The Journal of Agriculture and Natural Resources Sciences

T.J.A.N.R.S

Journal homepage: http://www.journals.wsrpublishing.com/index.php/tjanrs

ISSN:2383-238X

Original Article

Effect of Age of Seed Cane on Yield and Yield Components of Sugarcane at Tendaho Sugar Factory

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ARTICLE INFO

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How to cite this article:
Ayele, N., A. Getaneh, H. Hagos and M. Birruma. 2014. Effect of Age of Seed Cane on Yield and Yield Components of Sugarcane at Tendaho Sugar Factory. *The Journal of Agriculture and Natural Resources Sciences.* 1(3):165-171.

Article History:
Received: 18 October 2014
Revised: 10 November 2014
Accepted: 13 November 2014

ABSTRACT

An experiment was conducted at Tendaho Sugarcane plantation from January, 2012-December, 2013 to determine the effect of five seed cane ages (6, 7, 8, 9 and 10 months) on yield and quality of three sugarcane varieties (B52298, NCo334 and Mex 54/245). The experiment was carried out on fluvisol in a randomized complete block design (RCBD) in a factorial combination with three replications. The analysis of the data indicated that sprouting, number of tillers, number of millable canes, cane yield and estimated recoverable sugar were affected significantly ($p<0.01$) by the main effects of variety and seed cane age. However, sucrose (%) was affected significantly ($p<0.01$) only by the main effect of variety. In all the parameters considered none of them were affected by the interaction of variety and seed cane age. From the seed cane ages considered nine and ten months of ages had resulted in a significantly ($p<0.01$) lower cane and sugar yields than ages of six, seven and eight months, which were statistically at par. Therefore, it is concluded that seed cane age of 6-8 months is the right age at which seed should be harvested for planting at Tendaho.

Keywords: Seed cane, sugarcane, reducing sugars, age, Tendaho and moisture contente.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is propagated commercially by vegetative means which involves the planting of section of the stem of the immature cane which is known as seeds, seed cane, seed pieces and setts (Barnes, 1974; Sundara, 2000; Srivastava, 2006). The stem cuttings (setts) generally used for planting are sections with one or several buds (Dillewijn, 1952; Stevenson, 1965; Kakde, 1985; Sundara, 2000).The quality of seed cane used in planting is fundamental to the production of high yielding, healthy plant cane and that of subsequent ratoons (James, 2004).

To increase productivity conducting appropriate investigation to improve agronomic performance of the crop has paramount importance. Therefore, extensive studies toward achieving healthy uniform stand are essential to ensure optimum yield across the whole crop cycle (Permallo *et al.*, 2006). Among the most important factors to attain this goal is improving sprouting capacities of the cuttings (Dillewijin, 1952). Rao (1990) also indicated that early high rate of sprouting; higher tillering potential and vigor are the factors largely determining the initial stand of the crop and the ultimate yield. In line with this Kakde (1985) stated that the ultimate stalk population per unit area depends on the vigour of early growth which is dependent on the quality of seed used. Quality seed is characterized by its high viability, vigorousity, freedom from varietal mixing (true to type) and freedom from diseases and pests (Srivastava, 2006). Good sprouting is instrumental in the development of good crop (Bakker, 1999).

Quality of seed is affected by many factors among these age of the seed is the important one (Mengistu, 2013; Dillewijn, 1962). Similarly, Yeshimebet *et al* (2009) reported that age of seed cane significantly affected percent sprouting, tiller and stalk population which have effect on cane sugar yields; however, there was no significant interaction between varieties with age in any of the parameters considered. At Wonji/Shoa, Metahara and Finchaa Sugar Estates it is common to use the entire stalk by removing few parts of the top and lower portions for planting purpose with an age of 10, 8 and 9 months; respectively. However, at Tendaho Sugar Project the age of seed cane for planting was not studied for good early establishment. Therefore, this proposal was initiated with an objective to determine the effect of age of harvesting of seed cane on yield and quality of sugarcane at Tendaho Sugar Factory.

MATERIALS AND METHODS

Site Description

The experiment was conducted at Tendaho Sugar Factory Project in Afar Regional Estate sugar cane plantation from January, 2012 - December, 2013. The site is found in the Rift Valley of Ethiopia at an altitude and longitude ranging between 11^0 $30^{'}$ to 11^0 $50^{'}$ N and 40^0 $45^{'}$ to 41^0 $03^{'}$ E, respectively, with elevation ranging from 365 to 340 m. The area has a mean maximum and minimum temperature of 37.20 and 21.88 ^{0}C; respectively, with long-term average annual rainfall and relative humidity of 221.8 mm and 60.4%, respectively. The area has mean sunshine hours of 8.9 hr per day.

Treatments and Design

The treatments consisted of five seed cane ages i.e. seed canes were harvested at 6, 7, 8, 9 and 10 months, and three sugarcane varieties B52298, NCo334 and Mex 54/245. The study was carried out on fluvisol. The experimental design was randomized complete block design (RCBD) in a factorial combination with three replications. Area of each experimental plot was 58 m^2 (four furrows of 10 m length and 1.45 m width). The distance between adjacent plots and replications were 1.50 and 2.90 meters, respectively. The experiment had two phases. In the first phase planting was made in staggered fashion to get seed canes of 6,7,8,9 and 10 months at the same date to make planting the same date. Then in the second phase planting was done by using the seed from the first planting. UREA (46%) fertilizer was applied manually at 200 kg/ha a month after planting as per recommended for the plantation.

Data Collection

Prior to planting reducing sugars (%) and moisture content of the seed were taken and analyzed at Wonji Research Station. Reducing sugar content was analysed using Lane and

Eynon's original method (Kassa, 2010). Moisture content of seed cane was analysed following wet disintegration method described by Kassa (2010).
Sprouting count was recorded at 30th day after planting. Tillers per hectare were calculated from the counting data that was recorded at four and half month before moulding (earthing-up). The number of millable canes in each plot was counted and average cane weight of 20 stalks was taken per plot at harvest.

Harvesting was made at 12th months of age. Cane yield was taken from the middle two rows during harvesting and calculated on the hectare basis. For cane quality analysis, juice was extracted from 10 stalk samples using a sample mill. Percent recoverable sucrose (*rendiment*) was calculated using Winter Carp indirect method of cane juice analysis (James and Chung, 1993). Then, commercial sugar yield per hectare was calculated as follows;

$$ESY \ (t/ha) = CYH \ (t/ha) \times \mathrm{E}RS \ (\%)$$

Where;

ESY = estimated sugar yield
CYH = cane yield per hectare
ERS = estimated recoverable sucrose (%)

The cane and sugar yields were described as suggested by Sweet & Patel (1985) according to COTCHM method (Corrected Tones Cane per Hectare per Month).

Finally, data were analyzed using SAS general linear model (GLM) procedure (SAS Institute, 2000). Comparisons among treatments with significant differences for the measured and counted parameters were based on Tukey's Studentized Range (HSD) Test.

RESULTS AND DISCUSSION

Weather Condition during the Study Period

A total rainfall of 92.60 mm was recorded during the study period, however, the distribution was not even and maximum rainfall of 38.60 mm was recorded in July. The mean maximum and minimum temperature during the study period were 39.24 and 24.21 ^{0}C, respectively. The mean monthly temperature distribution of the study area indicated that low temperature prevailed from November to February (Figure 1).

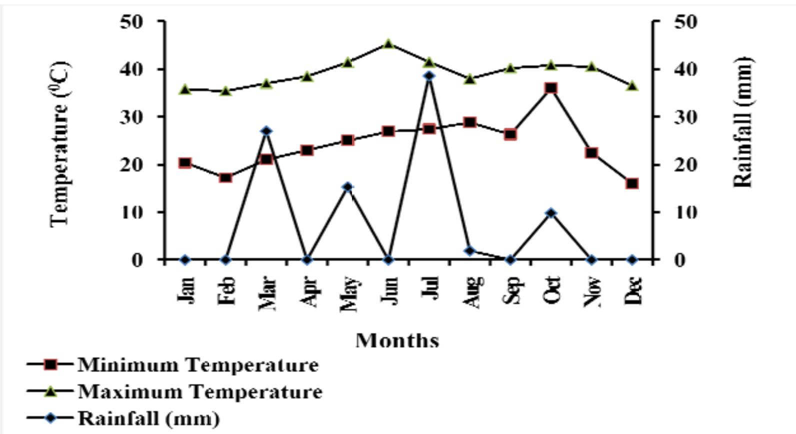

Figure 1. Monthly total rainfall distribution and the mean maximum and minimum temperature variation during the study period in 20012/2013 at Tendaho Sugar Factory, Ethiopia.

Relationships between seed cane age and amount of Reducing sugar and Moisture content

Reducing sugars (%) of seed cane showed a decreasing trend as age of seed cane increased (Figure 2). In line with this Verma (2004) stated that seed cane age and reducing sugar have an inverse relationship. Similarly moisture content of stalk had showed a decreasing trend (Figure 3). The moisture content observed in the seed was higher than 63% in all the ages considered and seed cane ages from 6 to 8 months had >70% moisture content. According to Srivastava (2006), moisture content in seed cane should be not less than 65% on weight basis. Furthermore, the amount of reducing sugars (%) from 6 to 8 months was found to be higher than 1.91%. The high moisture and reducing sugars might have contributed for the higher sprouting (%) observed in ages ranging from 6 to 8 months as compared to the 9 and 10 months of ages (Table 1).

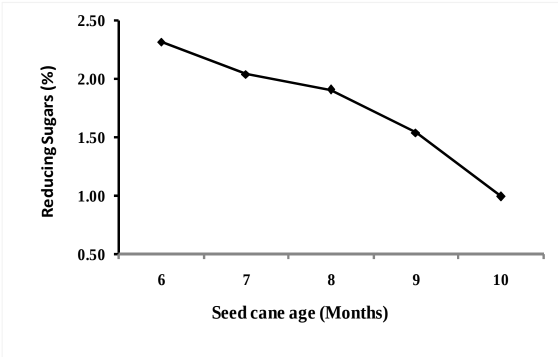

Figure 2: Reducing sugars (%) content as affected by seed cane age of cane during the study period in 20012/2013 at Tendaho Sugar Factory, Ethiopia.

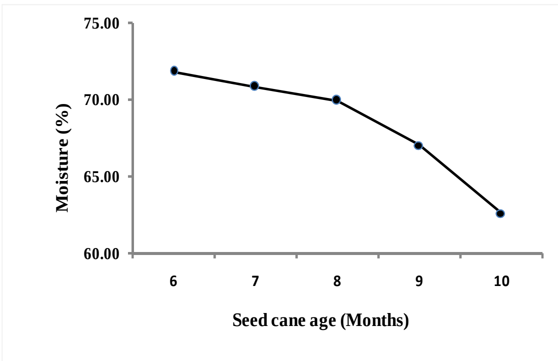

Figure 3: Moisture content as affected by seed cane age of cane during the study period in 20012/2013 at Tendaho Sugar Factory, Ethiopia.

Effect of variety and seed cane age on sprouting, tillering and number of millable canes

The analysis of variance showed that sprouting (%), number of tillers (000 ha) and number of millable canes (000 ha) were significantly ($p<0.01$) affected only by the main effects of seed cane age and variety (Table 1). However, the interaction was not significant (Table 1).

The variety B52298 gave a significantly ($p<0.01$) higher sprouting percentage (67.7%) than NCo334 (55.8%) and Mex 54/245 (52.0%), which were statistically not different. In number of tillers varieties B52298 and NCo334 gave a significantly higher ($p<0.01$) number of tillers than Mex 54/245 (Table 3). In terms of millable canes variety NCo334 gave a significantly higher (p<0.01) number of millable canes than B52298, which in turn outsmarted Mex 54/245 significantly (p<0.01).

The difference in percent sprouting, tillering and number of millable canes among the genotypes reflected the existence of genetic variation for the traits in these varieties. In agreement with this finding, different authors also indicated the presence of difference among genotypes in sprouting (Dillewijin, 1952; Clements, 1980; Bakker, 1999; Verma, 2004), number of tillers (Verma,2004; Srivastava, 2006) and number of millable canes (Feyissa *et al.*, 2008).

Table 1: Main effects and interaction effects of sugarcane varieties and seed cane ages at Tendaho Sugar Factory in 2012-2013

Source of Variation	Sprouting (%)	Number of Tillers (000/ha)	Number of Millable cane (000 ha^{-1})
Variety	**	**	**
Age	**	**	**
Age*Variety	NS	NS	NS
CV	10.8	9.04	9.8

** = significant at P < 0.01; Ns = non-significant; ha = hectare.

Seed cane age has affected significantly (p<0.01) sprouting, number of tillers and millable canes (Table 1 and 3). In general, seed cane age of six, seven and eight months gave a significantly higher (p<0.01) sprouting, tillers and millable canes than nine and ten months of seed cane ages (Table 3). Seed cane ages of nine months of age was superior in sprouting and number of millable canes formed than ten months of age; however, in terms of number of tillers there was no difference (Table 3). The current finding concurs with the findings of Yeshimebet *et al.*, (2009) who reported that younger cane has superiority in sprouting percentage than older cane.

Table 2: Main effects and interaction effects of sugarcane varieties and seed cane ages at Tendaho Sugar Factory in 2012-2013

Source of Variation	Sucrose (%)	Cane yield (t $ha^{-1}m^{-1}$)	ESY (t $ha^{-1}m^{-1}$)
Variety	**	**	**
Age	NS	**	**
Age*Variety	NS	NS	NS
CV	6.35	15.0	16.5

** = significant at P < 0.01; Ns = non-significant; t = tone; ha = hectare; m = month.

Poor sprouting observed in nine and ten months age cane has affected the number of tillers and millable canes formed (Table 3). Successful growth of sugarcane relies on success of sprouting (Kakde, 1985; Rao, 1990) which determines the initial stand and ultimate yield. According to Sundara (2000), the minimum sprouting percentage required for good stand establishment of cane should be above 60% indicating that the stand establishment in the current study was good in the six, seven and eight months of ages.

Effect of variety and seed cane age on cane yield, sucrose content (%) and estimated sugar yield

Sucrose percent cane was significantly affected (p<0.01) only by the main effect of variety (Table 2 and 4). However, cane and estimated sugar yields were significantly affected (p<0.01) by the main effects of variety and seed cane age (Table 2 and 4).

Table 3: Effects of sugarcane varieties and seedcane age on different parameters at Tendaho Sugar Factory in 2012-2013

	Sprouting (%)	Number of Tillers (000 ha^{-1})	Number of Millable cane (000 ha^{-1})
Variety			
B52298	63.7^{a}	213.3^{a}	112.5^{b}
NCo334	51.8^{b}	214.9^{a}	131.7^{a}
Mex 54/245	48.0^{b}	172.1^{b}	78.7^{c}
SE (±)	1.52	4.67	2.72
LSD (5%)	5.31	16.3	9.48
Seed Cane Age			
Six Months	66.61^{a}	256.1^{a}	120.7^{a}
Seven Months	63.26^{a}	249.1^{a}	122.0^{a}
Eight Months	61.42^{a}	248.2^{a}	122.8^{a}
Nine Months	45.76^{b}	126.2^{b}	101.0^{b}
Ten Months	35.44^{c}	120.8^{b}	71.8^{c}
SE (±)	1.97	6.03	3.51
LSD (5%)	8.06	24.7	14.4
CV	**10.8**	**9.04**	**9.8**

Means followed by the same letter in a column are not significantly different from each other; ha = hectare.

Table 4: Effects of sugarcane varieties and seedcane age on different parameters at Tendaho Sugar Factory in 2012-2013

	Sucrose (%)	Cane yield (t $ha^{-1}m^{-1}$)	ESY (t $ha^{-1}m^{-1}$)
Variety			
B52298	8.86a	7.32b	0.649a
NCo334	7.36b	8.75a	0.644a
Mex 54/245	7.33b	7.02b	0.513b
SE (±)	0.129	0.296	0.025
LSD (5%)	0.45	1.03	0.088
Seed Cane Age			
Six Months	7.93	8.89a	0.703a
Seven Months	7.83	8.70a	0.680a
Eight Months	7.84	8.66a	0.677a
Nine Months	7.75	6.99b	0.542b
Ten Months	7.9	5.24c	0.408c
SE (±)	0.167	0.382	0.032
LSD (5%)	NS	1.57	0.13
CV	**6.35**	**14.9**	**16.2**

Means followed by the same letter in a column are not significantly different from each other; m = month; ESY= estimated sugar yield.

The varieties B52298 and Mex 54/245 were found to be superior than NCo334 in sucrose content of cane (Table 4). In terms of cane yield NCo334 had outsmarted the rest significantly ($p<0.01$).

Seed cane age had affected cane and sugar yield significantly ($p<0.01$). In both parameters the nine and ten months of age cane planting resulted in reduced yield (Table 4). This was primarily emanated from the fact that the poor sprouting percentage occurred in the early phase of growth coupled with the lower tillering ultimately resulted in a reduced yield (Table 4). In agreement with this Kakde (1985) stated that poor early establishment affects yield of sugarcane.

CONCLUSION

Seed cane age affected early growth performance of all the varieties considered significantly. Ages of six, seven and eight months of seed canes were superior in all the parameters considered except for sucrose content of cane. Since yield of cane and sugar is superior in the younger aged seed canes (six, seven and eight months) than older aged (nine and ten months), therefore, seed cane ages of 6 to 8 months should be used for planting at Tendaho sugar factory.

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