Journal Siplieria Sciences ISSN 2709-2380
https://hdpublication.com/index.php/jss Volume 5, Issue 2, 2024, page 001-006
Subject Category: Agriculture DOI: https://doi.org//10.48173/jss.v5i2.275

Variation of sugarcane varieties in stems yield and juice quality under the conditions of Sulaymaniyah Governorate- northern Iraq

Nadir F. A. Almubarak[1], Nidhal Y. A. Alghargan[2], Zana M. Majeed[3], Ary O. A. Muhamed[3]

[1]Director of the Iraqi Center of Sugarcane Research - University of Diyala-Iraq
[2]Diyala Education Directorate - Ministry of Education-Iraq
[3]Directorate of Scientific Agricultural Research / Sulaymaniyah Governorate – Iraq

Abstract

This study aimed to investigate the effect of cultivating sugarcane varieties on the production of sugarcane juice and the purity of the juice as well as the yield of both the crop stems and the sugar under the conditions of Sulaymaniyah Governorate- northern Iraq. The space allocated for the experiment was divided according to a Randomized Complete Block Design (RCBD) with four replications. It included three different varieties: CP72-2086, CP89-2143, and CP81-325. The variety CP89-2143 produced the highest increase in the mean number of total stems, reaching 55.8 stems, while the variety CP72-2086 gave the lowest number of stems, reaching 45 stems. The variety CP89-2143 gave the lowest mean stem height, reaching 3.0 m, while the variety CP81-325 gave the highest mean stem height, reaching 3.8 m (3) 9 ;The variety CP89-2143 produced the highest increase in mean stem diameter, reaching 3.4 cm, while the variety CP72-2086 gave the lowest diameter, reaching 2.5 cm;(4) The CP89-2143 variety achieved the highest increase in mean stems yield, reaching 92.827 tons/ha, while the CP72-2086 variety gave the lowest yield, reaching 81.474 tons/ha. The CP89-2143 variety recorded the highest increase in sucrose percentage, reaching 16.0 %, while the CP72-2086 variety gave the lowest percentage, reaching 12.2: The variety CP89-2143 recorded the highest increase in the percentage of juice purity, reaching 87.5%, while the variety CP72-2086 gave the lowest percentage, reaching 67.6.% The variety CP89-2143 achieved the highest increase in the mean sugar yield, reaching 15.017 tons/ha, while the variety CP72-2086 gave the lowest yield, reaching 9.862 tons/ha.

Keywords: Sugarcane, Varieties, Stems Yield, Purity Percentage, Sugar Yield

Introduction

Sugarcane *Saccharum officinarum* L. is an important strategic agricultural and industrial crop. All countries of the world located between latitudes 35° north and south of the equator are interested in its cultivation. The interest of countries in growing this crop comes from its production of sugar, which is indispensable in all countries of the world, as well as the secondary industries produced from its waste, whether before or after industrialization (Alghargan, 2020).

Sugarcane varieties vary in their ability to record the highest number of stems, stem height, and single stem diameter with varying environmental conditions, as a loss in yield was observed in some varieties under those conditions (Shankar, 2015; Kumar et al., 2014).

The sugarcane variety *Saccharum officinarum* L. used in the current study is of economic importance and belongs to the Poaceae family. It is a hybrid between Noble Cane and three other species belonging to the genus *Saccharum*.

Sugarcane has a high ability to accumulate sucrose in the stems (Alghargan & Almubarak, 2023). This unique feature distinguishes the sugarcane plant from other plants. It grows well with sufficient sunlight and temperatures that range between 25-30˚. Its growth period in Iraq is 9 - 15 months and in the world 9 – 24 months.

Cultivation of different varieties of sugarcane in previously uncultivated sites in Iraq, such as Sulaymaniyah Governorate, located within the conditions of the northern region of Iraq, specifically in the Kani Banka station, affiliated to Sayed Sadiq District, is to determine the suitability of the sugarcane crop to environmental factors in that region, and the extent of its ability to Varieties to produce sugary juice and determine the purity of the juice, as well as knowing the extent of the crop's ability to produce stems and sugar.

Methods

The first field experiment was applied under the conditions of the northern region of Iraq for the period from 17 March 2022 to 22 March 2024 in the fields of the Kani Banka station affiliated with the Agricultural Research Directorate - Sayyid Sadiq District - Sulaymaniyah Governorate,Iraq Located between latitudes 34-36˚ and at an altitude of 882 meters above sea level, to study the effect of cultivating varieties of sugarcane on the production of sugarcane juice and the purity of the juice as well as the yield of both the crop stems and the sugar. The space allocated for the experiment was divided according to a Randomized Complete Block Design (RCBD) with four replications. It included three different varieties. Sugarcane was planted on 17 March 2022 after plowing and softening the soil. The rows were prepared with a distance of 1 m between one row and another, and a length of 15 m inside an experimental unit whose dimensions were 3 X 5 m. Each experimental unit included 3 rows, the distance between the experimental units. 1 m and between one replicate and another 2 m.

Chemical fertilizers, pesticides and herbicides were not added throughout the experiment period. The sugarcane crop was harvested on 28 January 2023. After implementing the experiment, data was recorded for the following characteristics: (1) Number of total stems/m; (2) Stem height/m (4) ;Stem diameter/cm. (5) Number of leaves/plant. from each experimental unit and sent to the company's research laboratory with the aim of studying the following qualitative characteristics:

Percentage of sucrose in the juice Polarity (pol %)

It is the weight of sucrose present in 100 cm^3 of juice, which was measured using a Saccharameter device. It is estimated by calculating the product of the device's reading with a special coefficient for each reading, from which the corrected pol% is obtained.

Percentage of total dissolved solids Brix

It is the percentage of dissolved solids in 100 cm^3 of juice as it is extracted using a Refrectometer device.

Purity of juice

It is the relative concentration of sucrose compared to other solids dissolved in the juice, and it was calculated according to the following equation

$$\text{Purity (\%)} = \frac{\text{Sucrose (\%)}}{\text{Brix (\%)}} \text{ X } 100$$

Sugar yield: It was calculated for each of the treatments according to the following equation:

$$\text{Sugar yield (tons/ha)} = \frac{\text{Sucrose (\%) X Stems yield (tons/ha)}}{100}$$

The data for the studied traits were analyzed statistically according to a Completely Randomized Block Design, and the significant differences between the arithmetic means were estimated using the Least Significant Difference (L.S.D.) test at the 0.05 level.

Results and Discussion

The effect of sugarcane varieties on vegetative growth characteristics and stem yield

Total number of stems

The data in Table (1) indicate that there were significant effects on the number of total stems. The variety CP89-2143 showed the highest increase in the mean of this trait, 55.8 stems/m², compared to the varieties CP81-325 and CP72-2086, which recorded 50 and 45 stems/m², respectively. The main reason for the decrease in the number of stems for the CP89-2143 variety may be due to its role in increasing the stem height (Table 1), as Kaffka and Grantz (2014) and Alghargan (2023) observed an inverse relationship between the stem height and the number of stems in sugarcane plants, as the number of crop stems decreases with Increase stem height.

Stem height

The data in Table (1) indicate that there were significant effects on stem height. The variety CP81-325 showed a significant increase in the mean of this trait, 3.8 m, compared to the varieties CP72-2086 and CP89-2143, which recorded 3.2 and 3.0 m, respectively. The superiority of the variety CP89-2143 in the mean of this trait by giving it the highest mean stem height at the stage of full maturity is evidence that it is the most efficient in exploiting its genetic and physiological capabilities, and it gave the highest mean of this trait at the end of the crop's growth, The height of the plant is affected by the genetic factor and environmental factors surrounding it (Alghargan, 2020). The differences between the varieties in the mean of this trait were consistent with the results of Medeiros et,al. (2013) who found a significant difference in the mean plant height between the genotypes studied.

Stem diameter

Data in Table (1) indicate significant effects on stem diameter. The variety CP89-2143 showed a significant increase in the mean of this trait by 3.4 cm compared to the varieties CP81-325 and CP72-2086, which recorded 2.8 and 2.5 cm, respectively. Alghargan (2020) indicated that genetic structures may vary in their ability to increase the number and size of vascular bundles and thus their variation in the mean stem diameter.

Number of leaves

The data in Table (1) indicate that there are no significant effects on the number of leaves among the studied varieties.

Stems Yield

The data in Table (1) indicate that there were significant effects on the stems yield. The CP89-2143 variety showed the highest increase in the mean of this trait, reaching 92.827 tons/ha, compared to the CP81-325 and CP72-2086 varieties, which recorded 83.590 and 81.474 tons/ha, respectively.

This can be attributed to the fact that there are a large number of genes that control the quantitative trait and its appearance, and this trait is affected by environmental factors to a greater extent.These genes may have been previously inactive in a certain environment, but they may show their influence in another environment with appropriate factors for the gene to express itself (Al-Barki, 2020). This is consistent with the variety CP89-2143, which showed superiority in most phenotypic and physiological traits, which was reflected in the stems yield per unit area (El-lattief,2016 and Alghargan, 2020).

Table 1. The effect of sugarcane varieties on some vegetative growth traits and stem yield.

Variety	Number of stems	Stem height (m)	Stem diameter (cm)	Number of Leaves / plant	Stems yield (tons/ha)
CP72-2086	45.0	3.2	2.5	22.1	81.474
CP89-2143	55.8	3.0	3.4	21.9	92.827
CP81-325	50.0	3.8	2.8	22.0	83.590
L.S.D 0.05	4.2	0.4	0.5	NS	8.927

The effect of sugarcane varieties on qualitative characteristics and sugar yield.

Sucrose percentage

The data in Table (2) indicate that there were significant effects on the sucrose percentage. The variety CP89-2143 showed the highest increase in the mean of this trait, reaching 16%, compared to the varieties CP81-325 and CP72-2086, which recorded 13.9 and 12.2%, respectively.

Al-Baraki (2020) stated that the effect of genes on qualitative traits is very large and may reach 100%, while the effect of the environment on these traits is very small. This is consistent with many results of previous studies on different varieties of sugarcane with this trait, including the study of Shankar (2015) on more than one variety of sugarcane.

The percentage of sucrose in the stem comes primarily from increasing the process of photosynthesis and increasing the efficiency of the process of transporting or accumulation sugars in the stems. This is due to the difference between varieties in the formation of the invertase enzyme, which has a major effect in converting monosaccharides into disaccharides (sucrose). The variety CP89-2143 showed this ability, which made it achieve a significant increase in the mean of this trait, superior to the other two varieties.

Percentage of total dissolved solids

The data in Table (2) indicate that there are no significant effects on the percentage of total dissolved solids (Brix).

Purity percentage

The data in Table (2) indicate that there were significant effects on the purity of the juice. The variety CP89-2143 showed the highest increase in the mean of this trait, reaching 87.5% compared to the varieties CP81-325 and CP72-2086, which recorded 80.7 and 67.6%, respectively.

Many studies have shown differences between sugarcane varieties in their ability to maintain juice quality characteristics (juice purity). Some of them deteriorate in the quality of their juice, as the degree of purity decreases, while the monosaccharides rise, and these varieties are undesirable when compared to varieties that maintain the characteristics of purity.

Therefore, the variety CP89-2143 was able to maintain the purity of its juice through its significant increase in the mean characteristic of the sucrose percentage (Table 2), which was reflected in an increase in the mean purity percentage.

Sugar yield

The data in Table (2) indicate that there were significant effects on the sugar yield characteristic. The CP89-2143 variety achieved the highest increase in the mean of this trait, reaching 15,017 tons/ha, compared to the CP81-325 and CP72-2086 varieties, which recorded 11,938 and 9,862 tons/ha, respectively.

Table 2. Effect of sugarcane varieties on quality characteristics and sugar yield.

Variety	Sucrose (%)	Brix (%)	Purity (%)	Sugar yield (tons/ha)
CP72-2086	12.2	18.0	67.6	9.862
CP89-2143	16.0	18.2	87.5	15.017
CP81-325	13.9	17.9	80.7	11.938
L.S.D 0.05	2.8	NS	12.1	4.430

The variation in the mean of this trait between varieties is due to their difference in the efficiency of photosynthesis and the resulting increase in the shoot, which led to an increase in sucrose yield.This variety (CP89-2143) recorded a significant increase in the mean number of total stems (Table 1), and this in turn led to an increase in the mean stems yield (Table 1) and the sucrose percentage (Table 2), and thus a significant increase in the mean sugar yield.

Conclusion

This study established high variability in the performance of the three sugarcane varieties at Sulaymaniyah Governorate, northern Iraq, based on the environmental conditions. Analyzing all the tested varieties, it was found that CP89-2143 possesses the best yield about the total number of stems, stem diameter, stem yield, percentage of sucrose and purity of juice. This variety, therefore, realized the highest sugar yield hence boasting of being the most appropriate for cultivation in this region especially with regards to sugar production. In selecting varieties therefore, the results highlight that only the proper type of germplasms should be grown to enhance overall sugarcane yields and juice quality as these poses a big deal for the sugar industries similar to the environment under study. Therefore, due to better genetic and physiological characteristics of CP89-2143 it would be useful to develop it further and cultivate it in similar climatic and environmental conditions as those used here.

References

Abd El-Lattief, E. A. (2016). Yield and yield attributes of sugarcane as affected by some crop management treatments. *International Journal of Research in Engineering and Applied Sciences*, *6*(12), 11-19.

Al-Barky, F. R. (2020). Plant breeding and improvement. *Ministry of Higher Education and Scientific Research-Al-Muthanna University*, 1.

Alghargan, N. Y. (2020). *Effect of transplanting date and cultivar on growth, yield and quality of Sugarcane Succharum officinarum L. juice* (Doctoral dissertation, Ph. D Dissertation. College of Education for Pure Science. University of Diyala).

Alghargan, N. Y. (2023). Effect of Levels and Times of Application of Super Micro Plus Nanofertilizer on Sugar Yield and Quality of Sugarcane Juice, Saccharum Officinarum L. Under the Conditions of the Central Region of Iraq. *International Journal Papier Advance and Scientific Review*, *4*(1), 33-41. https://doi.org/10.47667/ijpasr.v4i1.204

Alghargan, N. Y., & Almubarak, N. F. (2023, July). The Role of Levels and Times of Application of Super Micro Plus Nanofertilizer on some Growth Characteristics and Stems Yield of Sugarcane Saccharum officinarum L. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1214, No. 1, p. 012044). IOP Publishing. Https://doi.org/10.1088/1755-1315/1214/1/012044

Kaffka, S.R., D.A. Grantz. (2014.) Sugar Crops , University of California, Riverside, CA, USA.p242

KUMAR, S., Singh, P. K., Singh, J., & Swapna, M. (2004). Genotypes x environment interaction analysis for quantitative traits in sugarcane. *Indian Sugar*, *53*(10), 813-818.

Medeiros, D. B., Silva, E. C. D., Nogueira, R. J. M. C., Teixeira, M. M., & Buckeridge, M. S. (2013). Physiological limitations in two sugarcane varieties under water suppression and after recovering. *Theoretical and Experimental Plant Physiology*, *25*, 213-222. https://doi.org/10.1590/S2197-00252013000300006

Shankar, B. (2015). Effect of fertility levels on productivity and sustainability of sugarcane (Saccharum spp. hybrid complex) varieties under various planting seasons in clay loam soil of south-east Rajasthan. *Indian Journal of Agronomy*, *60*(1), 132-138. https://doi.org/10.59797/ija.v60i1.4428