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Challenging Endeavours to Grow Sugarbeet in Sudan: Pros and cons

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Abstract: *Attempts to grow sugarbeet in Sudan have continued unabated since 1999. These efforts were then reactivated by Gezira State, Sudan, in 2012. Considerable areas were planted with sugarbeet that gave promising results. Moreover, 2.1, 8.4 and 25.2 hectares that were planted with sugarbeet at Guneid and Assalaya Sugar Schemes for three seasons, harvested and crushed together with sugarcane in the cane mills, gave encouraging results. Furthermore, some researches were conducted in different irrigated areas in Sudan addressing several aspects of sugarbeet. In this regard, some varieties were tested and released for commercial production in Sudan. One example of such research, was an experiment conducted in Guneid Research Center in 2010/11. Its treatments included 13 cultivars (Strube and KWS; Germany, and Syngenta; Switzerland), 4 sowing dates: 14th and 28th October; 13th and 29th November, and 3harvesting ages: 5; 5.5 and 6 months. The results showed high yield and good quality crop: i.e. root yield ranged from 80 to 90 ton ha^{-1}, sucrose ranged from 16 to 18 % and the sugar yield ranged from 10 to 14 ton ha^{-1}. Considering strengths, the crop was planted by planters. No major diseases were recorded. The major insect pest was the leaf cutter* Spodoptera exigua *which was properly controlled by insecticides. Harvesters are not introduced as yet.*

However, the major problem facing sugarbeet cultivation in Sudan is the very short harvest time if it is planted in October to December. When the crop ages are 5.5 to 6 months, harvest time will be from mid-March to mid-May, which will miss the effective period of sugar accumulation (winter months) by about two months. Earlier planting of sugarbeet in July to September is more suitable and harvest time will be from mid January to late April. However, this timing is faced by rains, during this period, which will hinder land preparation and machine planting because the soil is a heavy cracking clay. Moreover, weeds and insects will be a nuisance. Therefore, for the success of sugarbeet crop, the problem of reconciling the planting time with harvest time that gives the maximum sugar production must be judiciously tackled.

Keywords: *Brix, cultivars, germination, insects, sowing date, sugarbeet, weeds*

INTRODUCTION

Sugarbeet as a sugar crop is mainly cultivated in the temperate and the Mediterranean regions. However, the recent development of the so-called tropical cultivars has shifted the cultivation of sugarbeet southwards to the tropics and subtropics (Nelson 2005). Even more, Asadi (2007) and Nelson (2005) have reported that in some tropical and subtropical regions like Sudan and Pakistan, sugarbeet processing can continue up to 270–300 days per year. Sugarbeet with its relatively short season and higher sucrose content can fit well in the crop rotation of larger agricultural schemes such as the Gezira in Sudan. As a root crop, sugarbeet can be succeeded by any cereal crop with an expected high production. Moreover, Sugarbeet will be a good option for the Sudanese farmers. However, sugarbeet seeds and technology should be imported from the developed countries of the temperate region.

The objective of this study was to review the attempts of introducing the sugarbeet crop into Sudan, elucidating constraints and encouragements.

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ADVANTAGES AND CONSTRAINTS OF SUGARBEET CULTIVATION IN SUDAN

Unlike the monocropping system of sugarcane, sugarbeet is a relatively short duration crop that matures within 5 to 6 months allowing land space for other rotational field or vegetable crops. It is thus giving chance to maximizing the land use efficiency. Moreover, sugarbeet consumes about one third of the irrigation water and one half of the fertilizer that are consumed by sugarcane for the same unit area. It is relatively tolerant to soil salinity and insensitive to micronutrient deficiencies. It was reported that sugarbeet recovery from N fertilizer was as much as 77% (Vallis and Keating, 1996). Therefore it can grow well in locations of relatively low soil fertility.

For successful beet sugar industry, sowing dates of sugarbeet crop, should be wisely done for more root and sugar yields. The effective period of sugar accumulation is winter which in Sudan coincides with December to February. To coincide with this period (winter season), planting of sugarbeet is recommended to be in August to early October. During this period the crop will have vigorous growth with a consequent relatively large leaf area that will maximize the process of photosynthesis and that the prevailing mild temperature at night will encourage sucrose storage instead of growth processes.

The wider planting period (August to early October) permits longer harvesting and processing period and consequently more production of sugar. However, if the planting is done during October to December, the harvest time will be from mid-March to mid-May, i.e., harvest period will be for two months only and this will be unsatisfactory since it misses the effective period of sugar accumulation (winter months) by about two months. On the other hand, if sugarbeet planting is done from July to September, the harvest time will be from mid-January to late April which is a suitable scenario. But this timing is faced by the rains (during this period) which will hinder land preparation and machine planting, because the soil is a heavy cracking clay, and that weeds and insects will be a nuisance. Therefore, for the success of sugarbeet crop, the problem of reconciling the planting time with harvest time that gives the maximum sugar production must be judiciously tackled.

The major insect pest is the leaf cutter *Spodoptera exigua* which is properly controlled by insecticides. No other major insect pests or diseases are observed as of now. Planting is done manually or by planters. Harvesters are not yet introduced. Sugarbeet seeds have to be imported every sowing season. Lack of baggasse as a by-product of sugarcane industry, is one of the disadvantages of sugarbeet since baggasse is a good source of energy for the sugar the industry.

PRACTICAL ATTEMPTS

Unabated attempts to grow sugarbeet in Gezira Scheme, Sudan, started earlier and recently reactivated by Gezira State, Sudan, in 2012 hitherto where about 150 hectares were grown with sugarbeet for processing. A small plant was brought from China to produce sugar from the sugarbeet, but the attempt was not so successful. Moreover, 2.1 and 8.4 hectares were planted with sugarbeet (cultivars Lenard and Ballade) within Guneid Sugar Scheme in seasons 2012 and 2013 (Sugarcane Research Center-Gneid 2014). Another 25.2 hectares were planted with sugarbeet in Assalaya Sugar Scheme in season 2015. The crop of these two locations which was harvested and crushed together with sugarcane in a mix in the cane mill, gave very promising and encouraging results. The data in

Table 1
Yields of beet and sugar (ton ha^{-1}) and sucrose % produced from sugarbeet in seasons 2012, 2013 and 2015 compared to their corresponding counterparts of sugarcane produced by the Sudanese Sugar Co.

Season	*Site*	*Area (ha)*	*Beet yield (ton ha^{-1})*	*Sucrose %*	*Sugar yield (ton ha^{-1})*
2012	Guneid	2.1	51	15.38	6.6
2013	Guneid	8.4	52	18.27	8.2
2015	Assalaya	25.2	31	19.86	5.4
2015/16*	SSC (cane)*	37000	62	12.8	6.1

* Sudanese Sugar Company (SSC) 2015/16

*Total sugarcane area of the Sudanese Sugar Co. in season 2015/16

Table (1) showed some results pertaining to these field experiments. These results indicated that even with that relatively low beet yield, the high sugar content of the sugarbeet compensated for its low yield and gave relatively comparable sugar yield to that of the sugarcane. Hence, it is perceived that with more improvements in the crop husbandry, sugarbeet can be a promising sugar crop in Sudan.

Also, researches were conducted in different irrigated areas in the country addressing several aspects of the crop. One example of this research, was an experiment conducted in Guneid Research Center in 2010/11 was demonstrated below.

MATERIALS AND METHODS

1. Sowing dates: 14/October, 28/ October, 13/ November and 29/ November.
2. Cultivars: three groups of cultivars were tested. These were 13cultivars; viz:
   a. 4 Strube cultivars: Sud-02-08, Sud - 03- 08, Sud - 01- 09 and Sud -02- 09.
   b. 4 Syngenta cultivars: HI 0662, HI 0532, HI 0473 and HI 826.
   c. 5 KWS cultivars: Sperenza, Juvena, Valentina, Mashad and Progress.
3. Harvesting age: 150, 165 and 180 days.

The sugarbeet seeds were sown on ridges 10 meters long, 60 cm apart and 15 cm between holes and putting two to three seeds per hole. Each plot was four rows. The plants were later thinned to one plant per hole. Root yield was obtained by harvesting the two inner rows (to avoid marginal effect), weighed and expressed as ton per hectare. Sugarbeet quality, i.e., sucrose % beet, ERS% beet (estimated recoverable sugar) and pulp% beet were determined according to ICUMSA (1994). Sugar yield (ton ha^{-1}) was the product of root yield x ERS% beet.

RESULTS AND DISCUSSION

Generally, the results showed that the root yield ranged from 80 to 90 ton ha^{-1}; sucrose content ranged from 16 to 18 % and the sugar yield ranged from 10 to 14 ton ha^{-1}. The data in Table (2) indicated that the sowing dates of October resulted in lower root population but higher root yield compared to those of November sowing dates. This was probably because there was enough time of relatively warmer climate for the vegetative growth in October compared to that of November and hence enough growth and plant canopy for the accumulation of sugar during the cool months of winter. Also the quality of the sugarbeet was in favour of October sowing dates as reflected in the higher pol% beet and sugar yield.

The results in Table (3) showed different response of the sugarbeet parameters to crop age. There were no significant differences in root population and root yield between the response to crop age. However, beet quality was lower when

Table 2
Effect of sowing date on yield and quality parameters of sugarbeet, site: Guneid, season 2010/11.

Parameters	*Sowing dates*				*S.E. (±)*	*C.V. %*
	14/10	*28/10*	*13/11*	*29/11*		
Plant population	75898 c	87721 b	88917 b	100483 a	1679	13.6
Root yield (ton ha^{-1})	87.6 b	97.9 a	87.9 b	84.0 b	2.3	15.6
Brix % beet	20.5 a	20.8 a	20.4 a	18.8 b	0.27	9.3
Pol % beet	17.9 a	17.8 a	17.2 a	15.7 b	0.24	9.7
ERS % beet	15.4 a	15.3 a	14.7 a	13.12 b	0.24	11.5
Purity %	87.5 a	85.8 b	84.1 b	83.4 c	0.54	4.4
Pulp % beet	3.5 d	4.2 c	4.7 b	5.5 a	0.12	26.2
Sugar yield (ton ha^{-1})	13.3 b	15.0 a	12.9 b	11.2 c	0.3	18.7

Means followed by the same letter are not significantly different according to DM R T.

Table 3
Effect of age at harvest on yield and quality parameters of sugarbeet, site: Guneid, season 2010/11.

Parameters	*Age (days)*			*S.E. (±)*	*C.V. %*
	150	*165*	*180*		
Plant population	90595 a	94523 a	92885 a	1524	13.6
Root yield (ton ha^{-1})	92.8 a	91.8 a	96.8 a	2.1	15.6
Brix % beet	20.8 a	20.7 a	18.8 b	0.23	9.3
Pol % beet	17.9 a	17.7a	15.8 b	0.21	9.7
ERS % beet	15.4 a	15.2 a	13.3 b	0.21	11.5
Purity %	86.1 a	85.7 a	83.8 b	0.47	4.4
Pulp % beet	3.5 c	4.3 b	5.5 a	0.11	26.2
Sugar yield (ton ha^{-1})	14.3 a	14.0 a	13.0 b	0.3	18.7

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

Table 4
Effect of cultivar on yield and quality parameters of sugarbeet, site: Guneid, season 2010/11.

Parameter /Variety	*Plant population*	*Rootyield (ton ha^{-1})*	*Brix % beet*	*Pol% beet*	*ERS% beet*	*Pulp (%)*	*Sugar yield (ton ha^{-1})*
SUD 02 08	92962 abc	94.8 a	19.7 cde	16.9 bc	14.5 cd	4.4 ab	13.8 a
SUD 01 09	97221 ab	89.8 abc	21.1 ab	18.4 a	15.5 ab	4.3 ab	13.8 a
HI 0662	88519 cd	89.0 abcd	19.6 cde	16.7 bc	14.4 cde	4.7 a	12.9 ab
HI 0532	78519 e	93.6 a	19.8 cde	17.0 bc	14.5 cde	4.6 ab	13.8 a
HI 0473	94352 abc	94.0 a	19.8 cde	16.6 bc	14.2 cde	4.4 ab	13.3 ab
Juvena	80000 e	93.1 a	20.4 bc	17.4 b	14.6 cd	4.4 ab	13.6 ab
Mashad	85926 d	90.5 ab	20.0 cd	17.2 b	14.9 bc	4.6 a	13.3 ab
Progress	90462 cd	85.5 bcd	20.4 bc	17.2 b	15.0 bc	4.3 ab	12.9 ab
S.E. (±)	1993	2.3	0.31	0.28	0.28	0.19	0.4
C.V. (%)	13.6	15.6	9.3	9.7	11.5	26.2	18.7

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

the crop age reached 180 days (6 months). These beet qualities were brix, pol, ERS, and juice purity which ended in more sugar yield for 150 and 165 days of crop age.

The data in Table (4) showed that many cultivars gave satisfactory good root yield, sucrose %beet and sugar yield. In details: root yield ranged from 80 to more than 90 ton ha^{-1}, sucrose ranged from 16 to more than 18 %beet and the sugar yield ranged from 10 to 14 ton ha^{-1}. These yields were comparable and sometimes exceeded the corresponding world values of sugarbeet production. It was thus decided that four cultivars were approved for commercial production of sugarbeet in Sudan, given the names Lenard, Ballade, Dorotea and Valentina.

CONCLUSION

The field research experiments on sugarbeet in Sudan have given promising results with respect to beet yield and sugar quality. These results are comparable to those of sugarcane and they have encouraged the decision makers to consider the introduction of sugarbeet as a second crop in the sugar industry in Sudan.

Sugarbeet has some merits over sugarcane. These merits are the shorter growing season, lower consumption of irrigation water and lower fertilizer

dosages compared to those of sugarcane in addition to its probable success in marginal lands and its probable accommodation in the crop rotations of large schemes such as the Gezira, Rahad and New Halfa. Sugarbeet can also be planted in some locations in the present sugar schemes taking advantage of sugarcane baggasse as a source of energy.

Based on the experience gained from the execution of these field experiments, some necessary issues have been confronted and need to be appropriately addressed. These issues include, but not limited to, diversification of the sources of the sugarbeet seeds, better understanding of the cultural practices of the crop, viz: sowing date, mechanical planting and harvesting, use of agrochemicals, and processing of the crop.

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