Growing faba bean and pea in the Nordic region

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Legumes Translated

Faba bean (*Vicia faba* L.) and pea (*Pisum sativum* L.) are cool-season grain legumes that pose different growing challenges and opportunities. Both are grown in the boreal-nemoral region (55 to 70°N) where the snow cover and temperatures below zero can last between three and six months. This practice note describes the main differences and similarities between them with regard to choosing the optimal site, their susceptibility to drought and waterlogging; weed management; pest and disease control; inoculation; harvesting and desiccation; and field management after harvest.

Outcome

Useful knowledge on cultivating faba bean and pea under Nordic conditions.

Uses of the crops

The most common grain legumes grown in the Nordic countries are pea and faba bean. Both provide a good break crop in the cereal-dominant monocultures common in many Nordic countries. There is a growing demand for both species, especially as part of the effort to increase domestic sourcing of raw materials for feed, and increasingly for the plant-protein food industry.

Pea plant. Photograph: Frederick Stoddard

Applicability

Theme: Understanding faba bean and pea in the Nordics

For: All growers

Where: On all farms

Timing: Seeding to harvesting and desiccation

Follow-up: Where possible, sow a catch/cover or winter crop soon after harvesting the legume to capture residual nitrogen. An interval of 3 years of non-legume crops is widely recommended between successive legume crops.

Impact: Understanding faba beans and peas, their challenges and opportunities

Pig and poultry production can make use of both crops as feed instead of imported soybean. In cropping systems, they fix atmospheric nitrogen and their residues provide residual nitrogen for the next crop. They are further valued for other attributes such as their ability to break soil-borne disease cycles and improve soil structure.

Choice of cultivar

There are relatively few well-adapted cultivars of these species available to Nordic farmers on account of the short growing season in the region. The key novelty in faba bean breeding is the reduction in vicine-convicine content (favism factors). These two natural chemicals restrict the use of faba bean for some people and in animal feeds. New cultivars have only 5% of the normal vicine-convicine content and are safe for all consumers.

For pea, resistance to lodging (standing ability) has long been the main problem for farmers. Most modern cultivars are semi-leafless, meaning that

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Table 1. Importance of soil conditions for faba bean and pea

	Faba bean	Pea
Soil texture	Grows well on clay soils	Grows well on loamy soils
Soil pH	6 – 8	5.5 – 7
Waterlogging	More tolerant	Less tolerant
Response to drought	Less tolerant	More tolerant

the true leaves have been replaced by tendrils and the stipules are greatly expanded, restoring the photosynthetic area. These cultivars stand up well because the tendrils form a strong network between plants.

Site characteristics

The opportunities for growing faba bean and pea in this region decline with increasing latitude. However, farmers grow faba bean and pea as far north as latitude 63°N. Common parameters for achieving good yield levels include soil type, pH level, water management and drought susceptibility (Table 1). The margins of pH tolerance are tested by farmers, often at the expense of yield. In soils with high organic content, vegetative growth is favoured so there is a greater risk of lodging and late maturity, but experienced farmers can achieve high yields in this situation.

Waterlogging and drought

Waterlogged soils lack oxygen, so roots suffocate. While faba bean is considered more resistant to waterlogging than other grain legumes, the wet conditions favour the growth and spread of diseases. In drought conditions, plants close their gas-exchange pores, preventing both the loss of water and the uptake of carbon dioxide for photosynthesis.

When water is not taken up from the soil, nutrients are also not absorbed. Drought can occur at any time in the growing season and appropriate management depends on its timing. Terminal drought, near the end of grain filling, is typical of Mediterranean climates and uncommon in northern Europe. Transient drought in the middle of the growing season can be managed with irrigation, if the infrastructure is available, and plant breeders seek ways of avoiding it through improved root systems. Drought during seedling establishment in May is common in northern Europe and exceptionally hard to manage, since the roots have had little opportunity to find water in the soil. Pea is less sensitive than faba bean to drought, as shown in both 2018 and 2021, when prolonged mid-summer drought reduced mean faba bean yields far more than those of pea.

Crop establishment

Inoculation

Both legumes form a nitrogen-fixing symbiosis with soil bacteria classified as *Rhizobium leguminosarum* symbiovar *viciae*. Different strains of this bacterium can make 5% difference in the amount of nitrogen fixed. It is widespread throughout Europe but the population may not be large enough if the field has no history of cultivation of pea, faba bean or its other hosts. Hence, inoculation with a commercial rhizobium preparation is widely recommended in this

Waterlogged faba bean. Photograph: Frederick Stoddard

circumstance. Intercropping legumes with non-legumes usually increases the nitrogen fixation of the legume as the companion takes up the available mineral nitrogen from the soil. To avoid desiccation, the drying out of the bacteria on the seed, the inoculum is applied shortly before planting – no more than a couple of days; see the video "Inoculating grain legumes" under further information.

Sowing takes place in early spring, as soon as the soil is sufficiently warm (about 5°C) and dry enough to take the weight of the seeder, which in Finland is usually at the beginning of May. Faba bean has one of the longest growing seasons of Nordic crops, so on most farms it should be the first to be sown. The shorter growing period of peas (approximately 90 days) allows for more flexibility when it comes to the seeding time.

Table 2 shows the main sowing requirements of both crops. Deep sowing helps to ensure access to water for the germinating seed, which reduces the effects of early-season drought, and reduces the risk of predation by crows and pigeons. The water requirement is high due to the relatively large seed size. The target populations are lower for faba bean than for pea. Faba bean cultivars adapted to the Nordic region tend to have small seeds, 300–400 g/thousand, but in climates with longer growing seasons, the most productive beans are in the 500–800 g/thousand range and broad beans for food use can be up to 3000 g/thousand. Peas are generally somewhat smaller than the smaller sizes of faba beans.

Soil compaction and removal of stones

Soil compaction is an issue for both faba bean and pea as it reduces their overall plant growth and yield. Good aeration, deep tillage and deep sowing ensure good emergence and root development. Autumn or spring tillage makes it easier to drill the soil during spring. Other farmers manage well with zero tillage and direct drilling, and yields are widely better in zero-tillage systems. Rolling after sowing presses down stones that can interfere with harvesting and rolling helps to prevent contamination with soil when harvesting.

Weed management

Few herbicides are available for use on any grain legume and the crops are sensitive to the residues of herbicides widely used against broad-leaved weeds in previous crops. In practice, this means selecting a field with minimal herbicide residues from preceding crops e.g. cereals. Seedlings of weeds are best controlled before the crop is 5–7 cm in height.

Fertilizers

The organic matter content of the soil and its available nutrients determine the amount of fertilizer needed. Fertilizer products that are low in nitrogen are most suitable for faba bean and pea, so the farm can take full advantage of their nitrogen-fixing ability. Although scientific experiments have widely failed to show any benefit of starter nitrogen, many farmers see one, so they apply starter nitrogen fertilizer at 20–40 kg/ha.

Phosphorus and potassium fertilization of faba bean and pea is similar to that for cereal cultivation. Potassium, phosphorus and magnesium improve resilience against disease, such as chocolate spot (*Botrytis*) of faba bean. Micronutrients may also be needed in some soils. For example, molybdenum is essential for nitrogen fixation.

Table 2. Sowing requirements

	Faba bean	**Pea**
Seeding time	As early as possible	Early, before cereals
Target plant population	60 / m^2	100–120 / m^2
Minimum soil temperature	3–5°C	5°C
Seed size	300–400 mg	250–320 mg
Seeding depth	6–8 cm	3–7 cm
Emergence time	6–14 days	5–12 days

Table 3. Key diseases of faba bean and pea

	Faba bean	Pea
Main diseases	Chocolate spot (*Botrytis fabae* and other *Botrytis* species)	Aphanomyces root rot (*Aphanomyces euteiches*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*) and Downy mildew (*Peronospora viciae* f. sp. *pisi*)
Other diseases that are less observed or have less economic impact	Sclerotinia stem rot (*Sclerotinia sclerotiorum*), rust (*Uromyces viciae-fabae*), root rot (*Fusarium* species), Downy mildew (*Peronspora viciae* f. sp. *viciae*)	Grey mould (*Botrytis cinerea*), powdery mildew (*Erysiphe pisi* var. *pisi*) and rust (*Uromyces pisi*)

Management during the growing season

Disease control

There are several diseases affecting faba bean and pea in the region (Table 3). Farmers have many tools with which to prevent the arrival of crop diseases and pests. To prevent disease outbreaks, the recommended minimum interval is 3 years of non-legume crops between successive legumes on the same field. Fungi such as *Sclerotinia* and *Phytophthora* can persist 3–5 years in the soil, whereas *Aphanomyces* root rot of pea survives for up to 10 years. Fungicide treatment of seeds improves the emergence percentage and protects the crop against some early disease symptoms. The use of such fungicides in some countries requires permits and is not widely practiced in the Nordic region. It is important to inspect the crops regularly for diseases and pests in July, during flowering, so any necessary treatment can be applied in a timely manner, according to the principles of integrated management.

Downy mildew requires cool growing conditions. It was widespread on faba bean in the cool summer of 2017 in the Nordic and Baltic countries, but is otherwise rare in this region. Rust of both legumes is a disease of warm, humid conditions and arrives late in the growing season in this region when it causes no detectable damage. Chocolate spot disease is almost universally seen as a few spots on faba bean leaves and is not a serious problem until the weather conditions are right, typically 20–22°C with nearly 100% humidity and damp leaf surfaces. In this situation, generally predictable from the weather forecast, the whole plant stand can be killed in 48 hours, so rapid fungicide treatment is vital.

Pest control

In Finland, both faba bean and pea are prone to attacks from aphids, leaf weevils, pollen beetles and pea moth caterpillars as well as birds.

Pea moth (*Cydia nigricans*) caterpillars eat the developing seeds in the pods of many legume species, but given a choice, they will take pea in preference to faba bean, lupin or lentil. Pea moths are detected using pheromone traps that are normally placed at least a week before flowering starts and examined every second or third day. More than ten moths after two consecutive checks indicates that pest control threshold has been reached. Chemical treatment normally commence around 8–12 days after their peak emergence. Adults of the leaf weevil, *Sitona lineatus*,

Chocolate spot at dangerous levels. Photograph: Frederick Stoddard

cut crescents from the edges of leaves and stipules. It is their larvae that do the damage by consuming the developing root nodules. Pyrethrum is the usual insecticide to control this pest and the intervention needs to be early, as once the eggs are laid on the soil, the damage to the roots cannot be stopped.

Both crops have aphids, the pea aphid being *Acyrthosiphon pisum* and the black bean aphid being *Aphis fabae*. Weather conditions greatly affect the spread of aphids: heavy rain washes off much of the population and a period of intensely dry weather desiccates them. The pest control threshold is reached when 10% of the plants are infested and the weather forecast indicates that conditions are good for the pest rather than for the plant. Genetic forms of resistance to aphids have not been identified in pea or faba bean, so breeding for resistance is unlikely in the near future. Both aphid species over-winter in hedgerows and woodlands. They spread from random landing points near the edges of the field, so a large field is likely to show less damage than a small one. There is some evidence that early-sown crops are more likely to be found by aphids, but this has to be balanced against the other benefits of early sowing in this region.

Seed weevils (*Bruchus pisorum* on pea and B. *rufimanus* on faba bean) ruin the seeds for food use and reduce their value for feed. Pea weevils have been present in the Nordic region for decades but the bean weevil is a recent arrival. Control is difficult because the eggs are laid within the flower and after hatching, the larva immediately penetrates the seed, so it is protected from most protection chemicals. Early detection with pheromone traps is vital, to be followed by appropriate treatment as advised by the local agricultural consultant.

Aphids on faba bean. Photograph: Frederick Stoddard

Lodging

Lodging makes the crops very hard to harvest. The strong stem of faba bean makes it more resistant to lodging than pea (Table 4). Rain during seed filling increases the risk of lodging. To prevent pea crops from lodging, companion crops with strong straw, such as oat, barley and wheat, are often used. The target is one cereal stem per pea stem, so the cereal sowing rate is 15–30 kg/ha, because at higher densities the cereal out-competes the legume.

Harvesting and desiccation

As the plants approach harvest readiness, first the pods and later the stems turn straw-coloured (pea) or black (faba bean). Lower pods mature before upper ones and when they start to open, it is a sign that harvesting needs to be done soon. Normally, all leaves have fallen by this time. In this region, faba bean is harvested at a moisture content of 18–20% and pea at 20–25%. In warmer climates, the harvest moisture content is 14–15%. Lower moisture content increases the risk of pod shattering and high moisture content allows seeds to get crushed in the harvester.

Table 4. Standing ability, seed coat and time of maturity of faba bean and pea

Faba bean	Pea
Stands well on its own	Prone to lodging, though semi-leafless cultivars have improved standing capability
Tougher seed coat, less breakage risk during handling	Thinner seed coat, more breakage risk during handling
Late maturity (e.g. ‘Kontu’, 107 days)	Earlier maturity (e.g. ‘Karita’, 98 days)

Although the seed coats are thick, legume seeds are more easily bruised during harvesting than cereal grains, so the combine harvester needs to be set up accordingly. The driving speed and drum speed are low, the fan speed high, the flails and screens open. Green pods are returned to the field by adjusting the top screen as they can cause blockages in the combine and other problems later in the dryer. The straw chopper has a lot of work to do in a faba bean crop, especially when the vegetation is dense, so it may need adjustment to make longer chaff.

Since some seeds are moister than others and may start heating and rotting, drying is started quickly but proceeds slowly, often in two stages, as the thickness of the seeds prevents the centre of the seed from drying as quickly as its perimeter. The drying temperature is usually 50–60°C. The target moisture content for faba bean is 14.5% (not below 14%) and for pea 15%.

Catch crops

After the harvest, the crop residues are rich in nitrogen. Most farmers leave them in place to nourish the succeeding crop. This comes at the risk of loss by leaching or nitrate or emission of nitrous oxide, a powerful greenhouse gas, so current recommendations include sowing a catch crop, cover crop or winter cereal that will start taking up nitrogen promptly.

Faba bean fixes about 80% of its nitrogen needs and pea about 70%. The EU project "Legume Futures" estimated that faba bean added about 24 kg of fixed nitrogen per tonne of harvested beans and that pea added about 6 kg. This helps to reduce the need for nitrogen fertilization of the next crop.

Pre-crop effect

The pre-crop effect of legumes consists of more than just nitrogen. The activity of the nitrogen-fixing bacteria supports other beneficial soil microorganisms. The nitrogen-rich residues help maintain the populations of larger soil fauna such as earthworms. A grass-free legume crop allows some soil-borne pathogens of main-crop cereals to die, so the following cereal grows better.

Harvest-ready faba bean. Photograph: Frederick Stoddard

Key practice points

The decision to grow peas or faba beans can be based on some guiding questions (non-exhaustive):

- Is sowing time an issue? The optimal time for sowing faba bean is very early in the growing season. This poses challenges if the weather does not permit early sowing. Pea can be sown a few days later.
- Are you worried about waterlogging? Faba bean is more tolerant.
- Are you worried about risk of drought? Pea shows more tolerance.
- Do you want a grain legume that is less prone to lodging? In that case, faba bean stands better than pea.
- Are you searching to diversify your crop rotation? Both crops provide nitrogen for the next crop and disease control.

Sources

Baddeley, J. A., Jones, S., Topp, C. F. E., Watson, C. A., Helming, J. and Stoddard, F. L., 2013. Biological nitrogen fixation (BNF) by legume crops in Europe. Legume Futures Report 1.5. Available from www.legumefutures.de

Dutton, P., Phelps, S., 2020. Understanding the differences between faba beans and peas. Saskatchewan Pulse Growers. https://saskpulse.com/files/newsletters/200325_Faba_bean_vs_pea.pdf

Jensen E.S., Peoples, M.B., Hauggaard-Nielsen H., 2010. Faba beans in cropping systems. Field Crops Res. 115, 203–216.

Marttila, T., 2017. Rehuherneen kysyntä kasvussa. www.satafood.net/site/assets/files/1350/rehuherneen_viljely_-_taneli_marttila.pdf

Stoddard, F.L., Rubiales, N., Villegas, T., 2010. Integrated pest management in faba bean. Field Crops Res. 115, 308–318.

Vilja-alan yhteistyöryhmä, 2018. Härkäpavun viljelijän huoneentaulu. www.vyr.fi/document/1/634/5b8a08f/huonee_d6ab01c_Harkapavun_viljelijan_huoneentaulu_nettiversi.pdf

Vilja-alan yhteistyöryhmä, 2019. Herneen viljelijän huoneentaulu. www.vyr.fi/document/1/859/1d59dee/oppaat_8cc387e_Kuivaherne_huoneentaulu_netti.pdf

Ylhäinen, A., 2022. Herneen kylvömäärä hakusessa. Käytännön Maamies 3. https://kaytannonmaamies.fi/share/38470/1a83af

Further information

Stoddard, F. L., 2017. Grain Legumes: an overview. In: Murphy-Bokern, D., Stoddard, F. L. & Watson, C. A. (Eds.). Legumes in Cropping Systems. CABI, Wallingford, pp. 70–87.

Schauman, C., Leinonen, P., Mäki, S., Stoddard, F. L., Lindström, K., 2021. Inoculating grain legumes. University of Helsinki. Legumes Translated video.

About this practice note and Legumes Translated

Authors: Frederick Stoddard, Kristina Lindström and Casimir Schauman

Publisher: University of Helsinki

Production: Donau Soja

Permalink: www.zenodo.org/record/6571901

This practice note was prepared within the Legumes Translated project funded by the European Union through Horizon 2020, Project Grant Number 817634.

Citation: Stoddard, F., Lindström, K. and Schauman C., 2022. Growing faba bean and pea in the Nordic region. University of Helsinki. Legumes Translated Practice Note 76. www.legumestranslated.eu

This project is funded by the European Union