

# Original Research Article

## Correlation among Yield, Quality and Mechanization amicable traits in Sugarcane Clones

### ABSTRACT

The experiment was conducted at Regional sugarcane and Rice Research Station, Rudrur, Nizamabad district, Telangana state in Randomized Block Design (RBD) with three replications. The analysis of variance revealed significant differences among genotypes for fifteen yield, quality and mechanization amicable characters. Correlation coefficient results indicated that cane yield was positively correlated with commercial cane sugar, number of tillers at 120 days after planting, number of shoots at 240 days after planting, millable canes, cane height, cane girth, single cane weight whereas purity % and angle of inclination showed negative correlation with cane yield. Sugar yield per hectare was positive and significant association with number of tillers at 120 days after planting, number of shoots at 240 days after planting, millable canes, cane height, single cane weight, Brix%, sucrose % and CCS% at 12 month. The Angle of inclination is negatively correlated with cane yield and positively correlated with ratio of crown weight to cane weight, brix%, sucrose%, purity% and CCS%. Results indicate that the genotypes should be selected on the basis of number of millable canes, cane length, cane girth and single cane weight for getting higher sugarcane yield. Furthermore, mechanization amicable genotypes can be selected which are near to erect nature and also having less crown weight.

**Key words:** Cane yield, correlation, Commercial Cane Sugar, Angle of inclination, sugarcane

### INTRODUCTION:

Sugarcane (*Saccharum spp.*) is an important agro-industrial commercial crop of India which plays a vital role because of its wider adaptability over varying agro climatic conditions and also unique among agricultural crops in the sense that 2-3 succeeding cane crops are raised from a single planting which is an integral component of sugarcane production system. Sugarcane (*Saccharum sp.*) is cultivated in about 5.9 million hectares with a total cane production of 490.53 million tons. The country's average cane yield hovers around 83.30 tons per hectare. In Telangana, sugarcane is cultivated on 28,000 ha with a total production of 2.94 million tons. The average cane yield in Telangana is 105 tons per hectare. (Indiastat, 2022-23)

Sugarcane is labour intensive requiring about 3300 man-hrs per hectare for different operations (Javed Ali 2015). Considering the present trend of availability of labour for sugarcane production, it has been

experienced that the development of mechanization amicable varieties is inevitable. Identification of superior clones suitable for mechanical harvesting to the region / state is essential so as to improve the production efficiency, cost effectiveness, cane loading efficiency infield losses and also encourage the sugarcane growers towards cane cultivation.

The correlation studies are used to measure the intensity and direction of character association. Since selection is usually concerned with improving a group of characters simultaneously, an understanding of inter se correlations is of prime interest of the breeder. Hence, in the present investigation an attempt is made to understand the type of association existing between sugarcane yield, quality and mechanization amicable characters.

### **MATERIAL AND METHODS:**

The present study comprised thirteen sugarcane genotypes were evaluated at Regional Sugarcane and Rice Research Station, Rudrur, Nizamabad, Telangana during 2021. These 13 genotypes were planted in Randomized block design with 3 replications. The plot size is of 1.2 m x 6 m long in four rows. The planting was done at 12 buds per meter row length. All the recommended cultural practices were followed to obtain a good crop. The data were recorded as per standard statistical procedures for yield, quality attributes and mechanization amicable parameters viz. Germination, Tillers count at 120 days after planting, Shoots count at 240 days after planting, Number of millable Canes, Brix, Sucrose, Purity, Commercial Cane Sugar%, Cane length, Cane girth, Single Cane weight, Cane Yield and Commercial Cane Sugar yield, mechanization amicable characters angle of inclination, ratio of crown weight to cane weight.

Yield components, such as germination count, number of tillers at 240 days after planting, number of millable canes, cane length, cane girth and single cane weight were evaluated for each genotype. The number of millable canes was counted within each plot. For the determination of the cane length, a measurement tape was used to measure a sample of ten canes. A vernier caliper was used to measure the diameter of the same ten canes, which the reading region was defined as one third of the cane height (from the basis to the top). Then, the ten canes were weighed, and the mean weight was obtained. The cane productivity was calculated from the weight of all millable canes per plot and the area occupied by each plot (t/ha). Brix was estimated with a hydrometer from juice extracted from 5-stalks samples per plot in the laboratory in the month of November. POL estimated using a polarimeter. Angle of inclination is measured using protractor for a sample of ten canes. Crown weight and cane weight ratio is measured by using the top crown weight and the cane weight. Crown weight is weight of the left-over crown portions of canes after harvesting the crop. Correlation coefficient analysis was calculated as per formulae suggested by Dewey DR and KH Lu, 1959.

### **RESULTS AND DISCUSSION:**

The analysis of variance revealed significant differences among genotypes for all the plant characters (Table 1). The PCV (phenotypic coefficient of variation) and GCV (genotypic coefficient of variation) values are ranked as low, medium, and high with 0 to 10%, 10 to 20%, and >20%, respectively [Shivasubramanian *et al.*]. The estimated phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for the traits indicating greater environmental influence on these traits for total variation. Low PCV values were exhibited by Cane length (5.31), Cane girth (9.53), Brix % at 12 months stage (7.99), Sucrose % at 12 month stage (8.27), Purity % at 12 months stage (3.13), CCS % at 12 month stage (8.76). Medium PCV for germination percentage (16.25), number of tillers at 120 days after planting (13.40), number of shoots at 240 days after planting (13.40), number of millable canes (13.40) and high PCV for Cane yield (28.75), CCS yield at harvest (31.45), angle of inclination (21.06), Ratio of crown weight to cane weight (29.84) and single cane weight (26.64) were recorded (Table 2).

The evaluation of heritable variation with the help of genetic coefficient of variation alone may be deceptive. Therefore genotypic coefficient of variation is not a correct measure to know the heritable variation present and should be considered together with heritability. Heritability values are categorized as low (0–30%), moderate (30–60%), and high (60% and above). Low and medium heritability values were not obtained in this study. High heritability was exhibited by all the traits. So, selection breeding for improvement of these varieties based on these traits may be reliable. But heritability alone provides no indication of the amount of genetic improvement that would result from selection of individual genotype. Thus, information of heritability should be coupled with genetic advance.

Genetic advance (GA) is referred to as the improvement of characters in genotypic value for the new population compared with the base population. Genetic advance as per cent mean is categorized as low (0–10), moderate (10–20) and high (>20). The genetic advance expressed as per cent of mean was high for Cane yield (57.41), CCS yield (63.32), Angle of inclination (42.31), Crown Wt/Cane Wt (53.99), Germination percentage (21.77), Tillers at 120 days after planting (25.73), Shoots at 240 days after planting (25.73), number of millable canes (25.74) and single cane weight (54.25). The high heritability coupled with high genetic advance was obtained for Cane yield, CCS yield, Angle of inclination, Crown Wt/Cane Wt, Germination percentage, Tillers at 120 days after planting, Shoots at 240 days after planting, number of millable canes and single cane weight. Thus, these characters are under the control of additive genetic effects and it confirms that selection based on the phenotypic performance of this trait is best for variety improvement program.

Cane yield is associated with its various components genotypically and phenotypically in various magnitudes. Further, their study has indicated the magnitude of the correlations among cane yield traits. In general, genotypic correlation coefficients were higher than their corresponding phenotypic correlation coefficients indicating a fairly strong inherent relationship among the traits. The lower estimates of phenotypic correlation indicated that the relationships were affected by environment at phenotypic level. Such environmental influence in reducing the correlation coefficients in rice was also reported by Chaudhary and Singh, 1994. The correlation coefficient results (Table 3) indicated that the cane yield was

positively and significantly correlated with commercial cane sugar (0.96\*\*\*), number of tillers at 120 days after planting ( $r=0.46^{**}$ ), number of shoots at 240 days after planting (0.46\*\*), millable canes( $r=0.46^{**}$ ), cane height( $r=0.47^{**}$ ), cane girth( $r=0.35^*$ ), single cane weight ( $r=0.93^{***}$ ). The Angle of inclination is negatively correlated with cane yield and positively correlated with ratio of crown weight to cane weight, brix%, sucrose%, purity% and CCS%. The increase in cane yield was due to combined effect of stalks per stool, length of stalk and weight per stool concluded by Chaudhry, 1982.

A Positive and highly significant correlation between cane yield and its components viz., single stalk weight, stalk length and millable cane number was reported by Bora *et al.*, 2014 and Gowda *et al.*, 2016. The correlation of number of millable canes with cane length was positive, whereas single cane weight showed negative correlation with tiller numbers (Table 3). Cane yield is in positive correlation with Number of Millable Canes at harvest reported by Kheniet *et al.*, 2015 and Reddy *et al.*, 2020. In case of sugar yield positive correlation was observed with cane yield, cane weight, number of millable canes, cane length, cane girth, Brix%, sucrose %, CCS % and purity % and non significant correlation was observed with cane girth.

Sugar yield per hectare is mainly dependent on cane yield, Brix%, Sucrose%, purity % and CCS %. 12 reported positive and significant association of sugar yield with number of tillers at 120 days after planting ( $r=0.38^*$ ), number of shoots at 240 days after planting (0.38\*), millable canes( $r=0.38^*$ ), cane height( $r=0.40^*$ ), single cane weight ( $r=0.93^{***}$ ), Brix% (0.48\*\*), sucrose % (0.51\*\*\*) and CCS% at 12 month (0.50\*\*). The negative correlation of purity% and angle of inclination with cane yield is one of the major constraints in the improvement of sugarcane (Table 3). Our results are in agreement with those mentioned by Kumar and Kumar, 2014 and Tadesse and Dilnesaw 2014, who found that the cane yield, considered as the most important character of sugarcane, was positively and significantly correlated with number of millable canes, stalk diameter and stalk weight. Moreover, they noted negative associations of cane yield with juice pol, and purity%.

Sucrose% had the positive correlation with Brix ( $r= 0.93^{**}$ ) and ration of crown weight to cane weight ( $r= 0.35^*$ ) and negative correlation with cane girth ( $r= - 0.54^{***}$ ). Similarly, the correlation of Brix was highly significant with CCS% ( $r= 0.86^{***}$ ). Our data showed negative significant correlation between cane yield and any of the sucrose-related traits. Tyagi *et al* (2012) also found a strong negative correlation between Brix, sucrose percent, purity percent in juice and cane yield/plot. This could be attributed to the difference in length of growth and time of sampling for sucrose traits. Bora *et al* (2014) found that sugar recovery had a high and significant correlation with field brix and sucrose. Hence these two characters must be given importance for improvement of sugar recovery. This study revealed that higher cane length, cane girth endowed with better single cane weight are the important characters which should be considered while selection to be made for higher sugar yield in sugarcane genotypes.

## **CONCLUSION:**

The study indicated that there is wide range of genetic variability among the tested clones for growth and yield characters. It is evident that the high heritability coupled with high genetic advance reported in characters Cane yield, CCS yield, Angle of inclination, Crown Wt/Cane Wt, Germination percentage, Tillers at 120 days after planting, Shoots at 240 days after planting, number of millable canes and single cane weight. Hence, selection of the best performing clones based on these characters may be utilized in future selection breeding programme. A perusal of the results of correlation analysis revealed that cane yield was positively and significantly correlated with commercial cane sugar (0.96\*\*\*), number of tillers at 120 days after planting ( $r=0.46^{**}$ ), number of shoots at 240 days after planting (0.46\*\*), millable canes ( $r=0.46^{**}$ ), cane height ( $r=0.47^{**}$ ), cane girth ( $r=0.35^{*}$ ), single cane weight ( $r=0.93^{***}$ ). Sugar yield per hectare was positive and significant association with number of tillers at 120 days after planting ( $r=0.38^{*}$ ), number of shoots at 240 days after planting (0.38\*), millable canes ( $r=0.38^{*}$ ), cane height ( $r=0.40^{*}$ ), single cane weight ( $r=0.93^{***}$ ), Brix% (0.48\*\*), sucrose % (0.51\*\*\*), and CCS% at 12 months (0.50\*\*). The Angle of inclination is negatively correlated with cane yield and positively correlated with ratio of crown weight to cane weight, brix%, sucrose%, purity% and CCS%. Hence, emphasis should be given to these traits while formulating selection criteria for improvement in cane, sugar yield and mechanization amicable characters.

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Table 1. Analysis of variance results for yield, quality and mechanization amicable traits in sugarcane																
Source of Variations	df	Germination %	No of tillers @ 240 DAP	No of shoots @ 240 DAP	No of millable canes	Brix%	Sucrose%	Purity %	CCS%	Cane Length (cm)	Cane Girth (cm)	Single Cane Weight (Kg)	Cane Yield (T/ha)	CCS Yield (T/ha)	Angle of Inclination	Crown Wt / Cane Wt
Replications	2	53.76	15.10	12.66	10.47	0.013	0.0002	0.22	0.0012	3.27	0.0008	0.00003	18.36	0.32	0.08	0.0001
Treatments	12	122.15	601.90	505.79	418.03	8.72	7.65	22.60	4.18	442.79	0.22	0.26	2484.74	54.79	425.96	0.0035
Error	24	18.57	14.16	11.90	9.83	0.04	0.0012	0.59	0.0014	11.53	0.002	0.001	26.16	0.42	3.65	0.0002

CCS-Commercial Cane Sugar, SCW-Single Cane weight

<b>Table 2. Genetic parameters for fifteen yield, quality and mechanization amicable traits of sugarcane clones</b>						
<b>S.No.</b>	<b>Genotypes</b>	<b>Coefficient of variation</b>		<b>Heritability (Broad sense %)</b>	<b>Genetic advance (GA)</b>	<b>Genetic advance as percent of the mean (%)</b>
		<b>Genotypic</b>	<b>Phenotypic</b>			
1	Cane Yield (T/ha)	28.31	28.75	0.97	58.05	57.41
2	CCS Yield (T/ha)	31.09	31.45	0.97	8.67	63.32
3	Angle of Inclination	20.80	21.06	0.98	24.13	42.31
4	Crown Wt / Cane Wt	27.97	29.84	0.87	0.06	53.99
5	Germination %	13.10	16.25	0.65	9.76	21.77
6	No of tillers @ 120 DAP	12.94	13.40	0.93	27.85	25.73
7	No of shoots @ 240 DAP	12.94	13.40	0.93	25.53	25.73
8	No of millable canes	12.94	13.40	0.93	23.21	25.74
9	Cane Length (cm)	5.10	5.31	0.93	23.76	10.13
10	Cane Girth (cm)	9.39	9.53	0.97	0.55	19.07
11	Single Cane Weight (Kg)	26.49	26.64	0.98	0.61	54.25
12	Brix%	7.93	7.99	0.99	3.48	16.20
13	Sucrose%	8.27	8.27	1.00	3.29	17.03
14	Purity%	3.01	3.13	0.93	5.37	5.97
15	CCS%	8.76	8.76	0.99	2.43	18.04

