Effect of Stalk Section, Coverage Depth and Date of First Irrigation on Seedcane Germination of Two Commercial Sugarcane Cultivars in Nigeria[1]

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ABSTRACT

Pot experiments were carried out in a screen house at the University of Ilorin, Nigeria, to study the influence of different sections of matured stalks, coverage depth and date of first irrigation after planting on seedcane germination of two commercial sugarcane cultivars. Top sections of matured cane stalks, when used as setts (cutlings with single bud) gave the fastest and the best germination. This pattern was the same for all coverage depths and dates of first irrigation tested. Similarly, date of first irrigation after planting significantly affected germination percentage irrespective of stalk sections and depth of coverage. Faster and higher germination were obtained when setts were irrigated at planting. Delaying first irrigation until five days after planting reduced germination by 24 percent. On the contrary, depth of coverage did not significantly influence the final germination percentage. Also, the interactions between date of first irrigation, coverage depth and sections of the stalk were not significant.

COMPENDIO

Se estudió la germinación de dos variedades de caña de azúcar y el efecto que sobre la misma tienen la sección usada de la caña madura, la profundidad de siembra y la fecha del primer riego. Los experimentos se hicieron en macetas y bajo invernadero en la Universidad de Ilorin, Nigeria. La mejor y más rápida germinación se obtuvo con estacas de un nudo y de la sección superior de la caña. Esto fue cierto para todas las profundidades de siembra y fechas de riego. De la misma manera la fecha del primer riego afectó el porcentaje de germinación sin importar la sección de la cual se tomó la estaca o la profundidad de la siembra. La más rápida y alta germinación se obtuvo cuando las estacas fueron regadas en el momento de la siembra. El retrasar el riego hasta cinco dias después de la siembra, redujo la germinación en 24 por ciento. Por el contrario, la profundidad de siembra no afectó significativamente el porcentaje final de germinación. La interacción entre las tres variables estudiadas no fue significativa.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is commercially propagated by cuttings of mature stalks with one or more buds. The basis of a good crop is considered to be good bud development on planted cuttings, followed by satisfactory tillering, as this provides the appropriate number of stalks required for good yield (11). However, optimum germination and early shoot vigour result when both the internal and external factors are optimal (5).

Among the external factors that have been reported to affect germination of sugarcane setts are temperature (8, 12), age of the bud/section of the stalk (3, 4, 7), and depth of coverage (1, 5, 10). Soil factors, particularly compactness and moisture, have been indicated to affect germination of cane (9). The amount of nutrients and reducing sugars present in the setts have been indentified as two internal factors affecting cane germination (7).

Sugarcane is the main source of sugar production in Nigeria. The land area under cane cultivation is very low (about 7 000 ha) and as such it has not been possible to set out an area for seed cane production. Thus, part of the mature cane stalks for crushing are used for planting. However, there have been reports of undesirable gaps in the field resulting from poor germination of setts (6). Replanting of such gaps is usually undertaken; however, this gives rise to canes of different physiological ages at harvesting, thereby reducing total sugar output. There have been no reports of factors affecting cane germination.

The objective of the present study was to evaluate the effects of stalk sections (age of buds), coverage depth and date of first irrigation after planting, on germination of the two commercial cane cultivars, Co 957 and Co 1 001.

MATERIALS AND METHODS

The study was carried out in a screen house at the University of Ilorin, Nigeria, using groups of 10-litre plastic pots, filled with sandy loam top soil (pH 4.4, om 2.2% – 2.20%, CEC – 16.17). Two com-

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mercial cultivars (Co 957 and Co 1 001), which together account for more than 60% of the total areas in sugarcane estates in Nigeria, were used in the study.

The study was designed as a factorial experiment of: a) section of stalk; b) coverage depth; and c) date of first irrigation after planting. There were three levels of each factor and two replications. Details of the various treatments of each factor are as follows:

a) Section of the stalk used as planting material

For the purpose of the present study, short single-budded setts were used. Whole stalks of mature cane (12 month-old) were cut into setts of single bud. The setts were classified as top, middle and bottom. Setts coming from the first metre of the stalk from ground level were classified as the bottom setts, the next metre up constituted the middle setts, while the remainder were classified as the top setts.

b) Coverage depth

- buds covered with 5 cm soil layer
- buds covered with 10 cm soil layer
- buds covered with 15 cm soil layer

c) Date of first irrigation after planting

- setts irrigated immediately after planting
- delaying first irrigation of setts until three days after planting
- delaying first irrigation of setts until five days after planting

In all cases the soil was irrigated to saturation at the first irrigation, and this was maintained by subsequent irrigation on alternate days until the study was terminated. For each factorial combination of the above factors, five setts were planted per pot, and each treatment combination was replicated twice. Termination percentages were estimated from emergence counts of seedlings undertaken from day seven to day 21 after planting, when the study was terminated.

All data collected were subjected to variance analysis, and treatment means were tested with least significance difference (LSD) at the 5% level.

RESULTS AND DISCUSSION

Variance analysis shows that two of the three main effects, section of stalk and date of first irrigation, are significant for Co 1 001. However, for Co 957, the significance of these two main effects was qualified by a significant interaction between them. For the two cultivars, the effect of date of first irrigation after planting was highly significant (at 1% level). While the significant effect of section of stalk was high (at 1% level) with Co 957, it was slight (at 5% level) in the case of Co 1 001. In both cultivars, the effect of coverage depth on the final germination percentages was not significant.

The significant interaction involving the section of stalk and date of first irrigation after planting in Co 1 001 implies that the reactions of setts to delayed irrigation depends on the section of the stalk. This explains why delayed irrigation, even for five days after planting, did not significantly affect the final germination percentage of top section, while the same treatment significantly affected the germination of both the middle and bottom sections. The three-way interactions involving section, depth and date of first irrigation were not significant for the two cultivars.

Germination was fastest and best with the top section cuttings of both cultivars at all dates of first irrigation (Fig. 1). A 100% germination of the top cuttings was obtained by the 13th and 17th day after planting for Co 1 001 and Co 957 respectively, when the cuttings were irrigated at planting. However, for the same periods and the same irrigation date, germination percentages of 90 (middle section) and 70 (bottom); 90 (middle) and 86.7 (bottom) were ob-

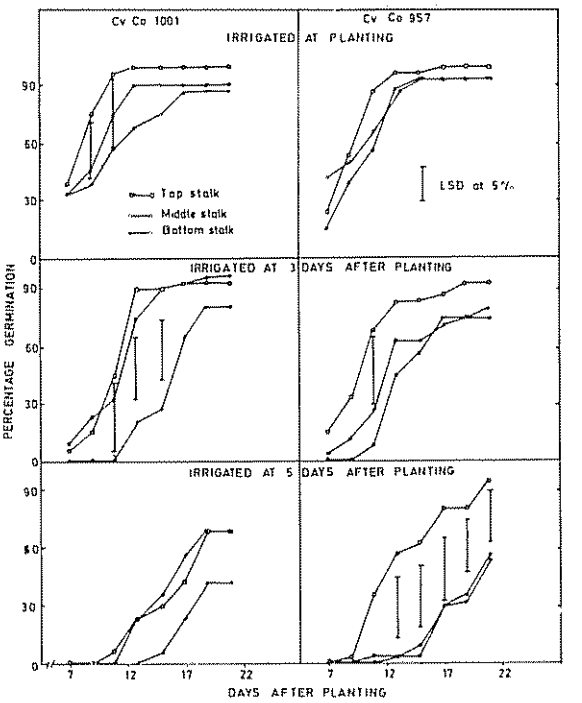

Fig. 1. Effect of part of stalk on germination percentage at different irrigation dates of all coverage depth.

tained for Co 1 001 and Co 957 respectively. These germination percentages were, however, not significantly different, except for the bottom section of Co 1 001 (7%) which was significantly different from the top and middle sections at P = 0.05

The top sections were neither significantly affected by the differential date of first irrigation after planting, nor by the coverage depth. However, the middle and the bottom sections were significantly affected by the differential date of irrigation after planting but not by coverage depth. Over all, the effect of delayed irrigation was most severe on the bottom sections of both cultivars. For example, germination percentages of 43.3 and 53.3 were recorded for the bottom sections of Co 1 001 and Co 957 respectively, when irrigation was delayed for five days after planting as against 70 and 86.7% germination respectively, for the cultivars when the same section was irrigated at planting

The superiority of the top section in germinability has been reported earlier. Clements (3) observed that top cuttings from the upper section of mature stalk germinated faster and with a higher percentage than did cuttings from the older basal portions of the stalks. Similarly, Das (4) reported that setts graded in order of ageing of buds showed gradual decline in germination percentages with an increase in age. The reports of these authors further showed that the differences in germinability due to age of buds were statistically significant. This was also true for the present study, where germination percentages of the top and bottom setts were significantly different at P = 0.05

It has been observed that the transition from the dormant into germinating stage of the buds is characterized by changes in the food constituents and sugars which are triggered by moisture (5). Similarly, the importance of sucrose inversion into glucose on germination has been clearly demonstrated by Singh and Ali (9). However, in studying the effect of reducing sugars on germination of cane setts, Plana and Alvarez (7) observed that top sections of mature stalks have a higher level of reducing sugars than the bottom section and hence showed better germination. This explains the superiority of the top section in germination, as demonstrated in this study

Fig. 2 shows that irrigation immediately after planting gave the best germination of setts from the three sections. The final germination percentage observed for the top sections of the two cultivars were 100, 93 and 83 for setts irrigated at planting, three and five days after planting respectively. However, the results of the same treatments for the middle and bottom sections respectively were 91.5, 86.3 and

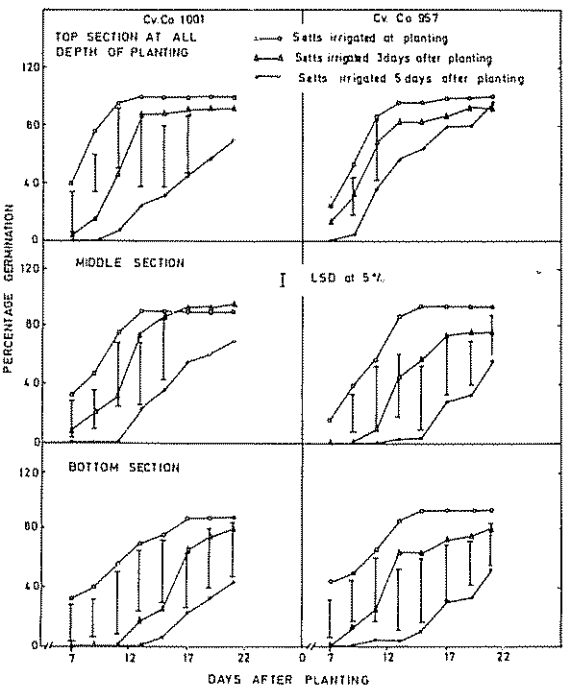

Fig 2 Effect of date of first irrigation after planting on the germination of sugarcane setts from three sections of matured stalk.

63.5; 90, 81.5 and 46.5 for setts irrigated at zero, three and five days after planting, in that order. Setts irrigated at planting achieved maximum germination percentage by the 15th day after planting, while those in which the first irrigation was delayed for three or five days after planting reached peak germination in 19 and 21 days respectively. Overall, all setts irrigated at five days after planting gave significantly poorer germination for all the three sections, while those irrigated at planting and three days after were not significantly different.

Superior germinability of cane irrigated at planting and loss of germinability with delayed irrigation has been reported in Hawaii (5). Similarly, Choudry (2) at Pusa, Bihar found in a pot experiment that well-watered setts germinated at about twice the rate of unwatered setts. The need for moisture to trigger the shift of the bud from dormancy to activity (5) could explain why setts irrigated at planting on the one hand germinated fastest and had the highest germination percentages, and why delayed irrigation, on the other hand, resulted in a slow rate of germination and probable failure of germination

Transition from the dormant into the germinating stage of the buds is characterized by changes in food constituents and sugars (5), and sucrose inversion into glucose is an important factor in germination (9). All

these are triggered by moisture (5). The importance of moisture in sucrose inversion and hence in germination was thus clearly demonstrated by the severe effect of delayed irrigation on the bottom sections (Figs. 1, 2) which had been shown to have low concentrations of reducing sugars (7). For instance, the bottom sections of Co 1 001 in which irrigation was delayed for three or five days after planting, recorded no germination 11 days after planting, while the same setts irrigated at planting recorded about 57% germination at the same period. Similarly, Co 957 recorded germination percentages of 67, 27, and 3.3 for bottom setts first irrigated at planting, three and five days after planting respectively. Therefore, if it is important to irrigate young seed cane at planting or shortly thereafter, it will be even more important to irrigate the field immediately after planting when more mature stalks are being used as planting material. However, in sugar estates in Nigeria, canes of 12 months or more in age are usually planted and irrigation is usually delayed for more than three days after planting, resulting in loss of germination and undesirable gaps in the plantation.

Analysis of variance (Table 1) showed that the effects of the date of first irrigation and section of stalks were significant at the termination of the study. However, Fig. 2 shows that moisture effect was significant for the top sections only for the first 15 days, while it was significant for the middle and bottom sections throughout the study period. Hence, the significant date of first irrigation and section of stalk interaction obtained with Co 957.

All the coverage depths (5, and 15 cm) considered in this study did not significantly affect the final germination percentage of all sections and at each irrigation date (Fig. 3). However, the shallowest depth (5 cm) gave the fastest emergence which was significantly better (P = 0.05) than the deepest depth (15 cm), up to eleven days after planting for both cultivars. Eleven days after planting the germination percentages recorded for Co 1 001 were 90, 90 and 50 for the 5, 10, and 15 cm coverage depth respectively, when setts were irrigated at planting.

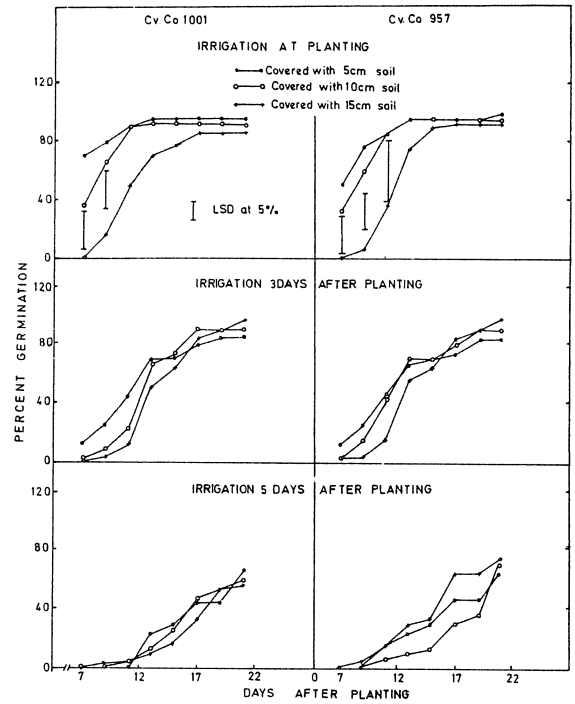

Fig. 3. Effect of coverage depth on germination of sugar cane setts at different periods of first irrigation after planting.

Table 1. ANOVA table showing the effects of main treatments and their interactions on germination (21 days after planting).

Sources of variation	Co 957				Co 1 001		
	Degree of freedom	Sum of squares	Mean squares	F	Sum of squares	Mean squares	F
Total	53	22 437.04			31 533.33		
Replication	1	362.96			66.6		
Treatments	26	17 037.04	655.27	3.38**	22 533.33	866.67	2.52*
Irrigation date (I)	2	6 414.82	3 207.41	16.55**	10 844.44	5 422.22	15.78**
Section of stalk (S)	2	5 348.07	2 674.07	13.80**	3 377.77	1 688.88	4.91*
Coverage Depth (D)	2	637.04	318.52	1.64	44.44	22.22	0.06
IS	4	2 740.74	685.18	3.54*	977.78	244.44	0.71
ID	4	118.52	29.63	0.15	2 177.79	544.45	1.58
ISD	8	1 125.92	140.74	0.73	4 000.00	500.00	1.45
Error	26	5 037.01	193.73	8.0	8 933.34	343.59	

* – Sig. at 5%
** – Sig. at 1%

CONCLUSION

From the foregoing, it is certain that cane seed germination and the consequent crop establishment are largely affected by the physiological age of the setts used as planting materials, and irrigation management. Top and middle sections of matured stalks germinated better than the bottom setts which are physiologically more mature. Therefore, younger cane (about six – eight months) will make the best planting material. Alternatively, the last 10 – 12 internodes of millable canes can be used with good results. Delaying first irrigation after planting for more than three days will result in poor germination and unsatisfactory crop stands. It is, however, advisable to irrigate immediately after planting for best crop establishment.

These results are in accordance with those obtained by Borden (1) who reported that deeper coverage delayed emergence and later resulted in seed mortality. In his study with buds covered with 2.5, 7.5 and 12.5 cm of Hawaiian soil, he found that 12.5 cm were usually unsatisfactory. However, Humbert (5) noted that the depth of soil used in covering seeds not only influences the germination and establishment of the stand, but also the early development of the cane stool. He thus warned that with shallow planting, care must be taken to keep soil moist by frequent light irrigation. This view was supported by this study when the shallowest depth (5 cm) recorded the poorest (not significant) germination percentage at delayed irrigation periods.

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