Sugar beet growing in the Netherlands

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Introduction
The total area of the Netherlands amounts to 3.4 million hectares, of which about 56% (= 1.9 million hectares) is used for agriculture and horticulture. Of this, 51% is used for grazing livestock, 6% for horticultural holdings, and 43% for arable farming. In 2004, out of the total area for arable farming of about 820,000 ha, 253,676 ha was used for growing maize, 195,842 ha for cereals, 163,905 ha for potatoes (seed, ware and starch) and 97,736 ha for sugar beet.

In the Netherlands the climate is very mild, with summertime day temperatures of about 20 degrees Celsius, and the number of days with severe frosts during winter is low. In some years, night frost in spring can damage sugar beet, especially on reclaimed peat soils. In autumn night frosts and rainy weather make the sugar beet grower harvest the crop by about mid-November at the latest. The average rainfall is about 780 mm/year is spread regularly over the year. In the Netherlands sprinkler irrigation is applied to some of the sandy soils in dry summers. It is not necessary to irrigate every year and if irrigation is needed sugar beet is the second or third crop to treat after horticultural crops or potatoes.

Sugar beet is grown all over the Netherlands on about 95,000 ha, with a range of different soil types, from sand and reclaimed peat to heavy clay soils.

Much attention is paid to increasing the yield and the quality of sugar beet. In 1950 a good yield in the Netherlands was about 35 tons per hectare, while recently average root yields have been 60 tons per hectare with an average sugar content of 16%, so an average sugar yield of nearly 10 tons per hectare is quite common. In good years, like 1992, 2003 and 2004, the average sugar yield exceeded 10 tons per hectare.

The number of sugar factories reduced drastically during the last century. Today we have two sugar companies, a co-operative, Royal Cosun, with two factories, and a private company, CSM Sugar, with one factory. 62.5% of the sugar beet crop is delivered to Royal Cosun and 37.5% to CSM Sugar. Both companies also have other activities. Royal Cosun deals with processing other crops, like potatoes, chicory, vegetables and onions; CSM plays an important role on the Dutch and international market for bakery supplies and food ingredients. The Dutch sugar factories are modern and have slicing capacities between 15,000 and 18,500 tons of beet per day. The sugar beet price depends on the internal and external quality of the sugar beet.

The Dutch sugar industry’s processing campaign normally starts mid-September and ends around Christmas.

Dutch arable farms are mostly small and private. The size of the holdings runs from about 30 ha to about 100 ha, with an average of 55 ha. The farmer and his family do the daily work, but for special jobs they need the help of a contractor (e.g. cereal and sugar beet harvesting). The average area of sugar beet per farm is 7.0 ha and 70% of the sugar beet is grown on arable farms (Table 1).
Table 1. Farm type and mean area of sugar beet per type of agriculture in 2003.

<table>
<thead>
<tr>
<th>type of agriculture</th>
<th>area of sugar beet (ha)</th>
<th>% farms</th>
<th>mean area of sugar beet per farm (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total area of sugar beet (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-3</td>
<td>3-7</td>
<td>7-10</td>
</tr>
<tr>
<td></td>
<td>10-15</td>
<td>&gt;15</td>
<td></td>
</tr>
<tr>
<td>arable farming</td>
<td>72,572</td>
<td>70.6</td>
<td>19.2</td>
</tr>
<tr>
<td>horticulture</td>
<td>2,185</td>
<td>2.1</td>
<td>42.7</td>
</tr>
<tr>
<td>fruit farming/orchard</td>
<td>678</td>
<td>0.7</td>
<td>57.0</td>
</tr>
<tr>
<td>pasture farming</td>
<td>8,030</td>
<td>7.8</td>
<td>41.5</td>
</tr>
<tr>
<td>poultry/pig farming</td>
<td>2,301</td>
<td>2.2</td>
<td>53.9</td>
</tr>
<tr>
<td>mixed crop</td>
<td>6,026</td>
<td>5.9</td>
<td>25.2</td>
</tr>
<tr>
<td>mixed pasture</td>
<td>1,234</td>
<td>1.2</td>
<td>40.9</td>
</tr>
<tr>
<td>mixed crop/pasture</td>
<td>9,761</td>
<td>9.5</td>
<td>29.4</td>
</tr>
</tbody>
</table>

Source: CBS (Central Statistical Office).

Drilling sugar beet

In the Netherlands, 100% of the seed is natural monogerm sown by 6, 12 or 18 row precision drills at a spacing of about 18-20 cm with a distance between the rows of 50 cm. The quality of the seed is excellent because the germination rate in the laboratory is between 95 and 100% and the seeds have an excellent drilling performance. On request IRS tests the suitability of seed lots for precision drilling. A normal plant emergence in the field is about 70-80% and Dutch growers try to achieve about 80,000 plants per hectare.

The sugar industry buys the seeds from the breeders and sells it to the growers, and since 1992 growers can only buy pelleted seeds treated with crop protection products like fungicides and insecticides.

Seeds from a number of breeding companies are sold: KWS, VanderHave, SES, Strube-Dieckman, Syngenta/Hilleshög, Danisco, Lion Seeds and Kuhn. New varieties are placed on the Recommended Variety List after a three years test period, provided they perform better than the four best varieties of the existing list. Better means a higher financial yield, but in some cases other special qualities, like sugar content, are also taken into account.

Table 2. Percentage of resistant varieties in the period 1998-2005.

<table>
<thead>
<tr>
<th>year</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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</thead>
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<tr>
<td>without specific resistance</td>
<td>72</td>
<td>65</td>
<td>56</td>
<td>46</td>
<td>36</td>
<td>26</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>rhizomania resistant</td>
<td>28</td>
<td>34</td>
<td>44</td>
<td>54</td>
<td>64</td>
<td>74</td>
<td>84</td>
<td>91</td>
</tr>
<tr>
<td>rhizoctonia resistant*</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>5</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>cercospora resistant*</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>nematode resistant*</td>
<td>-</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: sugar industry seed orders.
* rhizoctonia, cercospora and nematode resistant are multiple resistant varieties as in addition to their specific resistance, they are also rhizomania resistant.
In the Variety List the various important parameters, such as root yield, sugar content, K, Na and amino-N content, soil tare and so on are reviewed, and in addition a relative figure is given for the financial result of the varieties based on the Dutch sugar industry’s payment system. Variety choice is mostly based on the resistance needed and the financial result within the resistance category, with high sugar content as an important second factor. The concentration of crop protection products in the pelleted seeds is checked by IRS, so the grower has a guarantee of the quality of the seed. At the end of the year the sugar industry sends a form on which the grower can order the variety, number of seed units and treatment of the seed. After receiving the orders the sugar industry contacts the different seed companies to prepare and deliver the seed.

**Crop protection**

*a. Weed control*

In most areas of the Netherlands growers use the so-called ‘low-dosage system’ to control weeds, in which small amounts of chemicals are used on small weeds. By applying this system, growers get good weed control with a very low use of chemicals. Under Dutch conditions a normal weed population in sugar beet fields is controlled by a combination of 0.5 litre per hectare of products containing phenmedipham, metamitron and ethofumesate plus an additive, and on average 3-4 herbicide applications are made each season.

*b. Control of pests and diseases*

The sugar beet crop has to deal with a range of pests and diseases. All sugar beet seed used in the Netherlands is treated with 8 g TMTD (4 g thiram) per unit of seed to control fungi on the seed and 21 g Tachigaren (14.7 g hymexazol) against the soil fungus *Aphanomyces*. Both TMTD and Tachigaren control the soil fungus *Pythium*. In 2005 about 75% of the Dutch sugar beet seed was treated with 90 grams per unit imidacloprid (Gaucho) to control high densities of different soil borne insects as well as leaf attacking insects. From the other 25% about 72% was treated with 5 grams per unit methiocarb (Mesurol) to control low densities of soil borne insects while the remainder was not treated with an insecticide. Rhizomania and nematodes are widespread in the Netherlands. Out of the total area, 60% is infested with beet cyst nematodes while 90% is infested with rhizomania and 15% with Rhizoctonia. Damage due to rhizomania can be avoided by using resistant varieties while using Rhizoctonia and nematode resistant varieties diminishes the damage from Rhizoctonia and nematodes, respectively.

As in many other countries, the sugar beet crop can be infected by virus yellows, which is transmitted by aphids. Gaucho gives indirect protection for a period of about eights weeks against aphids and virus transmitted when the aphids feed on the leaves. *Rhizoctonia solani* is an increasing and extending problem, which causes very poor development and even complete yield loss of sugar beet and some other crops. A fine-tuned rotation and the use of Rhizoctonia resistant varieties can limit the damage. *Cercospora beticola* is the main foliar disease, and sugar yield reductions up to 40% have been observed. The disease was only prevalent in the south-eastern part of the country for many years, but in the last four years it has spread all over the Netherlands. Other foliar diseases such as mildew, rust, and Ramularia are increasing in prevalence and also cause yield reductions. The four foliar fungi can be controlled using difenoconazole (250 g/l). The
other approved fungicide benzimidazole is registered only for the control of Cercospora and in many areas resistance to benzimidazoles has been observed.

c. Limitations on agrochemical use

To produce high yields of high quality products reasonable amounts of crop protection products are needed to control pests and diseases in horticulture and agriculture. To reduce the total amount of crop protection products a multi-year crop protection plan was agreed in the late eighties between the government, growers’ organisations and some non-governmental organisations. Between 1990 and 2000 the total amount of crop protection products applied was reduced by 50% and new plans to increase sustainability are being discussed. Since 2005 all sugar beet growers have had to be certified for food safety. To guarantee this, third party audits are carried out to check whether growers stick to a check-list, issued by the sugar industry, the most important points of which are related to crop protection.

Payment system for sugar beet

For the sugar industry it is important to receive beet of good quality. Therefore the sugar industry encourages growers to produce high quality beet through a quality control system at the factory reception, and by paying for sugar beet according to its quality.

Quality determination and payment system

In the Netherlands sugar beet payments are based on tonnage, sugar content, extractability (WIN) and the amount of tare delivered to the factories. The different factors are measured at the beet reception according to uniform rules agreed with the sugar beet growers. The whole system is checked by an independent specialist from IRS, by representatives of the growers and by sugar company specialists.

Quality components

a. Sugar content

The sugar content is measured by polarisation from samples of about 40 kg of beet, taken at random from the lorries, and the sugar beet is paid for on the basis of sugar content. Today the sugar industry pays a premium or levies a penalty of 9% per tonne per percent of sugar higher or lower than 16. The industry is trying to encourage growers to deliver beet with reasonable sugar content, so a system has been developed in which the price deduction gets larger as the sugar content gets below 15% with a further reduction at 14.5% (Figure 1).

Figure 1. Bonus/penalty payment based on sugar content.
b. Extractability (WIN)

It is impossible to extract 100% of the sugar from sugar beet and extractability is influenced by a number of factors. The industry likes to process lots of sugar beet with a constant high extractability as big differences between the quality of different loads have a negative influence on daily factory capacity and hence on production costs. For assessing extractability, different European countries use slightly different formulae. In the Netherlands the following WIN formula is used:

\[
\text{WIN} = 100 - 3.42 \frac{(K+Na)}{\%S}, \text{ if } K+Na-aN \geq 35
\]

\[
\text{WIN} = 100 - \{1.42*(K+Na)+2*aN+70\} \%S, \text{ if } K+Na<35
\]

In this formula \(\%S\) = sugar content expressed as a percentage of beet, \(K+Na\) = potassium plus sodium expressed in mmol per kg beet and \(aN\) = amino nitrogen expressed in mmol per kg beet. The grower gets a bonus at high WIN and a deduction at low WIN. Figure 2 shows the bonus/penalty system, neglecting the small differences between the two Dutch sugar companies.

![Figure 2](image)

**Figure 2.** Bonus/penalty payment based on WIN (extractability).

c. Soil tare

In the Netherlands soil tare percentage is reasonably low and has decreased in the last 35 years (Figure 3).

![Figure 3](image)

**Figure 3.** Dutch soil tare in relation to white sugar produced in the period 1970-2004.
Every year a tremendous amount of soil is delivered to the factories. Transport costs of the soil to the factory, cleaning the beet, handling and storage of the soil at the factory site and removal of the soil, costs about €26 million per year: almost €250 per hectare of sugar beet. Due to high and rising costs, the Dutch sugar industry tries to encourage the growers and contractors to deliver clean beet. One of the measures taken to attain this is a payment system for the soil delivered to the factory. At the moment the contribution per tonne of soil is about €12.25. Before payment 65 kg of tare per net tonne of beet, is subtracted from the total tare including top and other tare.

Sugar beet fertilization

*Nitrogen* has an important influence on yield, sugar content and sugar extractability. If too much nitrogen is given to the crop, the root yield will remain high, but the sugar content will be low and the extractability poor. On clay, loess loam and sandy soils the amount of nitrogen to apply may be estimated by the formula:

\[
N \text{ amount} = (200- (1.7\times N_{\text{min}}))
\]

\(N_{\text{min}}\) is the amount of mineral nitrogen in kg per hectare in the soil layer 0-60 cm in February/March.

When the amount of \(N_{\text{min}}\) (mineral nitrogen) in the soil lies between 101 and 140 kg per hectare the grower is advised to apply 30 kg N per hectare; above 140 kg/ha an application of N is not necessary. When a well-developed forage crop is grown before sugar beet, a deduction is made of 30 kg N for grass or 60 kg N for legumes.

*Phosphate* influences the root formation of sugar beet plants and the amount of \(P_2O_5\) to apply depends on the phosphate content of the soil. As a general rule in a normal crop rotation with good yields, about 70 kg \(P_2O_5\) per hectare is removed yearly from the soil, which has to be compensated for.

*Potassium* influences the formation of carbohydrates in leaves and the transport of sugars to the root of sugar beet. The amount of potassium to be given to the soil depends on the soil concentration, soil type and crop rotation. As an average on sandy soils 200 kg/ha \(K_2O\) is removed per year, and on other soils about 150 kg/ha \(K_2O\).

A good *pH level* is very important for good development and growth and the optimum is crop and soil specific. The pH level on sandy soils depends on soil organic matter and rotation (the frequency of potatoes and sugar beet in the rotation). The pH level on clay soils depends on clay content and soil organic matter. Due to the fact that a change in pH level takes a while, the grower has to find the optimal pH for the crop rotation on his farm. In general, 200-250 kg basicity units are removed per hectare on reclaimed peat and sandy soils yearly, while on clay soils with <2% of carbonated lime the amount is approximately 400 kg/ha CaO.

Harvest

The Dutch sugar industry campaign usually starts in the second half of September and ends around Christmas. In general, sugar beet are harvested in the period mid-September until mid-November as after that period it is very difficult to harvest beet due to rainfall and frost.
To a large extent (95%) sugar beet is harvested by six-row self-propelled tanker harvesters, owned by contractors. Sugar beet is stored for a relatively short time on the farm in simple uncovered piles, and from there transported by transport companies to the factories. At the factory site there is enough storage capacity for about half a day’s processing. The sugar industry gives growers a bonus for deliveries in the first weeks of the processing campaign to compensate for loss of growth in this period, and in the last part of the campaign the growers get a premium to compensate for storage losses and the costs of covering the piles during frost.

**Co-products**
Sugar industry co-products (pressed and dried pulp, molasses and sugar factory lime) make a large contribution to the price level of sugar beet. In the Netherlands co-products are owned by the industry and sold on the market. At the moment the total value of co-products is about €85 million or about €14 per tonne of sugar beet. In the Netherlands, beet pulp is dried and sold via the feed ingredient industry to dairy farmers who use dried pulp or store pressed pulp in silos and use the silage for milk and meat production. Pulp is also sold to farmers with sows where it has a positive influence on environmental problems, as the dry matter content of manure produced by the sows is higher, and the ammonia level in the pig house is lower. Experiments are also being done to feed sugar beet pulp to fattening pigs with promising results. The factory lime from the Dutch sugar industry is sold as a fertilizer/soil improvement agent to farmers in liquid or solid form and is a highly appreciated liming material. Part of the factory lime is used in the substrate for mushroom production.

The sugar industry molasses is sold to the alcohol industry and the co-product of this alcohol industry (vinasses) is used in the dairy feed industry with a small part now used by farmers as a potassium fertilizer.

**Sugar beet research**
The central organisation for sugar beet research for both beet growers and the sugar industry is IRS (Institute of Sugar Beet Research), based at Bergen op Zoom. IRS covers the whole area of applied research on sugar beet cultivation (from variety testing to beet reception) and the agronomic aspects of co-products of beet processing (sugar factory lime and beet pulp). Crop protection, and in particular soil-borne pests and diseases, is a major research topic at IRS. Aspects related to crop rotation are covered by PPO-agv at Lelystad. Research institutes such as Wageningen UR carry out more fundamental research.

**Extension programmes in sugar beet**
Extension is an integral part of IRS-activities as IRS develops the written advisory material for all sugar beet growers, and advisors from the sugar industry, seed companies, crop protection industry, fertiliser industry, agricultural press, private advisors and contractors. Every grower can get access to Betatip (sugar beet growing guide) and Betakwik (growing support service) on the internet. A Cercospora Warning Service, based on two action thresholds was introduced to help growers in controlling Cercospora leaf spot, the main goals
of which are to give up-to-date and practice-based information to growers on control of the
disease, while and minimising the environmental impact and costs. In 2003 a Cercospora
Advisory Model was introduced, which is a weather-based system that indicates the need for
a fungicide spray based on weather favourable for infection by *Cercospora beticola*. This
Advisory Model is currently (2005) being fine-tuned for Cercospora, and because other foliar
diseases are becoming more important, it will be extended with data for these fungi in the
near future, developing into a Foliar Disease Advisory system.

How can sugar beet growers and their associations influence agricultural research and
education programs?

The basic principle in the Netherlands is: who pays decides. Furthermore, it is common
practice to have a consensus on decisions and transparency in policies. Several committees
advise on the IRS research program, involving both beet growers and the sugar industry. The
parties providing the finance make the final decision, which also holds for the extension
program. Independent information needed by growers when making decisions on ordering
seed or choosing a crop protection strategy is provided free of charge by IRS in different
forms (brochures for all growers, press bulletins and the internet).
FACT SHEET Dutch Sugar Sector

Area of sugar beet (2005): 93,000 ha

Number of beet growers (2005): 14,000

Yield (2004): 66.7 ton/ha roots, 10.8 ton/ha sugar

Sugar Quota (2005): 864,559.5 tons of white sugar

Sugar Companies: Royal Cosun
                CSM Sugar

Sugar Factories: Dinteloord (Cosun): 18,500 t/d slicing capacity;
                 Groningen (Cosun): 15,000 t/d slicing capacity;
                 Vierverlaten (CSM): 17,000 t/d slicing capacity.