less under April 25th planting, which resulted in reduction in the number of millable canes at the end of the season. Likewise, Shiv and Srivastava (1993) suggested that the March planted crops produce a

Table 1. Number of tillers ('000/ha) of sugarcane varieties under different planting dates at Faridkot and Gurdaspur

	Agroclimatic zone-IV: Faridkot		Agroclimatic zone-II: Gurdaspur	
Treatments	**120 DAP**	**150 DAP**	**120 DAP**	**150 DAP**
Dates of planting				
February 25	154.1	140.3	129.8	117.7
March 25	130.1	132.7	116.2	111.8
April 25	110.4	107.3	102.2	97.7
CD (0.05)	10.5	14.7	10.9	7.5
CV (%)	7.0	10.3	8.3	6.0
Cultivars				
CoPb 91	126.7	122.0	114.5	108.9
CoJ 88	145.3	136.2	138.8	127.1
Co 0118	120.7	118.7	102.0	93.8
Co 0238	133.5	130.3	108.8	106.5
CD (0.05)	14.1	12.6	8.9	7.4
CV (%)	10.8	10.1	7.8	6.9
D*V(CD 0.05)	NS	NS	15.5	NS

higher number of millable canes that declined with each consecutive postponement in time of planting. The results of the present study are in agreement with the results of Singh et al. (2017) who also reported that a reduction in the number of millable canes in the summer season planted sugarcane. Similarly, amongst cultivars, no. of millable canes were higher (112.6 '000/ha) in the cultivar CoJ 88 which was statistically on par with CoPb 91 (105.5 '000/ha) but, significantly more than Co 0238 (100.99 '000/ha) and Co 0118 (96.7 '000/ha) at Faridkot. However, cultivar CoJ 88 was once again best at Gurdaspur, with 111.0 '000/ha NMC, followed by CoPb 91 (98.0 '000/ha) and Co 0238 (96.3 '000/ha). At Gurdaspur and Faridkot, there was no discernible interaction between the planting dates and varieties.

Cane yield

At both (Faridkot and Gurdaspur) locations, maximum cane yield 128.39 and 136.26 t/ha, respectively, was observed under early (February 25th) planted crop that was 18.4 and 15.5% higher cane yield than the mid-planting crop and 36.9 and 31.2% more than the late-planting crop (Table 2). These results clearly indicated that Faridkot (Agro climatic zone IV) was more prone to yield losses under delayed planting, though at Gurdaspur (Agro climatic zone II), yield reduction was not much higher than Faridkot. Singh et al. (2017) recorded 46% cane yield reduction of sugarcane planted in the summer season over the autumn crop. Similarly, Tripathi and Pandey (1993) recorded 86.9 to 38.2 t/ha cane yield reduction with delayed planting from April to May. Among various varieties, cane yield was significantly higher in CoPb 91 (117.2 t/ha) and CoJ 88 (112.2 t/ha) followed by Co 0118 (93.3 t/ha) and Co 0238 (96.1 t/ha) at Faridkot, whereas at Gurdaspur, CoPb 91 produced 8.9, 25.9 and 14.0% higher cane yield than CoJ 88, Co 0118 and Co 0238, respectively.

Among different planting environments, constant cane yield was obtained by cultivar Co 0238 under agro-climatic zone-II, whereas; the performance of CoJ 88 was more constant for agro-climatic zone-IV. These cultivars can be chosen for cultivation in the respective agro-climatic zones of Punjab. Contrarily, Co 0118 showed a very uneven performance, at Faridkot and Gurdaspur. Therefore, planting between February 25th and March 25th, cultivar CoJ 88 was suitable for Faridkot and Co 0238 for Gurdaspur. Similarly, for late planting between March 25 and April 25, CoPb 91 is preferable for both locations (Singh et al. 2018).

Single cane weight

At Faridkot, the weight of a single cane was 1.2, 1.2, and 0.9 kg for February 25 (early), March 25 (mid), and April 25 (late) planted crops, respectively. However at Gurdaspur, the early, mid, and late planted crops the corresponding single cane weight was 1.4, 1.3, and 1.2 kg. Amongst cultivars, CoPb 91 had considerably greater cane weight (1.2-1.4 kg), followed by CoJ 88 (1.1-1.2 kg), Co 0118 (1.1-1.3 kg), and Co 0238 (1.0-1.3 kg), at both sites (Table 2).

Extraction and brix percent

Extraction percentage at Faridkot (Table 3) ranged from 53.5% (in late planting) to 55.9% (in early planting). Similarly, at Gurdaspur, crops planted in diverse environments followed alike a trend as that of Faridkot with extraction percentage range between 52.7% for late and 56.1% for early planted crop. High % extraction with larger growing length was achieved by early planted crops than late planted crop with short length and vice versa. However, % extraction of juice was not considerably different between the cultivars but, Co 0118 recorded maximum % extraction than other sugarcane cultivars. Likewise, brix %

Table 2. Yield and yield attributes of sugarcane cultivars under different planting dates at Faridkot and Gurdaspur

Treatments	Agroclimatic zone - IV: Faridkot			Agroclimatic zone - II: Gurdaspur		
	NMC **(000/ha)**	SCW **(kg)**	Cane yield **(t /ha)**	NMC **(000/ha)**	SCW **(kg)**	Cane yield **(t /ha)**
Dates of planting						
February 25	113.8	1.2	128.4	107.3	1.4	136.3
March 25	107.2	1.1	104.8	97.0	1.3	115.2
April 25	90.7	1.0	80.9	86.8	1.2	93.7
CD (0.05)	16.0	0.1	23.1	9.7	0.2	16.1
CV (%)	13.6	8.4	19.5	8.8	10.9	12.3
Cultivars						
CoPb 91	105.5	1.2	117.2	98.0	1.4	131.0
CoJ 88	112.6	1.1	112.2	111.0	1.2	119.4
Co 0118	96.7	1.1	93.3	82.8	1.3	97.1
Co 0238	100.9	1.0	96.1	96.3	1.3	112.7
CD (0.05)	10.9	0.1	12.2	7.8	0.1	11.1
CV (%)	10.6	6.9	11.8	8.2	7.0	9.7
D*V(CD 0.05)	NS	NS	NS	NS	NS	NS

Where, NMC= Number of millable canes; SCW = Single cane weight; NS = Non - significant

followed alike pattern as % extraction amongst the dates of planting (Table 3). The brix percent was significantly higher (18.5%) in the early planted crop, followed by 18.3 in delayed and 17.6% in the late planted crop at Faridkot. Among different cultivars, brix percentage was minimum in CoPb 91 (17.5%) and Co 0238 (17.9%) The period of sugarcane planting considerably affected the brix percent among different sugarcane cultivars, at both the study locations (Singh et al. 2017; 2018).

Sucrose and purity percent

Sucrose content of the selected cultivars was influenced by planting dates and cultivars at both sites. In Faridkot, the mean sucrose content in the February 25 crop was significantly higher (16.5%) than in the March 25 crop (16.1%) and April 25 crop (15.8%), while in Gurdaspur, the sucrose content in the early, mid, and late sowings was 16.8, 16.0, and 15.7%, respectively (Table 3). The Gurdaspur experimental site achieved relatively higher purity than the Faridkot site. Variety Co 0118 had a considerably high sucrose content at Faridkot (16.7%) and at Gurdaspur (16.6%), statistically equal to CoJ 88 (both 16.6%) but higher than Co 0238 (15.6 and 15.9%) and CoPb 91 (15.6 and 15.7%). CoPb 91 showed the least variation in sucrose content between mid (March 25) and late (April 25) sowings at Faridkot and Gurdaspur. Similarly, CoJ 88 (Faridkot) and Co 0118 (Gurdaspur) showed relatively consistent performance at different planting dates. At both stations, the planting date has a significant effect on the sucrose content of the various crops.

The variety planted on April 25 had the highest purity (89.5%) in sugarcane juice, which was considerably higher for the variety planted on March 25 in Faridkot at 88.3% and for the variety planted on February 25 at 89.3%; similarly, the purity in Gurdaspur was 90.5, 88.8, and 88.7% for the respective planting. For Co 0118, the purity level (90.7%) in Faridkot was significantly higher than CoJ 88 (89.5%), CoPb 91 (88.7%) and Co 0238 (87.2%), while in Gurdaspur it was Co 0118 (89.7%), CoJ 88 (89.5%), CoPb 91 (89.4%) and Co 0238 (88.8%). The percentage purity of sugarcane juice was significantly influenced by the interaction of planting date and varieties in Faridkot and Gurdaspur (Table 3).

Commercial cane sugar percent

Maximum CCS percent was (11.5 and 11.8%) in 25th February planted crop than 11.2 and 11.1% in 25th March and 11.0 and 10.9% in 25th April planted crop, respectively; at both the locations (Table 3). Results of the present investigation suggested that early planted crop produced the highest CCS than late planting owing to favourable weather conditions. At both locations, amongst the cultivars the sugar percentage was high (11.7 and 11.6%) in Co 0118 that was considerably at par (11.6 and 11.5%) with CoJ 88 but, Co 0238 statistically differed (10.8 and 11.0%) from CoPb 91 (10.8 and 10.9%). Planting dates and cultivars interaction had considerable differences at Faridkot, which was insignificant for Gurdaspur.

In early sugarcane planting, CCS was maximum (14.7 t/ha) than (11.7 t/ha) mid-crop and (8.9 t/ha) late plant crop at Faridkot (Table 3). Following similar patterns, the Gurdaspur also recorded higher sugar from early (16.0 t/ha) followed by (12.8 t/ha) mid and (10.2 t/ha) in late planted crop (Table 3). Nevase et al. (2004) concluded that CCS per cent (t/ha) decreased in late (18th SMW) planted crop as compared to early (45th SMW) planted crop. Amongst cultivars, better performance was recorded in CoJ 88 (13.0 t/ha) was at par with CoPb 91 (12.7 t/ha) but considerably different from Co 0118 (11.0 t/ha) and Co 0238 (10.4 t/ha) at Faridkot whereas, CCS % was high (14.4 t/ha) in CoPb 91 without any significant difference with CoJ 88

Table 3. Juice quality of sugarcane cultivars under different planting dates at Faridkot and Gurdaspur

Treatments	Extraction (%)		Brix (%)		Sucrose (%)		Purity (%)		CCS (%)		CCS (t / ha)	
	FDK	GSP	FDK	GSP	FDK	GSP	FDK	GSP	FDK	GSP	FDK	GSP
Dates of planting												
February 25	55.9	56.1	18.5	18.6	16.5	16.8	89.3	90.5	11.5	11.8	14.7	16.0
March 25	54.7	54.7	18.3	18.1	16.1	16.0	88.3	88.8	11.2	11.1	11.7	12.8
April 25	53.5	52.7	17.6	17.8	15.8	15.7	89.5	88.7	11.0	10.9	8.9	10.2
CD (0.05)	1.3	0.7	0.5	0.3	0.4	0.3	0.7	0.3	0.2	0.2	2.6	1.9
CV (%)	2.2	1.1	2.6	1.3	2.1	1.3	0.7	0.3	1.8	1.4	19.4	13.1
Cultivars												
CoPb 91	54.8	54.7	17.5	17.5	15.6	15.7	88.7	89.4	10.8	10.9	12.7	14.4
CoJ 88	54.5	54.5	18.6	18.5	16.6	16.6	89.5	89.5	11.6	11.5	13.0	13.8
Co 0118	55.2	55.0	18.4	18.5	16.7	16.6	90.7	89.7	11.7	11.6	11.0	11.3
Co 0238	54.2	53.8	17.9	17.9	15.6	15.9	87.2	88.8	10.8	11.0	10.4	12.5
CD (0.05)	NS	NS	0.4	0.2	0.4	0.2	0.5	0.5	0.2	0.1	1.3	1.3
CV (%)	3.0	2.6	2.3	1.1	2.2	1.1	0.6	0.5	2.2	1.1	11.2	10.2
DxV(CD0.05)	NS	NS	0.7	0.4	0.6	0.3	0.9	0.8	0.4	NS	NS	NS

Where, FDK= Faridkot; GSP = Gurdaspur; CCS = Commercial cane sugar

(13.8 t/ha) but, varied from Co 0118 (11.3 t/ha) and Co 0238 (12.5 t/ha) at Gurdaspur. Interaction between the dates of planting and varieties was non-significant at Faridkot and Gurdaspur.

Conclusion

Sugarcane productivity is largely affected by the planting seasons. At both locations, 25th February planting of sugarcane attained maximum cane yield primarily attributed to improved tiller population, single cane-weight, millable canes, extraction of juice and % sucrose in comparison to delayed and late planted crop. Among cultivars, cane yield (117.2 and 131.0 t / ha) of CoPb 91 was 4.3 % and 8.9 % higher than CoJ 88, 20.4 and 25.9 percent than Co 0118, 18.0 and 14.0 per cent than Co 0238, respectively; at Faridkot and Gurdaspur. Amongst different planting situations, Co 0238 and CoJ 88 at Gurdaspur and Faridkot, respectively, exhibited stable cane yield, while Co 0118 exhibited less uniformity in performance, at Faridkot and Gurdaspur. As a result, CoJ 88 and Co 0118 at Faridkot and Gurdaspur, respectively was, more profitable for planting crops between February 25th and March 25th however for delayed planting i.e. in the sowing window of March 25th and April 25th, CoPb 91 was more appropriate for cultivation at Faridkot and Gurdaspur.

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