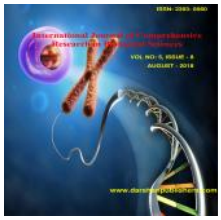
Available online at www.darshanpublishers.com
Volume -5; Issue -9; Year -2018; Pages: 1-6
ISSN: 2393-8560
DOI: http://dx.doi.org/10.22192/ijcrbs.2018.05.09.001
Abbr: Int. J. Compr. Res. Biol. Sci.



International Journal of Comprehensive Research in Biological Sciences

Research Article

PERFORMANCE EVALUATION OF SUGARCANE (*SACHARRUM OFFICINARUM* L) VARIETIES AT ARJO-DEDESSA, WESTERN ETHIOPIA

[1]Dereje Shimelis, [2]Feyissa Tadesse and [3]Belay Tolera, [4]Werku Tadele

[1]Sugar Corporation, Research and Development Center, Variety Development Research Program, Wonji Ethiopia P.O.Box 15, E-mail:d.shimelis@yahoo.com, Mobile: +251-934074616

[2, 3, 4] Sugar Corporation, Research and Development Center, Variety Development Research Program

Abstract

Sugarcane is one of the top agro-industrial crops grown in Ethiopia since 1962. Currently, the domestic demand of sugar is not balanced with the decreasing yield of both cane and sugar. As an intervention, new sugar development projects are under establishment and performance of commercial varieties of the old estates is being tested at these agro-ecologies. Thus, this work was amide for testing the performance of commercial sugarcane varieties at Arjo-Deddessa sugar project. Setts of twelve sugarcane varieties were planted in Randomized Complete Block Design with three replications and some of important yield and yield component data were taken for plant cane and ratoon. The data were subjected to analysis of variance by SAS software version 9.2 and treatment means were separated by DMRT at 5% level of significance. The analysis of varies revealed that the varieties were different in their performance for all the parameters taken at 5% level of significance. Based on the cane and sugar yield ton per hectare per month, Co740 is the top followed by D42-58. Beside to these varieties, N52-216 and N-14 were also the best ones. Thus, based on sugar yield ton per hectare per month, these varieties are the best forming ones and are recommended for seed multiplication for further commercial use.

Keywords: Sugarcane; cane yield, sugar yield

Introduction

Sugarcane (*Saccharum officinarum L.)* is a vegetative propagated, perennial crop which has high leaf area index and photosynthetic potential under strong sunshine, more than any other crop in tropics (Bassham, 1978). It is the major source of sugar, catering seventy percent of the sugar requirement in the world. Sugarcane is adapted to a wide range of tropical and semi-tropical climate, soils, and cultural conditions, and in long warm growing season. Hence, it is an important cash crop in many tropical and subtropical countries.

Sugarcane is one of the top agro-industrial crops grown in Ethiopia since 1962.Since then the consumption of sugar has been increasing form time to me. Currently, the domestic demand of sugar is not balanced with the decreasing production of cane as well as sugar yield. This is due to a number of factors like deterioration of varieties and land, improper implementation of agronomic practices, post harvest losses at filed as well as at factory and so on. Though, there is an intention to increase the area of cultivation in

different parts of the county, priority should also be given for the number improved varieties available both at the existing estates and the new projects. Because, improved variety is a major factor sustaining competitiveness of the sugar industries (Bischoff and Gravios, 2014). Sugarcane production could never be enhanced until and unless promising varieties together with suitable technologies are adapted by the growers (Khalid et al, 2014). Even though emphasis has been given to varietal improvement, the country has no its own breeding facilities because the crop by itself is not an easy crop for conventional breeding as other field crops.

Hence, the country is still stick on introduction of improved sugarcane varieties from different countries in form of cutting (sett) and fuzz (true seed) and local collection of land races (Essayas et al, 2014). Then, testing and selecting the best performing varieties for different agro ecology of the country's where the sugar factories reside. Because varieties respond differently to different environments causing a change in their degree of performance (Baenziger et al., 2006). As variety plays an important role in increasing the cane and sugar yield, proper selection is the prime important (Atkin et. al, 2014; Sanghera et.al, 2014). Selection of best variety alone to a given agro-ecology can improve the productivity of cane by 28-60 % (Katiresan et.al, 2001). Performance evaluation of commercial varieties of the old estates at the new projects is also one of the major tasks of the research and development center of the sugar corporation. Hence, this work was aimed to select the best performing commercial varieties of the old sugar estates at Arjo-Deddessa sugar project.

Materials and Methods

2.1. Description of the study site

Arjo-Dedessa sugar factory is located at Western Ethiopia of Oromiya Regional State in eastern Wollega, Eilu Aba bora and Jimma Zones at the Dedessa Rift Valley at a distant of 540 kilo meters from the capital through the route of Addis Ababa-Jimma-Beddelie-Nekemet road. The altitude of the area is 1,350 meters above sea level while its annual rainfall is 1,400 millimeter. Since metrology station was not established at the site during the trial period, meteorological data were taken from the feasibility study report. The area is categorized under warm sub-humid tropical climatic zone with the unimodal rainfall lasting from May to October. The mean temperature is 22.51^0C, with annual average maximum and minimum temperatures of 25.4^0C and 20.5^0C, respectively. The average relative humidity of the area is 75.51% ranging from average maximum to average minimum of 88.6% and 56.6% respectively.

2.2. Description of the treatments and Experimental design

2.2.1. Methodology

B52-298, Nco-334, B41-227, Co449, Co678, Mex54-245, N53-216, N-14, Nco-376, D42-58, Co740, and Co-680 are commercial varieties at old sugar factories of the country. The planting materials of these varieties were prepared and planted at Arjo-Dedessa sugar plantation. The experiment was laid out in completely randomized block design with three replications of the varieties. The dimension of each experimental plot was 6 furrows with of 5m length. Each furrow has a width of 1.45m and the distance between adjacent plots is also 1.5m. The space between replications and border crop was 2m and 3m respectively. Equal numbers of three budded setts of each variety were planted. All agronomic managements adopted uniformly throughout the growing season as per the practice of the plantation of the project.

2.2.2. Data collection and analysis

Data were collected from the four central rows of each plot through the growth period including number of milleble cane, number of internodes, cane height, single cane weight, cane yield per hectare per month, sugar percent cane, and sugar yield ton per hectare per month of plant cane and

ratoon crops. All data collected for each character were subjected to analysis of variance (ANOVA) using randomized complete block design to test the variations among the varieties. The analysis of variance was calculated using Statistical Analysis System (SAS) software version 9.2 (SAS, 2008). After testing the ANOVA, treatment means were tested with Duncan multiple range test (DMRT) at 5% probability levels (SAS, 2008).

Results and Discussion

The analysis of variance reveled that the mean square of the varieties over the two cropping type were found to be significant for all the parameters except purity at 1% level of significance. For purity it was found to be significance at 5% level of significance (Table 1).This result revealed that sufficient variability is present among the varieties and considerable improvement can be made through selection breeding. This is due to the fact that sugarcane varieties cultivated commercially are inter-specific hybrids and consequently differ in their performance because of the variation in their genetic makeup.

The longest stalk length (2.41m) was recorded for Co740 variety and it is similar with the result obtained by (Shanmuganathan et al, 2015) and shortest was obtained from Co-680(1.69m). As stated by El-Lattief, (2016) differences in stalk height existed among varieties could be attributed to the differences in their genetic ability of joint formation that determine stalk length. The highest stalk thickness was obtained from N53-216(28.22mm), B41-227(27.9mm), Mex54-245(26.87mm), Co449(26.78mm) and Nco-334(26.6mm) and the lowest thickness was found from Co678 and Co-680 (20.20mm). High numbers of internodes were recorded for Co740 and N53-216(27.33) and the least were for Co-680(19.33).Single cane weight is directly proportional with both stalk diameter and stalk length and it is a product of stalk diameter and stalk length which contributes substantially towards final cane yield (Shanmuganathan et.al, 2015; Rehman et.al, 1992). The highest single cane weight was obtained from Co740 (1.13kg), N53-216(1.09) and Mex54-245(1.07kg) and the lowest were from B52-298(0.69kg), Co-680 and Co678 (0.65kg). The top recorded single cane weight of this trial is comparable with the least result obtained by Shanmuganathan et.al, (2015).

Number of millable cane in thousands per hectare is resulted from effective tillers and it directly influences cane yield. Highest numbers of millable canes were recorded for N52-298(161.72) and which is lower than obtained by Feyissa et. al, (2014) from N52-298(146.49) variety. Lowest numbers of millable canes were obtained from Co-680(85.75) variety. Total soluble solids plays an important role in determining the sugar recovery per cent and maturity of the cane. D42-58 was superior in sugar percent cane (13.33%) and brix percent 20.80% followed by Co740 (20.27%).These results are in agreement with the findings of Keerio et.al, (2003) who studied a number of sugarcane varieties for their performance and found different levels of Brix%.

Cane and sugar yield are the major traits that can help us to find out the economic potential of a variety. In this trial the combined effects of plant cane and ratoon were significant for all the characters considered. This is due to the fact that, variation of cane and sugar yield among varieties indicated the difference in their inherent yielding ability (Soomro et.al, 2006). Co740 was found to be the superior variety both in cane and sugar yield ton per hectare per month of 8.1kg/ha/m and 1.07 kg/ha/m respectively. The second best cane yield per hector per month was obtained from N53-216(7.45), D42-58(6.88), N-14(6.82) and Mex54-245(6.57) where as in sugar yield per hectare per month D42-58(0.93) followed by N53-216(0.90), N14 (0.84), Co449 (0.81) and Mex54- 245(0.78). Both cane and sugar yield ton per hectare per month obtained from this trial is by far lower than the results obtained by Abiy et.al, (2016) and Feyisa et.al, (2014). For instance from this trial highest cane and sugar yield ton per hectare per month recorded was 8.10 ton/h/m and 1.07 ton/h/m respectively from Co740 variety where as Abiy et.al, (2016) found 11.26 and 1.48 t/ha/m respectively. This is due to the fact that the

Table 1 .Analysis of variance for 11 characters of 12 sugarcane varieties

Parameters	Block Df=2	Variety Df=11	Year Df=1	Variety x Year Df=11	EMS	CV (%)	R^2	Mean
Stalk Length(SL)	0.129 ns	0.229**	14.97**	0.119*	0.048	11.17	0.896	1.96
Stalk Diameter (SD)	19.59**	38.90**	446.00**	3.15ns	2.32	6.17	0.899	24.69
Number of Internodes(NI)	34.63 ns	52.62**	910.22**	44.04**	11.10	13.37	0.80	24.92
Single Cane Weight(SW)	0.084 ns	0.136**	5.89**	0.027ns	0.04	22.029	0.81	0.91
Millable Cane in 1000/ha(MC)	4250.01*	2506.74**	30151.50 **	788.09ns	730.24	22.81	0.69	118.24
Brix (%) (BX)	6.13 ns	18.00**	1303.90**	5.78ns	4.397	11.52	0.89	18.20
Puol % (PoL)	11.28 ns	20.94**	846.66**	6.64ns	3.98	12.08	0.86	16.52
Purity(PU)	61.53 ns	62.02*	351.13**	38.45ns	23.40	5.31	0.59	91.01
Sugar Percent cane(SP) %	9.08*	13.16**	307.93**	4.49ns	2.37	13.45	0.82	11.46
Cane yield ton/ha /moth(CY)	0.11 ns	8.75**	60.22**	1.64ns	1.93	22.78	0.70	6.09
Sugar yield ton/ha/moth(SY)	0.019 ns	0.205**	1.74**	0.09*	0.024	20.67	0.82	0.74

*** Significant at 1% level, * Significant at 5% level and ns- refers for non-significant, SL =Stalk length (m), Diameter (mm), NI = Number of Internodes, SW=Single cane weight (kg), MC=Number of Millable cane per ha in 1000s, CY =Cane yield in tone per ha per month, BX=Brix in %, PoL=Pol %, PU=Purity in %, SP=Sugar yield % cane, SY=Sugar yield tone per ha per month.*

experiment was undertaken both in irrigation and rain fed conditions. High genotypic coefficient of variance, heritability and genetic advance as percent mean were obtained only for sugar yield t/h/m(Dereje,2018).Hence based sugar yield ton per hectare per month, Co740, D42-58, N-14, and N53-216 are the best performing varieties at Arjo-deddessa sugar project.

Table 2. Combined means separated at 5% level of significance with DMRT for 11 characters of sugar cane varieties

	Characters										
Varieties	SL	SD	NI	SW	BX	PoL	PU	SP	MC	CY	SY
B52-298	1.84^{cde}	22.15^{c}	26.00^{ab}	0.69^{c}	18.07^{abc}	16.30^{bc}	91.27^{a}	11.25^{abc}	161.72^{a}	6.34^{abc}	0.72^{cde}
Nco-334	1.87^{cde}	26.6^{a}	27.00^{a}	0.91^{abc}	17.75^{bc}	15.87^{bc}	89.48^{a}	10.83^{bc}	109.89^{bcd}	5.64^{bcd}	0.65^{def}
B41-227	1.75^{de}	27.9^{a}	24.00^{ab}	0.88^{abc}	18.97^{abc}	17.02^{abc}	90.67^{a}	11.77^{abc}	110.52^{bcd}	5.68^{bcd}	0.67^{def}
Co449	2.08^{bc}	26.78^{a}	25.50^{a}	0.96^{ab}	18.07^{abc}	17.15^{abc}	95.25^{a}	12.27^{abc}	119.14^{bcd}	6.33^{abc}	0.81^{bcd}
Mex54-245	1.97^{bcde}	26.87^{a}	26.50^{a}	1.07^{a}	18.53^{abc}	16.83^{abc}	91.92^{a}	11.72^{abc}	104.89^{bcd}	6.57^{ab}	0.78^{bcd}
N53-216	2.16 ^{ab}	28.22^{a}	27.33^{a}	1.09^{a}	18.30^{abc}	16.87^{abc}	92.28^{a}	11.80^{abc}	121.49^{bcd}	7.45^{ab}	0.90^{abc}
N-14	1.97^{bcde}	23.12^{bc}	26.83^{a}	0.86^{abc}	18.23^{abc}	16.68^{abc}	92.03^{a}	11.62^{abc}	140.29^{ab}	6.82^{ab}	0.84^{bcd}
Nco-376	1.85^{cde}	23.26^{bc}	19.67^{c}	0.87^{abc}	17.33^{c}	15.48^{c}	90.25^{a}	10.60^{c}	92.36^{cd}	4.57^{cd}	0.52^{fg}
D42-58	1.98^{bcd}	23.93^{bc}	26.50^{a}	1.00^{ab}	20.80^{a}	19.07^{a}	92.22^{a}	13.33^{a}	121.38^{bcd}	6.88^{ab}	0.93^{ab}
Co740	2.41^{a}	24.58^{b}	27.33^{a}	1.13^{a}	20.27^{ab}	18.48^{ab}	91.60^{a}	12.85^{ab}	124.94^{bc}	8.10^{a}	1.07^{a}
Co-680	1.69^{e}	20.20^{d}	19.33^{c}	0.65^{c}	13.70^{d}	11.48^{d}	82.08^{b}	7.41^{d}	85.75^{d}	4.04^{d}	0.43^{g}

SL =Stalk length (m), SD (mm), NI = Number of Internodes, SW=Single cane weight (kg), MC=Numbers of Millable canes per ha in 1000s, CY=Cane yield in tone per ha per month, BX=Brix in %, PoL=Pol %, PU=Purity in %, SP=Sugar yield % cane, SY=Sugar yield tone per ha per month.

Conclusion and Recommendations

For economical use of varieties, it is a mandatory to test the performance of commercial varities of old estates to the new sugar development projects. Hence, based on mean performance of sugar yield and cane yield ton per hectare per month, Co74 is the outstanding variety and D42-58 is second. Beside to these varieties N52-216 and N-14 are also the best performing ones. Thus, these varieties are recommended for seed multiplication for further use at commercial scale for Arjo-dedess sugar project.

Acknowledgments

I would like to gratitude all staffs of the research and development center take part in this work starting from the execution of this experiment to final data collection.

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Quick Response Code	Website: www.darshanpublishers.com
	Subject: Agricultural Sciences
DOI:10.22192/ijcrbs.2018.05.09.001	

How to cite this article:
Dereje Shimelis, Feyissa Tadesse and Belay Tolera, Werku Tadele. (2018). Performance evaluation of sugarcane (*Sacharrum officinarum* L) varieties at Arjo-Dedessa, Western Ethiopia. Int. J. Compr. Res. Biol. Sci. 5(9): 1-6.
DOI: http://dx.doi.org/10.22192/ijcrbs.2018.05.09.001