I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS)
Rating : 3. 03

Effect of Pre-irrigation, Time of First Irrigation and Nitrogen Applied to Seedcane, on Germination of June Planted Sugarcane

*Salaheldin A. Mukhtar**

Abstract: *Two experiments were conducted in seasons 2011/012 and 2012/013 at Guneid Sugarcane Research Center farm. The objective was to improve the germination of June planted sugarcane by suppressing the high ambient and soil temperature that adversely affect germination at that time of the year in addition to giving nitrogen to the seedcane. Treatments consisted of pre-irrigation (irrigation before planting) versus no pre-irrigation (no irrigation before planting); and irrigation on first day immediately after planting versus irrigation on the second day; and a dose of 50 kg of nitrogen as urea given to seedcane farm eight weeks before cutting versus no nitrogen application. The results showed superiority of immediate irrigation in the first day and pre-watering over other treatments on germination only for the two seasons and the combine analysis also. There was a positive interaction between the named treatments. In this connection, there was a visual observation of bigger growth of the early germinated plants in the first season due to the interaction of treatments of irrigation immediately after planting and pre-watering so that the practice of split ridging usually done by machine was done manually to avoid destruction of bigger plants (resultant of the positive interaction) or the burying of smaller ones (resultant of the negative interaction). Moreover, effect of urea application to seedcane increased germination in season 2011/012 (first season) but was shown significant only for the reading at four weeks. The results also showed no significant differences between other measured agronomic and quality characters of sugarcane for the two seasons in response to all the tested treatments. The results also showed no significant differences between other measured agronomic and quality characters of sugarcane for the two seasons in response to all the tested treatments. The study confirmed the importance of June planting of sugarcane in Sudan because very high cane yield was obtained. Further, the suggested means to improve the germination of the planted sugarcane in June included pre-watering and irrigation immediately after planting. These treatments would increase the population of millable stalks and final cane yield when planted in commercial areas as usually done.*

Key words: *Germination, pre-irrigation, Seedcane, sugar yield, urea*

INTRODUCTION

Sugarcane in Sudan is usually planted in June and October. The June planting of sugarcane is relatively recent. It has the advantage that the crop will have longer growing season and thus higher cane yields will be attained (Agricultural Guide, 2015). Moreover, it permits the milling season for sugar production to start early and more cane and sugar can be produced. Further, June planting of sugarcane will also regulate the crop rotation in a way that every crop category (i.e. plant cane, first ratoon, second ratoon….etc) will have enough time for maturity and yield.

Satisfactory germination will lead to effective crop population and cane yield. However, under field conditions, it is reported that about only 60 per cent germination can be considered safe for raising a satisfactory crop (Sugarcane crop ebook 2007). Satisfactory germination requires suitable environmental conditions. Studies in Hawaii showed that planted setts given their first irrigation same day or sooner afterwards showed superior

* Sugarcane Research Center-Guneid, Sudan, *E-mail: salahamukhtar@hotmail.com*

germination (Humbert 1968). In this respect, it is also reported that the optimum soil temperature for germination ranges between 18 to 30 °C (Sugarcane crop ebook 2007). Also Humbert (1968) reported that 111° F (44 °C) soil temperature is too warm for good germination.

Nitrogen, in conjunction with carbohydrates, is vital for formation of proteins, thus building of the protoplasm, the living part of the cell. This demonstrates the importance of the presence of readily available N if formation of new cells is to take place, for instance, germination. In this respect, Bakker (1999) stated that uptake of N by the cane shortly prior to harvest of seedcane for planting can be beneficial. Smit (2010) reported that seedcane of unfertilized origin germinated significantly more poorly than that of fertilized origin and Sets planted in fertilized soil demonstrated significantly (Pd" 0.05) higher emergence counts compared to unfertilized soil. Sets planted in sun-dried soil did not grow roots or show signs of bud swelling and differentiation.

Although advantages of June planting of sugarcane is fairly stated, however, it is encountered by the high ambient and soil temperature availing during June. Maximum air temperature in June 2011 and 2012 recorded up to 43 °C. Even though, the soil temperature is not recorded, it is expected to be more than the registered air temperature at ten centimeters soil depth (Zheng *et al.,* 1993). These conditions usually adversely affects the germination. The field will be subjected to weed infestation enhanced by rains if the gaps are not properly filled. In this regard, it is observed that much supplying of gaps is practiced which costs labour and time in addition to economical losses.

The objective of this study was to improve the prevailing conditions for June planted sugarcane at Guneid Sugar Scheme firstly by using pre-irrigation, secondly by irrigation immediately after planting and thirdly by applying nitrogen in form of urea to the seedcane before cutting.

MATERIALS AND METHODS

The present research was conducted in seasons 2011/012 and 2012/013 at Guneid Sugarcane Research Centre farm which lies within the Guneid Sugar Scheme (latitude 14° 522 N and longitude 33° 192 E). The soils belong to the Vertisols order with more than 40% clay, smectitic with high CEC and pH, calcareous, low nitrogen and organic matter contents, low available bicarbonate – extractable P and non-saline non-sodic.

Three sets of treatment were assigned:

1. Pre-irrigation (W): two treatments; pre-watering 10 days before planting (W_1) versus no pre-watering before planting (W_0).
2. Time of irrigation (T): Irrigation in the first day immediately after planting (T_1) versus irrigation in the second day of planting (T_2).
3. Urea application to the field of seedcane (N): Planting with seedcane that received 50 kg urea/f eight weeks before cutting (1N) and planting with seedcane without urea before cutting (0N).

The experiment was laid out in an RCBD factorial design, with 8 treatments (2 x 2 x 2) and four replicates. The subplot was 4 ridges 10 m long and 1.55 m apart. Sugarcane cultivar Co 6806 was used as a test crop. Good 3-eyed cane setts (buds) were planted. The two inner rows of the subplot were adjusted to same number of setts. Other agronomic practices were done as usual throughout the growing seasons included application of herbicides, fertilization, insecticides (to combat termites), irrigation and weeding. It is worth mentioning that the split ridging that usually done to plant cane by machine was done manually in the first season because of big differences in growth due irrigation treatments to avoid destruction of some plants and the burying of other plants.

Agronomic data were recorded as follows: At the beginning germination percentages were taken at two, four and six weeks from planting. The number of millable stalks, stalk height and yield of cane were taken at harvest. Methods of measurements were those described by Clements (1980). Qualitative yield components included brix% cane (total soluble solids), pol% cane (sucrose content of cane), ERS % (estimated recoverable

sugar) and sugar yield in ton/f. Quality of the cane was determined according to the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) (1994).

RESULTS AND DISCUSSION

Tables (1 and 2) showed germination counts, and the interaction of pre-irrigation and time of first irrigation treatments for the two seasons and the combined analysis. The data in Table 1 and the combined analysis in Table 2 showed that irrigation first day and pre- irrigation treatments significantly exceeded the reverse treatments in germination count in the three recorded periods for the two seasons. There was a negative interaction between no pre irrigation and irrigation in the second day (Table 1 and 2) that was shown in germination and vice versa. However the germination count for the second season was relatively higher than the first one (Table 1 and 2). This was reflected in the higher millable stalk population recorded in the second season (Table 6). Example of the negative interaction of irrigation treatments was shown in the first season by the lowest germination readings of 6.3, 33.9 and 38 whereas the positive interaction was shown in the second season were 69.38, 85.05 and 89.4 were the highest germination counts recorded in 2, 4 and 6 weeks respectively. This was in conformity with what was reported by Humbert (1968) that planted cane setts should be irrigated sooner. Moreover, Humbert (1968) also stated that soil temperature should not exceed 111 °F (44 °C) while the soil temperature in Guneid Sugarcane Scheme in June was expected to exceed this temperature similar to what reported by Zheng *et. al.* (1993) since the air temperature in June 2011 and 2012 have recorded up to 43 °C.

Although Bakker (1999) and Smit (2010) have reported that giving nitrogen to the seedcane before planting would certainly improve the germination of sugarcane. In this study the response to the application of nitrogen as urea to the seedcane farm eight weeks before cutting was shown in the first season only on germination and was statistically significant only for the germination count at four weeks (Table 5). This was probably due that planting was done with selected good cane setts.

Strange enough, for the two seasons, those other agronomic and quality characters were not affected by the irrigation treatments for the two seasons (Table 3, 4, 5, 6,7 and 8). In other words, differences that showed in germination counts were not reflected in agronomic parameters such as stalk height, number of millable stalks and cane yield although differences in growth were visually observed in the first season to the extent that split ridging was done manually to avoid breakage of bigger plants and burying of smaller ones. Differences in millable stalks and cane yield disappeared probably because of that the small experimental plots were kept clean and other cultural practices were done properly. Moreover, bigger age of June planted cane that exceeded 16 months made that tillering probably compensated the lower germination. It is also reported that about only 60 per cent germination can be considered safe for raising a satisfactory crop (Sugarcane crop ebook 2007). In other words, it is easier to manage small experimental plots such as effective weeding, irrigation and other cultural practices than conditions in larger fields. Therefore, increasing germination will definitely save time, labour and possibly increase cane and sugar yields.

CONCLUSION

This study confirmed the importance of the June planting of sugarcane in Sudan and it can be started in May. In adoption of this practice, many advantages can be attained. Usually at this time of the year no other crop competes with sugarcane for labour. Moreover, chances of improvement are always there. The only hindrance is the high air temperature that will negatively affect the germination. Pre- irrigation of the farm before planting and irrigating first day immediately after planting greatly improved germination and counteracted the adverse effects of temperature. Therefore, planted setts should be irrigated immediately, not exceeding the first day or in other words the daily planted area should be equal to that can be irrigated. Pre- irrigation should be tried and adopted as a practice that will mollify the higher soil temperature at that time of the year.

Table 1
Effect of pre- irrigation and the first of irrigation after planting on germination of June planting of sugarcane

Character	Treatment	Season 2011/012				Season 2012/013			
		Irrigation 1st day	Irrigation 2nd day	Mean	S.E. (±)	Irrigation 1st day	Irrigation 2nd day	Mean	S.E. (±)
Germination %	Pre- irrigation	48.41 a	16.36 b	32.4 a		69.38 a	62.7 b	66.0 a	
at two weeks	No pre- irrigation	49.36 a	6.33 c	27.8 a		62.03 b	26.15 c	44.1 b	
	Mean	48.88 a	11.35 b		3.1	65.7	44.43	55.1	3.1
Germination %	Pre- irrigation	77.77 a	51.4 b	64.6 a		85.05 a	81.2 b	83.1 a	
at four weeks	No pre- irrigation	77.57 a	33.9 c	55.76 b		80.71 b	51.89 c	66.3 b	
	Mean	77.67 a	42.65 b		2.3	82.88	66.54	74.7	2.0
Germination %	Pre- irrigation	78.94 a	59.62 b	69.3 a		89.4 a	88.69 a	89.0a	
at six weeks	No pre- irrigation	79.43 a	38.0 c	58.76 b		87.95 a	62.63 b	75.3 b	
	Mean	79.19 a	48.81 b		2.3	88.68	75.66	82.2	2.9

Means followed by the same letter are not significantly different according to Duncan's M R T.

Table 2
Combine effects of pre- irrigation and time of first irrigation over the two seasons, 2011/012 and 2012/013 on germination of sugarcane

Character	Treatment	Combine analysis			S.E(±)
		Irrig. 1st day	Irrig. 2nd day	Mean	
Germination % at two weeks	Pre- irrigation	59.4 a	39.0 b	49.2 a	2.12
	No pre- irrigation	55.7 a	16.2	36.0 b	2.12
	Mean	57.6 a	27.6 b		
	S.E. (±)	2.12			3.0
Germination % at four weeks	Pre- irrigation	81.4 a	66.3 b	73.9 a	1.5
	No pre- irrigation	79.1 a	42.1 c	61.1 b	
	Mean	80.3 a	54.6 b		
	S.E. (±)	1.5			2.2
Germination % at six weeks	Pre-irrigation	84.4 a	74.2 b	79.3 a	1.8
	No pre- irrigation	83.7 a	50.3 c	67.0 b	
	Mean	84.0 a	62.2 b		
	S.E. (±)	1.8			2.6

Means followed by the same letter are not significantly different according to Duncan's M R T.

Table 3
Effect of pre-watering on germination and development of June planted sugarcane. Guneid, season 2011/012

Character	Pre-irrigation		S.E.(±)	Sig. level	C.V. (%)
	W_0	W_1			
Germination % 2 weeks	27.8 a	32.4 a	2.18	NS	28.9
Germination % 4 weeks	55.8 b	64.6 a	1.61	****	10.7
Germination % 6 weeks	58.8 b	69.3 a	1.52	****	9.5
Height (cm)	235.0 a	225.9 a	5.13	NS	8.6
No. of millable stalks	53770 a	51089 a	1360	NS	9.3
Yield of cane (ton/f.)	85.0 a	85.9 a	2.55	NS	10.3
Brix %cane	14.3 a	14.1 a	0.17	NS	2.9
Pol %cane	10.7 a	10.7 a	0.20	NS	2.8
ERS %cane	7.7 a	7.7 a	0.20	NS	3.5
Sugar yield (ton/f)	6.6 a	6.7 a	0.32	NS	10.3

Means followed by the same letter are not significantly different according to Duncan's M R T.

Table 4
Effect of time of first irrigation after planting on germination and development of June planted sugarcane. Guneid, season 2011/012

Character	*Irrigation after planting*		*S.E.(±)*	*Sig. level*	*C.V. (%)*
	1st day	*2nd day*			
Germination % 2 weeks	48.9 a	11.4 b	2.18	***	28.9
Germination % 4 weeks	77.7 a	42.7 b	1.61	****	10.7
Germination % 6 weeks	79.2 a	48.8 b	1.52	****	9.5
Height (cm)	226.5 a	234.4 a	5.13	NS	8.6
No. of millable stalks	53156 a	51703 a	1360	NS	9.3
Yield of cane (ton/f.)	87.5 a	83.4 a	2.55	NS	10.3
Brix %cane	14.3 a	14.1 a	0.17	NS	2.9
Pol %cane	10.6 a	10.8 a	0.20	NS	2.8
ERS %cane	7.6 a	7.8 a	0.20	NS	3.5
Sugar yield (ton/f)	6.7 a	6.5 a	0.32	NS	10.3

Table 5
Effect of nitrogen applied to seedcane on germination and development of June planted sugarcane. Guneid, season 2011/012

Character	*Urea (kg/f)*		*S.E.(±)*	*Sig. level*	*C.V. (%)*
	0.0	*50*			
Germination % 2 weeks	28.9 a	31.3 a	2.16	NS	15.7
Germination % 4 weeks	57.4 b	62.9 a	1.45	*	7.7
Germination % 6 weeks	62.4 a	65.6 a	2.10	NS	10.2
Height (cm)	230.4 a	230.4 a	7.21	NS	9.9
No. of millable stalks	534232a	51427 a	1038	NS	6.4
Yield of cane (ton/f.)	84.5 a	86.4 a	2.39	NS	12.6
Brix %cane	13.9 b	14.5 a	0.27	NS	6.9
Pol %cane	10.7 a	10.8 a	0.22	NS	6.7
ERS %cane	7.7 a	7.8 a	0.22	NS	8.8
Sugar yield (ton/f)	6.5 a	6.8 a	0.32	NS	10.3

Means followed by the same letter are not significantly different according to Duncan's M R T.

Table 6
Effect of pre-watering on germination and development of June planted sugarcane. Guneid, season 2012/013

Character	*Pre-watering*		*S.E.(±)*	*Sig. level*	*C.V. (%)*
	PW_0	PW_1			
Germination % 2 weeks	44.1 b	66.0 a	2.16	***	15.7
Germination % 4 weeks	66.3 b	83.1 a	1.45	****	7.7
Germination % 6 weeks	75.3 b	89.0 a	2.10	****	10.2
Height (cm)	290.8 a	290.5 a	7.21	NS	9.9
No. of millable stalks	63534 a	65481 a	1038	NS	6.4
Yield of cane (ton/f.)	75.4 a	75.7 a	2.39	NS	12.6
Brix %cane	15.8 a	15.8 a	0.27	NS	6.9
Pol %cane	12.8 a	12.9 a	0.22	NS	6.7
ERS %cane	9.8 a	9.9 a	0.22	NS	8.8
Sugar yield (ton/f)	7.4 a	7.6 a	0.30	NS	16.3

Table 7
Effect of time of first irrigation after planting on the germination an development of June planted sugarcane. Guneid, season 2012/013

Character	*Irrigation after planting*		*S.E.(±)*	*Sig. level*	*C.V. (%)*
	1st day	*2nd day*			
Germination % 2 weeks	65.7 a	44.4 b	2.16	***	15.7
Germination % 4 weeks	82.9 a	66.5 b	1.45	****	7.7
Germination % 6 weeks	88.7 a	75.7 b	2.10	****	10.2
Height (cm)	285.6 a	295.5 a	7.21	NS	9.9
No. of millable stalks	64592 a	64576 a	1038	NS	6.4
Yield of cane (ton/f.)	75.8 a	75.3 a	2.39	NS	12.6
Brix %cane	15.8 a	15.8 a	0.27	NS	6.9
Pol %cane	13.0 a	12.7 a	0.22	NS	6.7
ERS %cane	10.0 a	9.7 a	0.22	NS	8.8
Sugar yield (ton/f)	7.6 a	7.4 a	0.30	NS	16.3

Means followed by the same letter are not significantly different according to Duncan's M R T.

Table 8
Effect of nitrogen applied to seedcane on the germination and development of June planted sugarcane. Guneid, season 2012/013

Character	*Urea (kg/f)*		*S.E.(±)*	*Sig. level*	*C.V. (%)*
	0.0	*50*			
Germination % 2 weeks	54.6 a	55.4 a	2.16	NS	15.7
Germination % 4 weeks	74.1 a	75.3 a	1.45	NS	7.7
Germination % 6 weeks	82.7a	81.8 a	2.10	NS	10.2
Height (cm)	289.4 a	292.0 a	7.21	NS	9.9
No. of millable stalks	64787 a	64282 a	1038	NS	6.4
Yield of cane (ton/f.)	76.7 a	74.3 a	2.39	NS	12.6
Brix %cane	15.8 a	15.8 a	0.27	NS	6.9
Pol %cane	12.9 a	12.8 a	0.22	NS	6.7
ERS %cane	9.9 a	9.8 a	0.22	NS	8.8
Sugar yield (ton/f)	7.6 a	7.3 a	0.30	NS	16.3

Means followed by the same letter are not significantly different according to Duncan's M R T.

RECOMMENDATIONS

Based on the results of this study, it is fair enough to recommend the following for June planting of sugarcane in Sudan:

1. Pre-irrigation of the farm prepared for planting 10 days before planting.
2. Irrigation of the planted setts first day immediately after planting or in other words, the planting should cope with area that can be irrigated immediately.

References

Bakker, H. (1999), Sugarcane cultivation and management. Kluwer Academic / Plenum Publisher, New York, U.S. A.

Clements, H. F. (1980), Sugarcane Crop logging and Crop Control: Principles and Practices. The University Press of Hawaii, Honolulu.

Agricultural Guide (Arabic). (2015), Sugarcane Research Center-Guneid Staff. Sudanese Sugar Company, Sudan.

Humbert, R. P. (1968), The growing of sugarcane. Elsevier Publishing Company, Amsterdam , London, New York.

ICUMSA. (1994), International Commission for Uniform Methods of Sugar Analysis. In: Cane Sugar Handbook. Pub. British Sugar Corporation, London.

Smit, M. A., (2010), Characterising the factors that affect germination and emergence of sugarcane. In Proc S Afr. Sug. Technol Ass., 83: 230-234.

Sugarcane crop ebook. (2007*), http:// giongmia.files.wordpress.com.*

Zheng, D., E. R. Hunt Jr and S. W. Running. (1993), A daily soil temperature model based on air temperature and precipitation for continental applications. Climate Research. Volume 2: 183-191.