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### **Performance of Sugar beet Sown in Sudan under Comparatively High Temperatures (May-July)**

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#### **Abstract**

This study was carried out in seasons 2012 and 2013 in the Sugarcane Research Center-Guneid, Sudanese Sugar Company, Sudan following some attempts of mixing sugar beet with sugarcane in cane mills. The overall idea was to synchronize the maturity of beet crop (5 to 6 months of age) with the beginning of cane crushing season (factory start-up at November) where sugarcane quality was usually low. However ambient temperature at these months was relatively high (max temp.: 40-45 and min temp.: 20-25°C). In the first season sugar beet cultivar (Posada) was sown in three sowing dates: May 21, June 6 and 21 and in the second season it was sown in May 15, 30, June 15, 30 and July 15. Harvest was programmed at three crop ages: 5, 5.5 and 6 months.

In the first season some deaths of seedlings occurred and in the second season there was complete failure of germination for May 15 and 30 sowing dates. Otherwise, no significant differences between treatments were shown; however, tuber yield was relatively low in the two seasons recording 23 to 40 ton/ha compared to the sown sugar beet in winter months (October-December) that usually yielded 60 to 80 ton/ha tuber. Beet plants were still green and growing at harvest where high leaf weight (fodder) was recorded. Sugar beet quality was relatively high. Brix, pol and estimated recoverable sugar (ERS) % recorded 17.95, 15.74 and 13.24 in average respectively.

The study emphasizes the need for more research in the subject including selection of proper sugar beet cultivars. Crop management operations such as pre watering before sowing and water stoppage (dry-off) at harvest should be thoroughly investigated.

Keywords: Sugar beet cultivars, brix, pol, pulp, sowing dates, tuber yield

#### **Introduction**

Sugar beet (*Beta vulgaris*) which is known as a temperate crop, has high sugar content and many other benefits. However, in recent years heat tolerant varieties have been evolved (Nelson 2005). Accordingly, sugar beet cultivation has moved southwards from temperate regions to the subtropics and tropics. In this regard, Asadi (2007) and Nelson (2005) reported that in some tropical and subtropical regions like Sudan and Pakistan, sugar beet processing can go from 270 to 300 days /year. Sugar beet with its relatively short season can well be accommodated

in the crop rotation of large agricultural schemes such as Gezira in Sudan. As a root crop, sugar beet can be succeeded by any cereal crop with expected good production. Moreover, realizing its high sugar content, short growing season, sugar beet as a cash crop, will improve the income of farmers. For these reasons, intensive field tests on sugar beet in the Sudan, have continued unabated at the Sugarcane Research Center at Guneid and other research stations since early 2000 in an attempt to introduce sugarbeet in the sugar industry in Sudan beside sugarcane. (Sugarcane Research Center-Guneid, Annual Reports 2004/2013). Attempts to mix sugar beet with sugarcane in cane mills have also been tackled. The obtained results of these efforts were quite promising and in most cases very encouraging.

The objective of this research was to study the cultivation of sugar beet in sugarcane schemes in summer (hot weather) to synchronize its harvest with that of the beginning of the cane crushing season where sugarcane quality was usually low.

## **Material and Methods**

The present research was conducted at Guneid Sugarcane Research Centre farm which lies within the Guneid Sugar Scheme (the intersection of latitude 14° 52' N and longitude 33° 19' E). The soils belong to the Vertisols order with clay content ranging from 40 to 55% c. Moreover, these soils were characterized as deficient in nitrogen, phosphorus and micronutrients.

The study was conducted in two seasons, 2012 and 2013. Treatments of this study consisted of three sowing dates. In the first season sugar beet cultivar (Posada) was sown on May 21, June 6 and 21 and in the second season, due to failure of sugar beet that was sown in May 15, 30 to germinate, sowing dates of cultivar Posada were extended to June 15, 30 and July 15. Harvest was done at three crop ages: 5, 5.5 and 6 months. The experiments were laid out in randomized complete block design with 4 replicates.

Land preparation was done by disc ploughing, harrowing, leveling and planing, then ridging (building of rows). The experimental plots were four rows; each row was 10 m long and 0.7 m apart. Beet sowing was done manually by placing 2 to 3 beet seeds per hole at a depth of 3 to 5 cm and 15 cm between holes. After germination, thinning was done to leave one beet seedling per hole.

The fertilization consisted of phosphorus as TSP (120 kg /ha) before planting. Nitrogen was applied at a rate of 240 kg urea/ha as a split dose, half was applied at planting and the other half after two months from planting (recommendations of the Executive Committee for Sugar Beet Introduction, Production and Industrialization, 2012). Dursban (chlorpyrifos) was applied at planting to control termites which are omnipresent in this soil. The main insect pest of beet plants is *Spodoptera exigua* (cotton leaf worm) which was controlled by the insecticide Match (Lufenuron) whenever the need arised.

In the first season (2012) harvest was done at crop ages of 5, 5.5 and 6 months by harvesting one-third of the inner two rows each time. The collected data was handled by combine analysis. In the second season (2013) since the sugar beet performance was poor, only one harvest was done at the crop age of 5.5 months. Fresh tubers (sugar beet roots) were cleaned and weighed for each plot and tuber yield per hectare was calculated. Also the above ground crop (leaf weight, fodder) was determined. For the two seasons five tubers were randomly collected from each experimental unit and macerated to determine the quality of the sugar beet, namely: pol % (sucrose content), brix % (total soluble solids), estimated recoverable sugar (ERS) % and pulp % of beet were determined at the sucrose laboratory following the methodology of the "International Commission for Uniform Methods of Sugar Analysis (ICUMSA 1994). The sugar yield was estimated by multiplying the tuber yield by ERS in the juice.

## Results and Discussion

In the first season (2012) some sugar beet seedlings have withered to death whereas in the second season (2013) there was complete failure of germination of May 15 and 30 sowing dates. The lack of germination might be attributed to the prevalent high maximum temperature in season 2013 compared to that at sowing dates in 2012. The difference in temperature between the two seasons ranged from 2 °C to 6.2 °C (Table 1).

Table 1. Maximum temperature in 4 days at sugar beet sowing dates in summer, one day before sowing.

Season	Temperature (°C)		Difference in temperature(°C)
	2012	2013	
Sowing date 1	40.2	42.2	2.0
Sowing date 2	41.1	43.6	2.5
Sowing date 3	34.6	40.8	6.2

The data in Table (2) showed that there were no significant differences in sowing dates and harvesting ages between the treatments in the first season for all the measured characters. Again, the data in Table (3) indicated that there were no significant differences in sowing dates between the treatments. However, tuber yield was very low in the two seasons registering 25 to 50 ton/ha compared to that of sugar beet sown in winter months (October-December) that usually gave tuber yields of 60 to 80 ton/ha (Sugarcane Research Center-Guneid, Annual Reports 2004/2013). The exception to this statement, is that the tuber yield for sowing date 15 July in the second season (2013) where high tuber yield was recorded (74.7 ton/ ha). This might be due to that the recorded high temperature (40.8 °c) for July 15 sowing date was less effective compared to that of the other recorded high temperatures for other sowing dates. In both seasons of the study, sugar beet plants were still green and growing at harvest as reflected in the recorded high leaf weight (fodder).

Table 2. Effect of summer sowing on quality and yields of sugar beet

Sowing date	Age (month)	Pol % beet	ERS %beet	Tuber yield (ton/ha)	Yield of leaves (ton/ha)	Fiber % beet
21.5.2012	5	17.23	14.73	47.1	8.32	1.79
	5.5	15.14	12.64	45.0	5.84	4.44
	6	15.50	13.00	45.0	5.83	2.30
6.6.2012	5	15.20	12.70	42.1	6.30	2.96
	5.5	15.32	12.82	40.7	5.78	2.94
	6	15.39	12.89	53.0	7.10	2.96
21.6.2012	5	16.38	13.88	16.2	5.12	2.29
	5.5	15.50	13.00	46.4	7.06	2.30
	6	16.02	13.52	44.9	9.17	1.81

Table 3. Effect of summer sowing dates on quality and yield of sugar beet, season 2013

Sowing date	Tuber yield (ton/ha)	Leaf yield (ton/ha)	Brix% beet	Pol% beet	ERS% beet	Sugar yield (ton/ha)
15/6/013	39.2	16.8	17.45	15.66	13.16	5.2
30/6/013	25.0	13.3	19.03	16.72	14.22	3.5
15/7/013	74.7	46.7	17.4	14.24	11.74	8.8
C.V.	24.12	39.72	8.96	7.03	8.37	23.83

However, the sugar beet quality was relatively high for the two seasons. In this regard, the respective values of brix (total soluble solids), pol (sugar content) and estimated recoverable sugar (ERS) percentages were 18, 15.7 and 13.2.

## **Conclusions and Outlook**

Although the results of the present study were not as promising and encouraging as those obtained during winter seasons, yet summer sowing of sugarbeet to be synchronized with cane crushing at harvest is still seen as a valuable option that worth continuous research efforts. These efforts should include selection of proper sugar beet cultivars, crop management operations (such as watering before sowing), water stoppage (dry-off) at harvest and crop age should be thoroughly investigated.

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