

Sugarbeet: Can it be a Potential Feed Stock for Ethanol Production in India?

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Abstract: After achieving blending of ethanol[*at*]12% in petrol during the Ethanol Supply Year 2022 - 23, during the current & subsequent years meeting the blending targets appears challenging due to multiple issues associated with the availability of sugarcane and grains, there is dire need for developing alternate feed stocks to achieve the target of producing 10, 000 + million liters of ethanol to make EBP20 a success. Sugarcane production and crushing since always witnesses surges and even with sugarcane crushing[*at*]350 million tonnes it is to be too optimistic to think of achieving the blending target of 20% unless ethanol' is made available through other sources. Sugar Beet may be one such crop which has the promise to become a potential feed stock for ethanol production in future if climate resilient indigenous varieties are developed.

Keywords: sugar beet, ethanol, blending, climate

1. Introduction

Sugar Beet is a temperate crop, botanically known as *Beta vulgaris L.* It belongs to family *chenopodiaceae*, the spinach family. It is a man - made crop and is the product of human selection from fodder beet for higher sugar content. The impetus for the development of Sugar Beet in Europe came when there was an embargo on the import of sugarcane sugar during the world war.

Sugar Beet is a temperate crop and is mainly cultivated in cold countries where sugarcane cultivation is not feasible. Out of the total sugar production in the world, 27% sugar is produced from sugar beet. Some countries in sub - tropics also have taken up sugar beet cultivation. India is in search for feed stocks other than those from sugar industry & grains to cope up with the requirement of ethanol for Ethanol Blending Programme. Out of the various feed stocks being considered viz. Sweet Sorghum, Cassava, Sweet Potato & Cellulosic feed stocks, etc., Sugar Beet appears to hold promise to become a potential feed stock, producing ethanol directly from juice. There are challenges as regards climatic conditions, seed availability and market assurance but the crop scores many points over the Sugarcane crop with respect to crop duration, irrigation water requirement and sugar content. Sugar Beet is one of the three crops (sunflower and soybean being the other two) which were introduced in India around the same time after independence i. e. in 1950s. While the other two have now established themselves commercially in India, Sugar Beet is still to contribute significantly to the Indian agricultural scenario.

Sugar Beet is the last of the trio whose potential still remains unexplored in India. However, there is a buzz in the country over Sugar Beet cultivation during the last few years both in the tropical and sub - tropical regions for producing ethanol and trials have been conducted by various organization including National Sugar Institute, Kanpur who also assessed the strength and weaknesses of the Sugar Beet crop. In the present article, the author has tried to bring forth various aspect related to Sugar Beet cultivation in the country and its possible use for ethanol production only as the country is

already surplus in sugar production from the last several years.

Global Sugar Beet Scenario

The scenario with respect to Sugar Beet production, yield and area under cultivation is given in the table no.1 - 3. As regards cultivation of Sugar Beet in terms of quantities are area under cultivation, It may be seen from Table No.1 that top five countries are Russia, France, Germany, USA and Turkey. However, as regards yield of Sugar Beet per hectare, as per data reported by FAO - 2019, highest yields have been reported by Chile, to the extent of approx.102 MT/Ha.

Table 1: Top Countries in Sugar Beet Yield MT Per Hectare - 2019

S. No.	Countries	Yield (MT/Ha)
1	Chile	101.66
2	Spain	91.21
3	Belgium	88.04
4	France	85.14
5	Netherlands	83.92
6	Switzerland	82.86
7	Denmark	80.69
8	Sweden	74.70
9	Canada	72.89
10	Germany	72.74

Table 2: Top Countries in Sugar Beet Production (Metric Tons) - 2019

S. No.	Countries	Quantity (MT)
1	Russia	54, 350, 115.00
2	France	38, 024, 390.00
3	Germany	29, 728, 300.00
4	United States	25, 945, 480.00
5	Turkey	18, 085, 528.00
6	Poland	13, 836, 620.00
7	China	12, 272, 900.00
8	Egypt	10, 525, 138.00
9	Ukraine	10, 204, 530.00
10	United Kingdom	7, 721, 789.04

Table 3: Top Countries in Sugar Beet Harvested Area (Hectares) - 2019

S. No.	Countries	Area (Hectares)
1	Russia	1, 133, 253.00
2	France	446, 600.00
3	Germany	408, 700.00
4	United States	396, 310.00
5	Turkey	310, 100.00
6	Poland	240, 780.00
7	China	223, 357.00
8	Ukraine	221, 300.00
9	Egypt	207, 527.00
10	United Kingdom	108, 709.00

Sugar Beet- The Indian

Context

The Sugar Beet crop was introduced in the country earlier with the object of augmenting for sugar production looking to cyclic ups & down of sugarcane production at that time. In 1960s, extensive exploratory trials were conducted all over the country to find out suitable area of root and seed production. Based on the preliminary trials, it was felt that Sugar Beet could be grown during winter in North India, while Kashmir valley and hills such as Darjeeling and Shimla were found suitable for seed production. To strengthen the research and development activity, an All India Coordinated Research Project on Sugar Beet was launched in 1971 by the Indian Council of Agricultural Research with centers at Lucknow, Pantnagar, Sriganaganagar, Phaltan, Jalandhar and Kanpur. Later on, Kalyani in West Bengal, Solan in Himachal Pradesh and Mukteshwar in Kumaon hills were added to the list. At the same time, a Sugarcane - cum - Sugar Beet (600 TBD) plantation white sugar factory was established at Sriganaganagar in Rajasthan. which used to process Sugar Beet after end of sugarcane processing.

Sriganaganagar provided the testing ground of the production and processing technology. India opted for self - reliance for

Sugar Beet seed and an open - pollinated, diploid Russian variety namely, *Ramonskaya* - 06 (R - 06) was found suitable for Indian conditions along with some other anisoploid varieties from Europe. The seed production of R - 06 was successfully undertaken by The National Seeds Corporation in Srinagar and later on the same was shifted to Himachal Pradesh. The crop was a pretty success with the farmers and factory.

Sriganaganagar Sugar Mills had a commercial run of almost over thirty years when the factory was closed due to reasons not exclusive to Sugar Beet. One of these, however, was the trade liberalization which closed the remunerative disposal of Sugar Beet molasses to a Mumbai - based pharmaceutical company. The best average root yield obtained during the run was 39 t/ha and a sugar recovery of 11.32%. It may be borne in mind that this was made possible without the best available varieties and agricultural practices. As per the studies conducted at that time, the Sugar Beet crop was found to be the most remunerative rabi crop as compared to wheat and mustard.

Sugarcane production in country has seen many ups and downs, sometimes brought about by failure of rains, but more often due to issues related to payments of sugarcane supplies. In early 2000s and during the period 2012 - 2015, many southern states were reeling under consecutive droughts leading to insufficient cane supplies to the factories and at this juncture, some multinational Sugar Beet seed companies came out with tropicalized Sugar Beet varieties and a need was felt to conduct feasibility trials. The work done at the five centers with two of these in Maharashtra, showed that Sugar Beet could be grown successfully from October to May. The possibility of having more than one crop a year was also not ruled out under tropical agro - climates. The package of practices along with the suitable varieties was developed. The potential for root was observed to be 60 - 80 t/ha with a sugar content in the roots of 13 - 15 %. The following table no.4 gives the performance of Sugar Beet varieties with respect to yield and sucrose content reported from diverse seed sources:

Table 4: Results of trials of various Sugar Beet varieties

S. N.	Varieties	Sucrose Content (%)		Root Yield (t/ha)		Gross sugar 180 DAS* (t/ha)
		150 DAS*	180 DAS*	150 DAS*	180 DAS*	
1	LK - 27	13.05	14.93	78.22	67.92	10.868
2	LKC - 95	12.71	14.98	76.00	65.05	11.058
3	SYT - 06 - 07	14.26	16.40	84.79	70.99	10.807
4	SYT - 06 - 13	14.50	16.67	75.37	69.24	10.890
5	IN - 06	14.13	16.06	90.77	69.33	9.566
6	IN - 07	14.28	15.76	65.27	61.32	10.248
7	PAC - 60002	14.88	17.14	81.49	70.62	11.444
8	PAC - 60006	13.56	16.18	72.20	66.97	11.097
9	FELICITA	13.07	15.19	84.63	80.82	11.728
10	RASOUL	13.38	14.88	64.86	55.56	9.044
11	LS - 6	13.14	16.22	82.77	70.42	11.484
12	SHUBHRA	13.78	17.67	93.59	77.77	13.253
	Mean	13.73	16.01	79.16	68.83	10.957

* DAS – days after sowing

Such trials were carried out at National Sugar Institute, Kanpur on several Sugar Beet varieties, namely LS - 6, SZ - 35, PAC - 60008, LKC HB, LKC LB and LKC 2006. The yield was estimated to be about 80 tonnes per hectare although the same was varying to significant extent from one

variety to another. The beet juice was also assessed for the ethanol production potential and the same was observed to be about 80 - 100 liters per ton of Sugar Beet on laboratory scale. It was also observed that under the similar agro - climatic

conditions few varieties LKC HB, LKC LB and LKC 2006 didn't perform.

The Recent Indian Scenario

The changing bio - fuel scenario in the country aiming at ethanol blending target of 20% by 2025 has started looking at Sugar Beet for ethanol production. Several sugar factories in Andhra Pradesh, Maharashtra, Karnataka and Punjab gave Sugar Beet trial, after having been convinced of its agronomical feasibility through in - house crop experimentation. In this, a key role has been that of some of the institute e. g. Indian Institute of Sugarcane Research & that of the multinational Sugar Beet seed companies, such as Syngenta, SES Vanderhave and KWS through their Indian operations. These companies are still active in providing the know - how, seed and guidance in growing and handling of Sugar Beet which also involves their commercial interest looking to possible vast Indian market. The SDF financed the fabrication and setting up of a pilot plant for Sugar Beet processing at Samarth SSK Ltd. in Maharashtra, while it was taken up by some other private factories too of their own to assess the economics of Sugar Beet cultivation and ethanol production, but could not be taken forward due to multiple issues including sustainable performance of crop.

As regards, use of Sugar Beet for Sugar production is concerned trial was taken up during 2006 - 07 at M/s Samarth SSK Ltd, Ankushnagar, Jalna, Maharashtra by processing Sugar Beet juice with sugarcane juice but was abandoned later on. Presently, M/s Rana Sugar Ltd., Punjab has taken up Sugar Beet cultivation for sugar production, however not much information is available about farm & factory productivity.

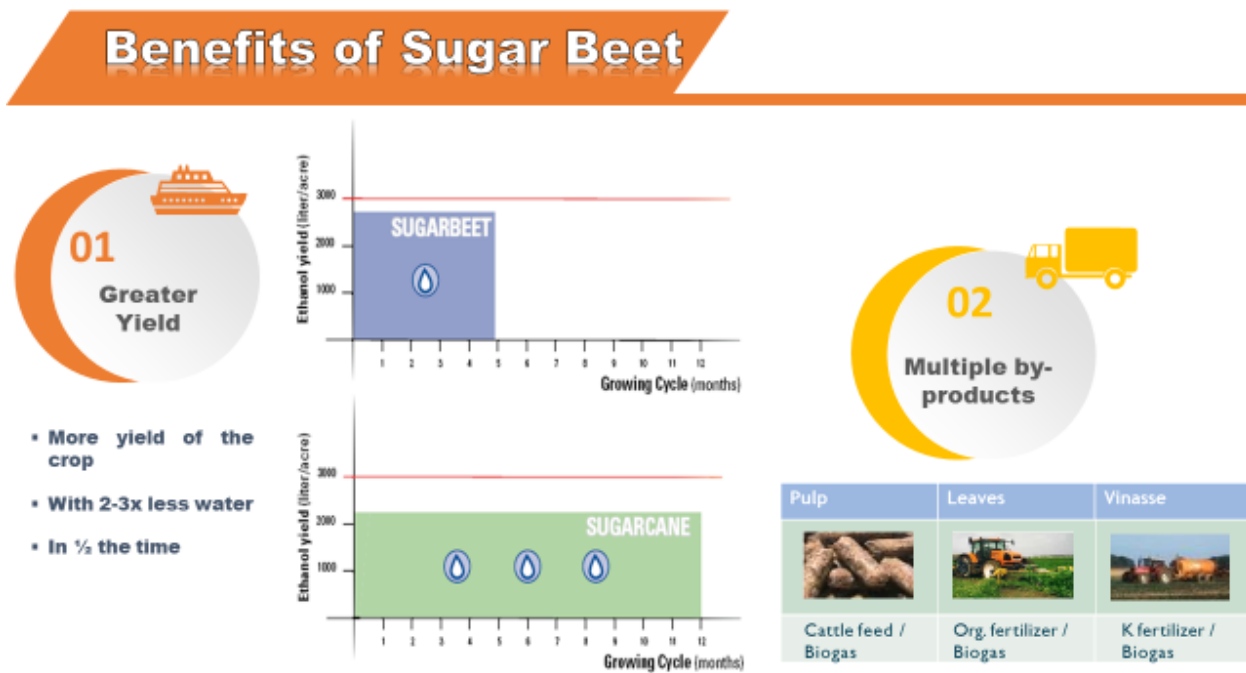
The Need for a Stimulus

The history of Sugar Beet development in Europe and the USA and also at Sriganaganar (Rajasthan) in India shows that unless there were incentives given by the Government, Sugar Beet could not be a success. In Sriganaganar, it was the extra canal water provided for every acre of Sugar Beet and the assured purchase of Sugar Beet by the sugar factory was a big attraction. On the similar lines, farmers need to be attracted to the crop through other such incentives. Being an industrial crop, at the first instance Government may provide financial assistances for the establishment of Sugar Beet processing units particularly for producing ethanol as it was provided to sugar industry feed stock based & grain based ethanol units earlier.

A contract for the timely purchase of the entire produce has to put in place as being practical for sugarcane & thus a greater understanding & bonding between the distillers & Sugar Beet growers shall be required where in central & state governments to plan their role by way of policy framework with respect to procurement price etc. Further, support for availability of seed, fertilizers and pesticides along with technical guidance in raising the crop has to be provided. The central and state agricultural extension and development machinery has to make an all - out effort to be equal partners with the farmers and the factory to lend the necessary support with their active presence and post - harvest management of the produce in fact it can move forward only after putting an ecosystem at place.

The Positives and Pitfalls

Sugar Beet has been shown to be agriculturally feasible under Indian conditions. It has the potential sugar yield comparable or even better to sugarcane in half the time with water saving of 30 - 40%.



Some suitable varieties have been identified and the production technology has been developed. The mechanization of sowing operation is at place & can be

implemented as per local conditions. As we go along and gain experience of growing it in specific locations, innovative refinements in crop and produce management shall have to be

introduced. In fact, working models for successful cultivation of Sugar Beet are already available in countries like Egypt, Morocco, Iran Pakistan, EU and North America, which have a wide range of agro - climatic conditions and from largely manual to totally mechanized making precision farming. India is endowed with a wide range of climatic conditions which allow us to be self - reliant in Sugar Beet seed production. However, the availability of seed of the desired varieties shall have to be assured. This could be the first & most important factor & preferably the seeds should be indigenous one's not banking up overseas multinational companies. A business model has to be developed in the form of contract farming where various stakeholders commit themselves to their specific role in the entire venture. This was being done at Sriganaganagar among farmers, factory and seed companies. As mentioned earlier the state government has to play the role of a facilitator and observer for fair play by various stakeholders.

Thus, Sugar Beet has all the potential to become a viable biofuel crop in India. Most of the components are already worked out and can be integrated in a mission mode with the appropriate government policy, industrial entrepreneurship and committed agricultural department. It may also be mentioned that Sugar Beet has an in - built tolerance to saline and alkaline soil conditions. It is therefore capable for bringing under plough and reclaim vast tracks of salt affected soils in the country, estimated to be around 6.7 million hectares. For integrating Sugar Beet with the existing cropping pattern, a lot of work has been done and this may be tailored to suit the new locales. It can easily be grown as an intercrop with sugarcane to increase sugar productivity per unit time and area.

As mentioned earlier the crop has potential for utilization of Sugar Beet juice for industrial fermentation so as to produce ethanol. Successful trials are reported to have been carried out by some sugar companies but the projects could not be pushed further for want of Sugar Beet quality and want of seeds. However, processing of Sugar Beet shall require additional machinery, particularly at juice extraction stage.

2. Conclusion

Efforts are being made from the last two decades to establish Sugar Beet as an industrial & Biofuel crop but as yet it has not proved its worth on commercial scale. Major area of concern is availability seeds of desired sugar beet variety produced indigenously and the major thrust is being given by the overseen seed companies to capture the vast market. As observed. many varieties failed to deliver results on sustainable basis due to abrupt changes in climatic conditions as a result of "Global Warming," Despite many factors been in favour, this remains a challenge. Other issues can be resolved and are not considered as a deterrent in establishing Sugar Beet as a Biofuel crop.

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