The Effect of Different Cane Portions on Sprouting, Growth and Yield of Sugarcane (Saccharum spp. L.)

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Abstract

A field experiment was conducted during 2003/2004 to determine the effect of different cane portions/cuttings on per cent sprouting, subsequent growth and cane yield of sugarcane variety N-14. The trial was executed on a sandy soil at Wonji-Shoa Sugarcane Plantation. The experiment was laid in randomized complete block design (RCBD) with four replications and five treatments comprising setts from top, middle, bottom; mixture of top+middle, and mixture of top+middle+ bottom stalk portions. The results of the experiment showed that cuttings taken from the middle and top portion of the stalk showed better results in sprouting and improved sprouting by 54.75 and 54.30%, respectively, over those taken from the bottom portion. Similarly, setts (cutting) taken from the mixtures of top and middle; top, middle and bottom portion of stalks cutting improved sett emergence by 45.5 and 47.5%, respectively, as compared to cutting taken from bottom portion. Besides, statistical analysis showed highly significant differences ($P<0.01$) in sprouting of different stalk portions from the bottom portion, i.e. treatments (T_1, T_2, T_4 and T_5) significantly increased sprouting percentage over the bottom stalk portion. On the other hand, no significant effects of different stalk portions were observed on plant population, plant height, cane yield and its components at harvest. Cane growers are also advised to use the middle and top portions of cane plant as planting material for commercial sugar production. However, further studies are necessary considering a range of commercial sugarcane varieties and soil type in all sugar plantations in Ethiopia to come up with clear-cut recommendations.

Index Terms-, cane portions/setts, growth, sprouting, sugarcane, yield

I. Introduction

Sugarcane, *Saccharum spp*. is propagated commercially by the vegetative method using stem cuttings known as setts, seed-pieces or seed canes, and it is apparent that planting material has substantial influence on sprouting of sugarcane (Barnes. 1974). Thus, the selection of proper and suitable planting material is the most important factor among the various agronomic practices which require due attention.

Age of the seed material, portion of a stalk, number of buds per sett, nutritional status of seed cane, duration between cutting and planting are known to have considerable effect on sprouting and subsequent growth of sugarcane (Barnes, 1974; Clements and Ghotb, 1969; Worku, 1992).

Apart from other aforementioned factors, portion of a stalk cutting used as seed (i.e., different age of the same stalk) has more influence on sprouting (Barnes, 1974; Clements and Ghotb, 1969). Buds on different portion of stalk also differ in the rate of sprouting (Clements, 1940). Clements (1980), Das (1981) and Work (1992) found higher germination percentage in cuttings taken from the upper portion, and the time required for sprouting was also much shorter when compared to cuttings taken from the middle and lower portions. Similarly, Kakde (1985) stated that older buds of a stalk are relatively slower in the rate of sprouting. Alvarez and Planar (1987) found that sprouting, number of tillers and stalks per hectare were highest in setts taken from the middle and upper portion of cane.

Field experiment conducted in Ethiopia at Metahara Sugarcane Plantation has showed that the upper and the middle portions of the stalk cuttings of three sugarcane varieties, viz. B41/227, B52/298 and Mex54/245 gave higher germination percentage with higher number of tillers and cane height than the lower portion (Worku, 1992). At Wonji-Shoa Sugarcane Plantation, the whole stalk discarding few upper and lower internodes is used as planting material and no investigations were made in this respect to identify the more suitable cane portions for planting purpose.

Therefore, this study was conducted with the objective of evaluating the effect of different cane portions on sprouting, subsequent growth, yield and its attributes.

II. Materials and Methods

A field experiment was conducted during 2003/2004 to determine the effect of different cane portions/cuttings on per cent sprouting, subsequent growth and cane yield of sugarcane variety N-14. The trial was executed on a sandy soil at Wonji-Shoa Sugarcane Plantation. The experiment was laid in randomized complete block design (RCBD) with four replications and five treatments comprising setts from top (T_1), middle (T_2), bottom (T_3), mixture of top+middle (T_4) and mixture of top+middle+bottom (T_5) portions of stalk. Each plot consisted of four rows of five meters in length and spacing of 1.45m (plot area of $29m^2$). In each row 25 two-budded setts were planted at 5cm overlap. Data were collected from the middle two rows (plot area of $14.5m^2$). All other conventional practices of the plantation were followed.

The plots were harvested at 23 months of crop age. Plant growth, yield and yield parameters were recorded to measure

treatment effects. Percent sprouting at 45 days, plant height and plant population count at 12 months, stalk length, stalk girth and number internodes per stalk, number of millable cane and stalk weight per plot and estimated cane yield/ha were recorded accordingly.

The data were subjected to statistical analysis of variance (ANOVA) using the Mstat computer package. Duncan's Multiple Range Test (DMRT) was used to compare treatment means following methods described by Gomez and Gomez (1984).

III. RESULTS AND DISCUSSION

Percent sprouting

Sprouting percentage in all treatment was recorded once at 45 days after planting. Percent of sprouting was remarkably different among portion of stalk cuttings and varies between 55.2 to 85.5 % (Table 1). The lowest and highest percent of sprouting were recorded in bottom and middle portions, respectively. Cutting taken from the middle and top portions of the stalk showed better results in sprouting and improved sprouting by 54.75 and 54.30% respectively, over those taken from the bottom portion. Similarly, setts (cutting) taken from the mixtures of tops and middle; top, middle and bottom portion of stalks improved setts emergence by 45.5 and 47.5%, respectively, as compared to cutting taken from bottom portion. Besides, statistical analysis showed highly significant differences ($P<0.01$) in sprouting of different stalk portions from the bottom portion, i.e. treatments (T_1, T_2, T_4 and T_5) significantly increased sprouting percentage over the bottom stalk portion (Table 2). But no significant difference was observed within the rest treatments. In this study cutting taken from the middle portion of the stalk had shown slightly greater effect over the top portion, which could almost negligible. The significantly high percent sprouting in the middle and top portions than the bottom portion could be attributed to the availability of more food reserves. Aging of buds also attributes to the lower percent of sprouting in the bottom portion. Moreover, the result of this study also supports earlier observations (Das 2005; Worku, 1992) that percent sprouting showed a gradual decline with aging of buds. This could be due to the loss of tenderness of aging buds, drying up of covering scales (Das, 1981) and possibly to all kind of injuries (Barnes, 1974).

Research findings in other countries also revealed that in aging buds the internal physiological conditions are liable to under go changes affecting the sprouting (ching, 1972; Subbaro, M.S. and Prasad, R.B., 2010). It is believed that aging could cause internal change like accumulation of growth inhibitors (Das, 1981), metabolic and enzymatic depletion of essential reserves (Zeleny, 1964), denaturation of proteins (Gupta, 1978), damaging to synthesizing ability and increasing sensitivity to stress conditions and field pathogens (Delouche, 1969). Therefore, in the present study the low percent sprouting in the lower portion of stalk cutting to which older buds attached could be due to one or more of the aforementioned factors.

Plant population and plant height

Plant population count was done after the attainment of maximum tiller production at an age of 12 months. The data in Table 1 reveal estimated average number of plants/ha. The highest number of plants was produced from the middle (1.5862 x 10^5/ha) and the lowest from the mixture of top and bottom portions (1.4897 x 10^5/ha). Except for the middle portion the number of plants produced from the bottom portion was superior to the rest of the treatments. This could be due to poor sprouting, gappy stands and probably high compensational potential of the variety N-14 that favored increase in tiller production on stool basis. However, there was no significant difference among treatments. Similar results were also reported by Kakde (1985) that poor sprouting and gappy stands favor increase in tiller production, although the compensation potential is a varietal character and different from variety to variety. It was also observed that the overall mean height of the plant obtained from the bottom portion was relatively superior over the treatments. In both cases no significant difference among treatments was observed.

Table 1. Effects of different stalk portions on sprouting and subsequent cane growth

Treatment	Percent of sprouting*	Plant population ('000)/ha	Plant height (cm)
T_1	85.25 a	151.034	207.6
T_2	85.5 a	158.620	212.4
T_3	55.25 b	153.793	218.2
T_4	80.5 a	150.689	202.4
T_5	81.5 a	148.966	203.6
CV (%)	**8.55**	**11.33**	**7.57**

*** - Means followed by letters within the same column are significantly different at 1% probability level.**

Yield and its component at harvest

The results in Table 2 indicated that stalk length, girth, number of internodes per stalk, number of millable canes and cane yield/ha were not significantly affected by the treatments.

Table 2. Effects of different portions of stalk cuttings on yield and yield components

Treatment	Stalk length (m)	Stalk girth (cm)	Number of internodes per stalk	Number of millable cane ('000)/ha	Cane yield (Qt/ha)
T_1	2.96	2.05	33.5	156.897	3116
T_2	2.9	1.98	32.6	161.379	3061
T_3	3.01	2.11	31.7	155.345	3244
T_4	2.85	1.87	31.4	150.862	2790
T_5	2.92	1.95	31.9	145.172	2501
CV (%)	4.47	11.05	4.57	6.36	9.22

The highest length of millable cane (3.01m) was recorded in the bottom portion. Mean stalk girth was also higher in bottom portion. This could be due to poor sprouting in bottom portion that led to the primary shoots to be sparsely populated, and it highly likely that they had received an adequate quantity of light,

water and nutrients for their own development. Hence, such favorable growing conditions might have attributed for the higher stalk length and stalk diameter which resulted in higher weight and their seemed to be a positive correlation between stalk length and weight, stalk diameter and weight as indicated in the previous studies (James, 2007). The overall mean number of millable canes and cane yield obtained were higher fore the top, middle and bottom portions as compared to the overall mean values obtained (T_4 and T_5) from the mixed portions. The highest number of millable cane yield (1.61379×10^5 qt/ha) was obtained from the middle portion but the highest cane yield (3244qt/ha) was obtained from the lower portion. These differences might have been due to differences in yield components such as number of millable cane, height and thickness of stalk and weight per stalk. Thus, a higher number of lighter stalks and a less number of heavier stalks, respectively, were directly related to the higher cane yields of the middle and bottom portions. Similarly, Stevenson (1965) reported higher yield fro a small number of heavy stalks, or a number of lighter stalks. The relative influence of various yield components on cane yield has been studied by other investigators (James and Miller, 2009) have reported that the number of millable cane found to be the most important component of cane yield; and the non-significant higher yield obtained from the bottom portion in the present study could be attributed, at least in part, to higher stalk length and diameter as compared to the other treatments.

IV. Conclusions and Recommendation

The results of this study suggest that stalk cuttings taken from the middle and top portions significantly improved sprouting over the matured bottom portion. On the other hand, no significant effect of different stalk portions was observed on plant population, plant height, cane yield and its components at harvest. Cane growers are also advised to use the middle and top portions of cane plant as planting material for commercial sugar production. However, further studies are necessary considering a range of commercial sugarcane varieties and soil type in all sugar plantations in Ethiopia to come up with all encompassing recommendations.

References

[1] Alvarez, F. and Planar, R., 1987. The influence of different stalk cuttings on the dynamics of tillering and stalk population of sugarcane variety C187-68. Cultivos Tropicale (Cuba). Vol. 8(2) p73-83.

[2] Barnes, A.C., 1974. The sugarcane. 2nd edition. Leonard Hill, Ltd., Londom.

[3] Clements, H.F., 1940. Factors affecting germination of sugarcane. Hawaiian Planters. Recrd44: 117-146.

[4] Clements, H.F., 1980. Sugarcane crop logging and crop control principles and practices. Hawaii; Honolulu, pp. 510.

[5] Clements, H.F. and Ghotb, A. 1969. The numbering of leaves and internodes for sugarcane nutrition studies. Proceedings 13th Congress, International Society of Sugarcane Technologists, Taiwan pp 569-584.

[6] Ching, T. M. 2000. Metabolism of germinating seeds. In seed biology Vol. II pp 103-205.

[7] Das, S.D., 2005. Influence of aging of seed cane on germinabilty and vigor of seedlings of sugarcane. Seed Research V. 9(2) 162-166.

[8] Delouche, J.C., 1969. Planting seed cane quality. Proceeding Belt-wide. Cotton production Conference, New Orleans. Pp 16-18.

[9] Gupta, V.S., 1978. Crop physiology. Oxford and IBH Publishing Co. LTD., New Delhi. PP 42-43.

[10] Kakde, J.K., 1985. Sugarcane and production. Akola, Metroplitan Book Co., LTD., New Delhi. 384p.

[11] Herbert, L.P., 1967. Association between yield components and yield of sugarcane varieties in Louisiana. International Society of Sugarcane Technologists. p. 760-763.

[12] James, N.J. 2007. Yield components in random and selected sugarcane varieties. Crop science. V. 11(6): pp245-248.

[13] James, N.J. and Miller, J.D., 2009. Selection in two seedlings of four sugarcane progenies. Crop science. 11(6): 245-248.

[14] Stevenson, G.C., 1965. Genesis and breeding of sugarcane. Longman. London.

[15] Subbaro, M.S., and Prasad, R.B., 2010. Studies in India on the germination of sugarcane. Indian journal of plant physiology. V. 3(2):181-194.

[16] Worku Burayu, 1992. The influence of different portions of the stal cuttings and number of buds per set on sprouting, tillering and yield of sugarcane, M.Sc thesis. Alemaya University of Agriculture, Ethiopia.