Sugar beet: A complement to sugar cane for sugar and ethanol production in tropical and subtropical areas†

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abstract

Twenty years ago, it would have been considered impossible growing sugar beet in tropical regions. The climate and the lack of know-how of local farmers were all limiting factors for the sugar beet crop. But times have changed, thanks to sugar beet seed breeders such as SESVanderHave. Significant efforts have been recently done to introduce sugar beet in regions where it has now a limited presence as a commercial crop. In field trials in India during 2007-2009 at ten sites beet yields of between 68 t and 106 t/ha was achieved with sucrose content of 20% on average. However, perhaps the key obstacle to the rapid introduction to beet production and beet sugar processing in cane factories in tropics is the rather heavy capital investment to upgrade factories to allow them to process sugar beet. But the need to increase the sugar and ethanol production level for many developing countries, the need to diversify the crop portfolio to reduce production costs and to secure the supply in factories, as well as the extraordinary yield potential of sugar beet has increased the interest for the use of sugar beet in new markets. Therefore, SESVanderHave has invested heavily in the development of tropical sugar beet, especially in India, where the company has set up its own research programmes with local research institutes and farmers.

Keywords: sugarbeet production, tropics

Remolacha azucarera: Un complemento a la caña azucarera para la producción de azúcar y de etanol en las áreas tropicales y subtropicales

Hace veinte años se hubiera considerado imposible cultivar remolacha azucarera en regiones tropicales. El clima y la falta del conocimiento práctico de los agricultores locales era un factor limitante total para el cultivo de la remolacha azucarera. Pero los tiempos han cambiado, gracias a los productores de semilla de remolacha azucarera tales como SESVanderHave. Recientemente se han hecho considerables esfuerzos para introducir la remolacha azucarera en regiones donde ahora tiene una limitada presencia como cultivo comercial. En pruebas de campo en la India, en diez lugares durante 2007-2009, se consiguieron rendimientos de remolacha de entre 68 t y 106 t/ha con un contenido promedio de 20% de sacarosa. No obstante, quizás el obstáculo clave para una rápida introducción en los trópicos de la producción de remolacha y del procesamiento de la remolacha azucarera en ingenios de caña es la importante inversión de capital necesaria para mejorar las fábricas para permitirles el procesamiento de la remolacha azucarera. No obstante, la necesidad de muchos países en desarrollo de aumentar el nivel de producción de azúcar y de alcohol, la necesidad de diversificar la cartera de cultivos para disminuir costos y asegurar el suministro a las fábricas así como el extraordinario rendimiento potencial de la remolacha azucarera, han aumentado el interés en el uso de la remolacha azucarera en nuevos mercados. En consecuencia SESVanderHave ha invertido fuertemente en el desarrollo de la remolacha azucarera tropical, especialmente en la India, donde la compañía ha establecido sus propios programas de investigación con institutos de investigación y agricultores locales.

Beterraba sacarina: Um complemento a cana-de-açúcar para a produção de açúcar e etanol em áreas tropicais e subtropicais

Vinte anos atrás, seria considerado impossível cultivar beterraba sacarina em regiões tropicais. O clima e a falta de conhecimento dos agricultores locais eram fatores limitantes para a cultura da beterraba sacarina. Mas os tempos mudaram graças aos desenvolvedores de sementes como o SESVanderHave. Importantes esforços foram feitos recentemente para introduzir a beterraba sacarina em regiões onde ela tinha presença limitada como uma cultura comercial. Em experimentos de campo em dez locais na Índia de 2007-2009 foram obtidos rendimentos de beterraba entre 68 t e 106 t/ha com teor de sacarose de 20% em média. No entanto, talvez o maior obstáculo a introdução rápida da produção de beterraba e o processamento do seu açúcar em indústrias canavieiras nos trópicos é o investimento pesado necessário para atualizar as fábricas para permitir o processamento da beterraba sacarina. A necessidade de aumentar o nível de produção de açúcar e etanol em muitos países em desenvolvimento, a necessidade de diversificar o portfólio de culturas para reduzir os custos de produção e garantir o abastecimento nas fábricas, assim como o potencial de rendimento extraordinário da beterraba sacarina levaram a um aumento no interesse no uso da beterraba em novos mercados. Portanto, a SESVanderHave tem investido fortemente no desenvolvimento de beterraba sacarina tropical, especialmente na Índia, onde a empresa criou o seu próprio programa de pesquisa com institutos de pesquisa locais e agricultores.
India’s urgent need for energy requires sugar beet

India’s economy is one of the fastest developing in the world. As the population grows steadily, the demand for energy is intensifying every day. The country is already importing about 70% of its petrol requirement. Therefore India is desperately looking for alternative and renewable sources of energy. In this process, ethanol as a transport fuel is likely to play an important role. India already has a small ethanol industry based on molasses. However, this feedstock is only available in short supply and feedstock alternatives have to be found. Because of the Brazilian ethanol model, sugar cane is often looked up as the most promising feedstock for ethanol. During the past couple of years, however, India has regularly faced shortages of sugar cane which has led to significant sugar imports. In addition, analysts expect sugar consumption in India to increase approximately by 50% in the next 10 to 15 years (from 20 Mt in 2005 to 32 Mt in 2020) which will already put a lot of pressure on the cane crop. Under such circumstances, it becomes urgent for India to analyze the possibility of growing other sugar-rich crops as a complementary raw material for sugar and ethanol production.

The sugar beet plant (Beta vulgaris) originates from the coastal areas in the Mediterranean regions and extends in the Northern coastal area, where it has always been considered as a very stable and productive crop, as well as an excellent head of the rotation. In people’s mind, sugar beet is unfortunately not adapted to warmer regions of the globe such as India. However, the recent development of sugar beet varieties able to grow in the tropics and the subtropics is about to change this belief. Traditional sugar beet perform very well in extreme American and European locations (Southern California, Southern Spain, Southern Italy, etc.) where yields up to 25 tons of white sugar per hectare can be reached under practical farming conditions. Long seasons and a very good conversion rate of incoming sun energy into root dry matter and especially sucrose are factors contributing to the high yield potential. Within this genetic pool, hybrids were selected for their tolerance to heat and to diseases occurring in the tropics; with success.

The key advantages of sugar beet in comparison with sugar cane are well-known: a shorter growing cycle (around 5 months), a lower water requirement (about 1/3 to 1/2 of the water needed to grow sugar cane) and a slightly higher sugar and ethanol yield.

Figure 1. The fungus Sclerotium rolfsii may cause severe root rots on sugar beet in tropical and subtropical areas

Figure 2. Sugar beet in India has shown a tremendous yield potential in some trial locations of the Maharashtra state in India
Sugar beet: A complement to sugar cane for sugar and ethanol production in tropical and sub-tropical areas

Studies by SESVanderHave with tropical sugar beet commenced in India in 2005 (Figure 2); both by agricultural research institutes and sugar factories (Figure 3). These studies have shown that sugar beet yields with high sugar contents can be achieved. Tests are now in a semi commercial stage to introduce the sugar beet as a commercial crop.

Also in other tropical and subtropical regions, sugar beet has shown excellent results. In the Australian continent, several tests have been made with very interesting results. The water use efficiency of the crop was in several cases the trigger to start these experiments. In Indonesia, some experiments have been running to use sugar beet as an off season crop for sugar production. The idea was to produce a product comparable to red sugar of cane at the farmers’ place and to collect this product when the roads are accessible after the rain season. In the highlands of Africa and South America there are large areas with temperatures very comparable to the temperate zones, where sugar beet could appear to be very efficient in the conversion of the very intense sun energy. Most optimal are the sub-tropical regions with a wet and dry season where sufficient water is available.

Table 1. Sugarbeet yield and brix results from 10 trial locations spread across the Maharashtra state in India (presented as the mean of 2 growing seasons 2007-08 and 2008-09). Harvest was done 150 days after sowing (VSI, 2009)

<table>
<thead>
<tr>
<th>Location</th>
<th>Yield (t/ha)</th>
<th>Brix (%)</th>
<th>Yield (t/ha)</th>
<th>Brix (%)</th>
<th>Yield (t/ha)</th>
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<td>79.9</td>
<td>20.9</td>
<td>60.1</td>
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<td>59.5</td>
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<td>22.9</td>
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<td>81.3</td>
<td>21.0</td>
<td>69.4</td>
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<td>79.2</td>
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Challenges can be overcome

There are also challenges ahead for the sugar beet crop, which can be overcome by intensive research. Moving sugar beet from one area to the other and especially when moving to the hotter areas with often suboptimal conditions of irrigation, several new diseases can appear, for which not always the proper resistances or chemical treatments are yet known. The effects of the well known pests and diseases (Figure 1) can be more severe under hotter and higher moisture regions. Besides agronomic improvement, chemical and genetic solutions have to be developed and improved to secure stable yields needed for the application of sugar beet as a significant agricultural crop.

Positive experiences

Together with the Indian research institutes, SESVanderHave has demonstrated that growing sugar beet in a country like India is feasible from an agronomic point of view. There is large potential to apply sugar beet as a profitable crop outside the current regions of production. To exploit these opportunities, significant investments per acre (2.500 to 3,000 liters of ethanol per acre). In addition, sugar beet tolerates well mildly saline soils, provides a variety of co-products, that can be used to produce biogas (tops and leaves, vinasse) pulp could be also used to produce biogas in some sugar beet factories such as Agrana in Hungary or cattle feed (pulp and molasses). In comparison with sugar cane, sugar beet also allows farmers to have a crop rotation, which is probably one of the easiest and most efficient ways to maintain soil fertility and to better control pests and diseases pressure. Finally, by processing sugar beet after or before the sugar cane campaign, factories can stretch their operations over a longer period of time and reduce their production costs.

Conclusion: Sugar beet will be part of the future in India
Figure 3. In 2010 SESVanderHave launched its first series of courses for local farmers, teaching them how to grow sugar beet in India.

in the identification of appropriate agronomic practices and specific genetic tolerance to the types of pests found in the local environment are needed. In addition, considerable financial inputs are at stake to realize an adequate processing structure; which may require political support at some point.

In fact, as long as adapted hybrids are cultivated, performances comparable to the most productive EU countries can be achieved in a shorter period of time: SESVanderHave’s results show that the crop had already reached important yields after 5 months in India, whereas in Europe sugar beet usually stays between 6 to 8 months in the ground to reach an equivalent performance. For sure: sugar beet will be part of the future in India.

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