

# Soya beans - experience from Denmark

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## Introduction

Organically and locally grown soya beans (*Glycine maxima* L.) are demanded in Denmark. A protein source with these characteristics may be used for food and feed:

- Vegetable drink alternatives to dairy products suitable for vegetarians, diabetics, lactose allergy sufferers and ethnic groups.
- Fodder in organic husbandry farming, e.g. egg-producing hens and pond farming fish.

Increasing interest of organic products is the driver for home grown soya beans rather than imported soya beans despite organically grown. Long-distance transportation of soya beans is not regarded as sustainable and may not fit to the organic concept. Furthermore, the quality and supply of organic soya beans at the global market is fluctuating.

## Experiences 2005-2007

During 2006-07 soya beans have been grown at Jyndeved Experimental Station, located in South Jutland close to the German border. The aim of the growing was to produce a batch of Danish grown soya protein acting as a source in feeding experiments on egg-producing hens in organic husbandry. The growing was carried out using the most reasonable practice and did not include any experiments in crop management. In 2007 the yield was around 1.7 t/ha cleaned and dry seed, which is 75% of the average world yield of soya beans. The yield in Middle- and South Europe is higher, 2-3.5 t/ha, but in Poland the yield is 1.2-1.6 t/ha ([www.faostat.fao.org](http://www.faostat.fao.org)). The protein concentration of the soya beans harvested in 2006 and 2007 was almost as high as the normal concentration of 40-45% in imported soya beans. This means that there is a potential for growing a valuable protein source for organic layers as well as for other animals in Denmark, which in the long term means that the production will be less dependent on imported soya.

These values indicate that growing of soya beans in Denmark may be possible, but there is a need for development of crop management to achieve a higher and stable yield. Denmark is situated at the northern boarder of the growing range of soya beans, and to our knowledge soya beans have never been grown commercially on Danish farms. Therefore, we assume pests and diseases related to the crop rotation to be absent, and infestation by spread of airborne pests and diseases to be of minor importance.

## **Project 2008-2010**

A new project *Dansk, økologisk dyrkning af sojabønner til fødevarer- og foderformål* (Danish, *organically grown soya beans for feed and food*) is carried out at University of Aarhus in cooperation with the SME Naturli' Foods A/S and the Danish Agricultural Advisory Service, Organic Section. The project is supported by the Danish Food Industry Agency at the Ministry of Food, Agriculture and Fisheries.

The aim of this project is to evaluate the possibilities of growing soya beans organically in Denmark by clarifying basic questions regarding establishment, soil fertility and harvesting. The project runs field experiments in the growing seasons from 2008 to 2010.

## **Variety**

Soya beans are grown at latitudes close to Denmark (Canada, Germany and Poland) and even in Sweden (Gotland). Well-performing varieties from these places are purchased for testing varieties under Danish climate conditions. Varieties suitable for production of vegetable drink alternatives to dairy products are preferred, particularly varieties with pale seeds and low content of flavour.

## **Sowing time**

At higher latitudes early establishment is important for the utilization of sunlight during the short summer. In most crops early establishment is preferred as early and well-developed crops produce higher seed yields than later sowing. However, cool soil may delay emergence of seedlings and night frost may injure sensitive crops sown too early. Three sowing times are tested: mid April, primo May and mid-ultimo May.

## **Sowing method**

Bed or ridge growing are used to increase the soil temperature that may increase seedling emergence and development during the early growth phases. In addition, the nutrient rich topsoil is concentrated in the ridge causing a fertile bed for root development. The first pods are set close to the soil surface and the first pods are often the highest-yielding. The sowing method may affect how close the first pod is to the soil surface, and this distance interacts with harvest method as higher placed pods are easier to pick up by the harvester.

The sowing method also interacts with the opportunities for mechanical weed control, but it is unknown how the soya beans' crop stand is affected by harrowing. Three sowing methods are tested: Growing on ridges 75 cm inter-row space, growing with 75 cm inter-row space on plain field, and growing as broadcasted (12 cm inter-row space on plain field). Mechanical weed control is conducted by techniques and strategies appropriate to the inter-row distance.

## **Soil fertility and plant nutrients requirement**

As soya beans can fixate nitrogen from the atmosphere, nitrogen fertilization is assumed to be less important. However, knowledge of soya beans requirements for soil fertility is important when selecting fields suitable for growing soya beans in Denmark. The hypothesis is that soya beans may be grown on less fertile soil with respect to nitrogen availability. This is of particular interest on organic farms that prefer to use the limited nitrogen resources for small grain cereals.

The effect of soil fertility will be tested in 2009 in two long-term experiments: The *Vekselvirkningen* at Jyndevad Experimental Station including effects of phosphorus and liming, and the *Askov-LTE* at Askov Experimental Station including rates of animal manure (slurry) and treatments fertilized with straight phosphorus and potassium fertilizers (Petersen et al., 2008). The soya beans replace the nitrogen fixing crops in the crop rotation of the long-term experiments. Differences in soil fertility are accumulated during >60 and >110 years, respectively.

In 2008 application of animal slurry was included in the sowing method experiment. The manured treatment seems a little greener, but we are not able to ascribe the effect to a single nutrient as animal slurry is a mixed nutrient source.

### **Harvest time**

We expect that the soya beans ripen in September-October when combined harvesting often are difficult due to the weather conditions in Denmark at that time of the year. In general, stripper harvest is more suitable for the harvest of grain crops with high moisture content. Therefore, the soya beans in this experiment are harvested by stripper harvesting followed by drying and cleaning. Different machine settings for optimal stripper harvesting will be tested. The cleaning must be done carefully, as broken seed are undesired in the production of vegetable drink alternatives to dairy products. Three dates for harvesting are tested with respect to yield, quality and demand for drying.

The project focuses on seed production for production of vegetable alternative to milk. However, soya beans may be of interest for feeding animals. We assume that the heavily digestible stems are left behind in the field by stripper harvesting causing a higher protein concentration and easily digestible silage.

### **Dissimilation of results**

We intend to keep the homepage <http://www.soja.djfprojekt.dk/> updated with information during the growing season. Reports and publications will also be available.

### **Outlook**

The project will clarify basic questions regarding growing soya beans in Denmark, making us able to produce cultivation guidelines on how to achieve a minimum of 2 t/ha dry seed of organically grown soya beans. In future, we imagine that the requirement of today when producing vegetable drink alternatives to dairy product will be met by contract cultivation of 1,000 ha yielding 2 t/ha. Another 1,000 ha may be cultivated with soya beans for high-valuable fodder.