SLU EkoForsk

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Contents

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Ecoswine – an interdisciplinary research programme within organic pig production

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Current breed evaluations are based on records from conventional production. This project is studying the interaction between genotype and environment (organic or conventional) with the help of field data from 6-7 organic herds. The ranking of breed boars on the basis of the growth and conformation of approximately 3000 offspring on these farms is being compared with the ranking given by their breeding score. The variation between boars in proportion of joint inflammations in offspring is also being studied. In addition, reproductive characteristics in approx. 120 sows in organic production are being compared with the results from their sisters in conventional production.

Nutrition, health and meat quality in organic pigmeat production
An important component of organic pig production is that the needs of the animal for natural behaviour patterns are supplied. Here, feed seeking and grubbing fulfil an important function. Food is thus not simply about nutrients.

The influence of different crude forage sources on production, post-slaughter carcase characteristics and pig behaviour is being investigated in a field study in collaboration with slaughter pig producers. To improve our knowledge on the incidence of parasites and infections in organic slaughter pig production, the health status of the animals is being monitored through regular sampling of dung and blood.

The programme also has a grant from Formas.

Intercropping of lupin and faba bean with cereals for green forage or silage

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The forage used today for beef cattle mainly consists of different species of grass and clover from several-year leys. The legumes in the ley fix atmospheric nitrogen and thereby also provide an important nutrient supplement to following crops. For the organic farmer it is very advantageous, both from a soil fertility and animal feed perspective, if one-year nitrogen-fixing crops can be included in the crop rotation.

Through co-cropping of cereals and pulses (e.g. peas) for whole crop silage, the entire vegetation can be harvested on a single occasion – and an energy and protein-rich feed is obtained.

Despite the fact that cereals grown for whole crop silage have been relatively common in e.g. Denmark, they have been uncommon in Swedish conventional farming. Within organic farming, however, the method has been used to a greater degree.

By tradition, the combination oats/peas is commonly used but other mixtures are also possible. The risk for attack by pea root rot (*Aphanomyces euteiches*) means that peas should not recur more often than every sixth to eighth year in the crop rotation and it is therefore of great interest to investigate the possibility of combining the cereal with another nitrogen-fixing legume

Broad beans (*Vicia faba*) and various species of lupin (*Lupinus angustifolius*, *Lupinus lutea* and *Lupinus alba*) are all nitrogen-fixing but are not attacked by pea root rot and can therefore be appropriate replacement crops. The older lupin types contained high concentrations of alkaloids and tannins, which made them unsuitable as feed. The varieties available today are considered suitable as feed for both cattle and pigs.

Time of harvest is decisive, not only for its effect on the feed value of the crop but also for the ease with which the material can be ensiled. The weed competitive ability of different combinations of cereals and legumes is very variable. Blue lupin is regarded as having low competitive ability against weeds at an early stage, while broad beans are competitively strong.

The project is studying the effect of weed harrowing on co-cropping of broad beans, spring wheat, oats and barley in various combinations and harvested on two occasions. Insowing of ley is also included in the trial.

Cultivation and weed management in narrow-leafed lupin and faba bean

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The dairy cows found on organic farms today have been bred within conventional farming and have a requirement for an additional protein supplement in order for milk production to be acceptable.

For ruminants, feedstuffs not originating from KRAV-approved production may constitute a maximum of 5% of the annual feed intake. For non-ruminants the figure is a maximum of 15% and for poultry a maximum of 20%. With certain exceptions, the rule is that the degree of self-sufficiency regarding feed must be at least 50% based on annual feed intake (per farm). There is therefore a great need within organic farming to be able to self-produce protein-rich supplement feeds for production of beef cattle, sheep, pigs and poultry. The requirements for different feed qualities vary between animal species.

Since the infection risk for pea root rot (*Aphanomyces*) prevents cultivation of peas at closer intervals than 6-8 years, there is an urgent need for other complementary protein sources. Vetch can also be attacked by pea root rot and is thus not suitable as a substitute crop. The new lupin varieties have a considerably lower alkaloid content than the former types and are considered suitable as a protein source for both beef cattle and pigs. The aim of this project is to study the effects of weed harrowing and row hoeing in broad beans and lupins grown to full maturity.

Faba beans intercropped with spring wheat as whole crop silage – yield and feed value

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Interest in faba beans (*Vicia faba* L.) has increased in recent years in both conventional and organic cropping. Peas and broad beans are important in the creation of a sustainable plant growing system due to their nitrogen-fixing ability, not least in organic cropping. Peas can be affected by root rot if they occur too frequently in the crop rotation, so broad beans are an alternative. Reaching full maturity of a broad bean crop can be a problem except in the most southerly parts of the country. The alternative is to harvest the beans as whole crop silage, preferably with cereal as an intercrop.

The aim of this research programme is to provide data on optimal harvest time for whole grain silage of cereal and faba beans. The project is also evaluating the feed value of the crop, its yield and its ensilability.

The major proportion of the project is being carried out in field trials situated in Värmland and Västerbotten. These trials are investigating four times of harvesting. In addition to yield, the feed value of the crop is being analysed. The proportions of leaves, stems and pods and the botanical stage of development of the crop are also being determined.

The research programme also includes an ensiling study. The feed value of the crop, both at harvest and after ensiling, is being evaluated.

Non-chemical weed control in row crops

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The aim of this project is to investigate various non-chemical weed control methods in row crops with the aim of providing farmers with background data regarding the methods can be appropriate for a certain crop.

It is preferable that such research be carried out on different textures of soil, e.g. a peat, a sandy soil and a light clay loam, and in different geographical locations representing all of Sweden. The experimental sites are Torslunda Experimental Station and Ekhaga Experimental Farm.

Two methods are being studied – weed harrowing and row harrowing with scraping tines. Both methods are simple and can probably be used in a number of crops. There is a lack of current knowledge about the suitability of the methods for a large number of crops. We know little about whether weed harrowing can be used in e.g. carrots and beans (field beans, broad beans) or

whether oilseed rape can be treated using scraping tines.

The trials are generally being carried out in the form of block experiments with four replicates. The plots are treated mechanically and compared with one control plot per treatment. Statistical analysis is by multifactor-ANOVA, and in certain cases paired samples. Recording of weeds is carried out before and after treatment.

Weed harrowing is being carried out in the following crops: carrot, sugarbeet, seed-grown onion (only on Öland), dill, beans (broad beans on Öland, kidney beans at Ekhaga), oilseed rape, beetroot, spring wheat (only in Uppland). Treatment of the crops is taking place at two stages of development, with recording of the total weed control effect and control of the three most dominant weeds. Crop yield is also being recorded.

Row hoeing with scraping tines is being carried out in the following crops: carrot, sugarbeet, dill, beans (broad beans on Öland, kidney beans at Ekhaga), oilseed rape, beetroot. Treatment of the crops is taking place at two stages of development, with recording of the total weed control effect and control of the three most dominant weeds. Crop yield is also being recorded.

Management of couchgrass by competition and cutting

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Couchgrass (*Elymus repens* L., Gould) is overall one of the most important weeds in Sweden due to its pernicious underground runners. Couchgrass can be controlled mechanically by repeated soil tillage or with chemical herbicides. To reduce the risk of leaching of nitrogen, there is an environmental protection programme that promotes reduced soil tillage. This in combination with the lower cost of chemical weed control has meant that at the present time, couchgrass is often controlled using glyphosate.

Within organic farming, where chemical weed control is not permitted, there is a need for alternatives to soil tillage to reduce the leaching risk. Within conventional farming there is also a move to reduce the use of chemical herbicides, which means that there is a need for alternative weed control techniques. Concrete examples of situations where couchgrass control should be carried out in a different way are in catch crops in the autumn after harvest of the main crop, in green manure crops on organic farms, in water protection zones where crop protection chemicals are not permitted and in stubble fields in the autumn before spring ploughing.

The aim of this project is to investigate changes in weed population dynamics and particularly the extent to which couchgrass can be inhibited and/or eliminated with the help of cutting together with competing crops. Creeping thistle, another perennial weed species, can namely be successfully controlled through repeated cutting in combination with competition from the crop.

Tuber growth and yield of different organically grown potato varieties

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Potato is easily attacked by leaf blight, particularly in organic growing where the potential to control the disease is limited. When potato is attacked by leaf blight, the haulm must be killed to prevent the disease spreading to the tubers, soil and the surroundings. Once the potato haulm has been killed, the plant can no longer continue to store carbohydrates and tuber growth ceases. The time of the attack is thus very significant. If it occurs early in the season, the yield losses can be very great.

The aim of this project is to determine growth curves for different potato varieties, in both fresh crops and in crops affected by leaf blight. The intention is to use these curves to calculate the effects of various degrees of leaf blight attack and to calculate the size of the tuber yield at different times during the growing season. This can be done by taking continuous harvests during the season. The trial is a time of harvest investigation. The first harvest is taken when the largest tuber is approx. 30 mm and harvesting continues at least once a week for a total of 12 harvesting occasions.

The experiment includes three different potato varieties with different susceptibility to leaf blight – Fresco, Matilda and Escort. These different varieties have different rates of development and yield capacity. Fresco is an early variety that is very sensitive to leaf blight. The disease develops rapidly, but since Fresco is an early variety the tubers have time to develop a relatively long way before growth is interrupted. The variety Matilda is somewhat more resistant to leaf blight than Fresco. Escort is a variety with good resistance to leaf blight and can often escape attack right up to harvest.

To allow tuber development to be assessed in a healthy crop to full maturity, the trial includes a treatment with chemical control of leaf blight.

Mulching with plastic at time of sowing of row crops

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The problem with weeds in row crops is most acute around the actual plants in the row. In organic growing, the labour input for hand weeding is 150 hours/ha in sugarbeet and 300 hours/ha in carrots. Further improvement of organic growing requires new methods for weed control with a radically reduced input of labour costs.

The Danish company Holmgaard Innovation has developed a machine for mulching with plastic in conjunction with sowing of e.g. sugarbeet. In some small investigations the equipment has proven to function so efficiently that it can represent a breakthrough for the possibility of controlling weeds without the use of herbicides. However, there is still a lack of basic knowledge regarding the ability of the equipment to control weeds, the effect on germination of the commercial crop and the effect on pests.

The production of important basic data and an objective assessment of the machine are preconditions for a breakthrough in new sowing technology in organic growing.

In a minor pilot trial at Alnarp, with sugarbeet, onions and carrots, the machine was tested in 2001, but the resources were not available to monitor the results more closely. The carrots and onions emerged in reduced stands but without weeds in the row, while the sugarbeet germinated poorly and was eaten by birds as a result of late sowing.

We aimed to investigate the sowing of a range of different crop seeds such as sugarbeet, onion, carrot, cabbage, etc. with the new sowing technology. This investigation was carried out in conjunction with the manufacturer Holmgaard Innovation and took place in organic growing at Alnarp during the 2002 and 2003 seasons.

In the investigation, we evaluated:
- Technical function of the machine,
- Weed control effects and variations between species,
- Germination, emergence and vitality of different crop seeds,
- Incidence of insect attack.

The investigation was carried out in the form of one controlled field trial per year, with statistical treatment of the parameters studied.

Evaluation of soil media for organic production of nursery plants

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Nursery growing of crop plants for subsequent transplantation in the field is an important method for improving the competitive ability of crops against weeds and for making optimal use of the growing season. Increased knowledge about the soil composition required to produce the best transplants is extremely relevant for the development of organic vegetable growing. At present, there is a lack of knowledge about the optimal concentrations of various plant nutrients in transplants as regards their future development in the field.

The aim of this project is to study how different soil mixtures affect plant quality at transplantation, field establishment and continued growth to harvest. The plant nutrient concentrations are being monitored by analyses of soil and plants.

Intake of birdsfoot trefoil and white clover in stall-fed beef heifers

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Ley growing and grazing occupy a central role in organic production. The legume birdsfoot trefoil has attracted great interest in recent years as a complement to more common legumes used mainly for grazing.

Since 1997, birdsfoot trefoil has been studied with respect to crop growing characteristics, feed utilisation and parasitological aspects, with funding from SJFR and the Swedish Board of Agriculture (Jordbruksverket). As part of this project, studies on grazing beef cattle have been carried out at Rådde Experimental Farm and 2002 was the last research year in this interdisciplinary project.

In some cases, earlier studies have shown increased growth of beef animals grazing birdsfoot trefoil leys compared with white clover leys. A behaviour study also showed that beef animals, given the choice, grazed significantly more of the birdsfoot trefoil ley (61% of the observed time) than the white clover ley. However, without accurate estimates of daily feed intake and nutrient content, it is difficult to draw conclusions regarding whether the higher growth on birdsfoot trefoil grazing was due to greater feed intake or better nutrient utilisation. The present complementary consumption study on stall-fed animals aims therefore to obtain a more reliable estimate of feed

intake than that achieved earlier in the grazing study.

The aim of the study is to quantify the relationship between dry matter intake and animal growth in plots with birdsfoot trefoil or white clover, and to study whether there are differences in feeding behaviour as regards selection between the legume species. The latter will be manifested through differences in chemical analysis of the feed given and feed residues.

In conjunction with the stall-feeding trial, beef heifers are grazing either white clover- or birdsfoot trefoil-based ley in the grazing study and growth of the animals is being monitored during the entire period. Plant material from the same leys is also being used for the indoor study, where different groups of beef animals are fed either birdsfoot trefoil/grass forage or white clover/grass forage for one month. This means that direct comparisons can be made between consumption of both species mixtures in the stall and animal growth on grazing. The amount of feed and its dry matter (DM) content are determined daily before feeding for each group. In addition, residues are weighed and their DM content determined. The botanical composition of the feed is being determined and its nutrient quality analysed with respect to crude protein, energy, fibre and condensed tannins. The animals are weighed at the start of the study, after two weeks and at the end.

Legume control by mixing varieties of ryegrass and white clover for silage and grazing

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In organic ley production, regrowth yields often present nutritional problems, with excessively high crude protein contents and low fibre values. Complete control of legumes is difficult to achieve in practice. In spite of this, there are currently species and cultivar materials that could improve the control potential considerably. New species, new cultivars and mixtures of different cultivars with differing growth patterns, development rhythms and persistence can exploit different niches in a crop stand and thereby complement each other. Cultivar mixtures are being used by some practitioners, a few seed companies are offering e.g. ryegrass mixtures with up to five different cultivars, but comparative research is lacking at our more northerly latitudes.

Grazing is very important in organic milk and meat production. A combination of cutting leys and grazing is in many cases an appropriate solution from a practical perspective. Today there is no cultivar/species testing for grazing, which is a disadvantage. The organic experimental farms Rådde and Ekhaga offer unique possibilities to compare the effects of cut forage and grazing in late regrowth.

A late diploid (2n) cultivar of perennial ryegrass is considered to have a stronger competitive ability against white clover in regrowth cuts than a tetraploid cultivar (4n). In cultivar testing, there is currently a proportion of red fescue cultivars that include tall fescue as a crossing-in component. The overwintering ability is often good, but knowledge is lacking on the nutritional value and competitive ability of these cultivars.

The aim of this project was to investigate the effects of various cultivar mixtures with perennial ryegrass/hybrid fescue co-cropped with white clover as regards yield, nutritional value, persistence and botanical composition.

In the experiments, the white clover Ramona is being mixed with various combinations of the perennial ryegrass cultivars Herbie (late, 2n), Helmer (medium-early, 4n) and Condesa (late, 4n) or with the hybrid fescue Hykor. Commercially available mixtures of Gunne (early, 2n), Helmer and Leia (late, 4n) and Fennema (medium-early, 2n), Lasso (late, 2n), Sameba (late, 2n), Tivoli (late, 4n) and Meltra (late 4n) are also being tested. The experiments are cut twice a season, after which half the area is grazed by beef animals while the other half is cut a third time.

Green manuring as a multifunctional tool in vegetable growing

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The aim of this interdisciplinary research programme is to develop locally adapted vegetable growing systems with the help of green manure crops.

Green manure crops with nitrogen-fixing legumes add locally produced nitrogen to the cultivation system. This project is investigating different ways to utilise the nitrogen fixed in green manure crops and how these affect plant nutrient supply to the commercial crop, attack by pests through effects on their population dynamics and internal quality of the produce. We are also investigating how crop security and the economy of the grower are affected.

Within the programme, we are studying four different systems for using green manure in white cabbage growing:

- Direct incorporation of the green manure crop
- Co-cropping of green manure crop and commercial crop
- Biodigestion of the biomass from the green manure crop
- Composting of the biomass from the green manure crop

Six commercial growers are participating in the experiments. The project also includes two large shared field trials, Uppsala and Umeå, where 10 researchers are collaborating.

All aspects of green manuring are being weighed together to produce a growing system that is financially and organically sustainable.

Crop rotation with horticultural and agricultural plants with plant residues returned as biodigestate

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The aim of the project is to achieve nutrient supply within a five-year crop rotation through including a green manure crop and returning residues from the commercial crop and the green manure in the form of biodigestate. The crop rotation includes the following crops:

- Green manure
- Beetroot/sugarbeet
- Spring wheat
- Peas
- Spring barley with undersown crop

The advantages of this system are that:

- Plant nutrients can be saved from one season to the next and can therefore be used at the desired time in the next season.
- Nitrogen fixation in the green manure is probably increased, since the cut biomass is removed
- The biodigestate is liquid and can therefore be used in the growing crop
- Biogas is produced as a by-product

The beetroot crop is in a separate treatment with different pre-crop treatments and associated quality studies.

Quality bread grain – high protein content through combination of preceeding crop and fertiliser

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Organically grown quality wheat is in short supply on the market and meeting the demands of flour millers is very difficult at the present time. A common strategy in organic wheat growing is to take the benefit of nitrogen-fixing preceeding crops. However, after break-up of leys or other soil tillage, the risk of nitrogen losses is great.

The picture shows white mustard as a catch crop

In a five-year project, the after-effects of a clover/grass ley were investigated at different times and combined with sowing of a catch crop. The highest yields and protein contents were obtained when the ley was ploughed under at the beginning of August. However, the technique for establishing the catch crop can be improved and herein lies potential.

Supplying nitrogen in the form of different organic fertilisers before sowing and in the growing crop is another potential method to improve nitrogen availability to the wheat, since cumulative experience has shown considerable differences in nitrogen mineralisation rates between different products and types of animal manure. A third option is to use different soil tillage measures during the growing season to stimulate soil processes in general and nitrogen mineralisation in particular. Research has shown e.g. that row hoeing promotes protein storage. However, different wheat cultivars react differently.

In this project, we are combining different nitrogen supply strategies in different ways and investigating the effects on yield and protein content of both spring and winter wheat.

The following sub-projects are included:

1. *Spring wheat. High protein content through N-rich pre-crop and catch crop combined with medium-late acting supplement of organic fertiliser.* Field trial with and without catch crop after ley break-up where beef cattle manure and Bio Vinass are added at various times. The manure types represent cropping systems with and without animals resp. at comparable levels. Three trials (R7-340) were established in 2002. For the 2002 harvest, only the effects of organic fertiliser were investigated.

2. *Winter wheat. High protein content through N-rich pre-crop combined with measures to stimulate nitrogen mineralisation during spring/summer.* Field trial where the effects of different weed control soil tillage systems (tine harrowing, weed harrowing and row hoeing) are compared with untilled, with and without addition of cattle slurry. Three trials (R7-145) were established in 2002.

3. *Winter wheat/spring wheat. High protein content through N-rich pre-crop combined with measures to stimulate nitrogen mineralisation during spring/summer. Cultivar comparison.* Field trial where the effects of different weed control soil tillage systems (tine cultivator, weed harrow and row hoe) are compared with untilled. Different winter wheat and spring cultivars are being compared. Test baking and sensory analysis is being carried out in selected treatments. Four trials in spring wheat (R7-341) were carried out in 2002 and four in winter wheat (R7-146) were established in 2002.

Research on soil tillage and spring wheat cultivars in organic cropping (Sub-project 1 of Quality Bread Grain)

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Preliminary experiments have shown that greater row spacing and restricted seed rate combined with row hoeing produce considerably higher protein content in wheat with an acceptable reduction in yield. However, different cultivars react differently.

In experiments in 2002 at four different sites/regions, spring wheat at various row spacings was investigated with one to three harrowings to 12 cm and two row hoeings at 24 or 36 cm row spacing. The cultivars Dragon, Svenno and Ölänskt wheat were included.

Weed competition, straw and grain yield and quality were evaluated.

Effects of surface pan breaking with tine cultivator in spring

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Organic farming is to a great extent dependent on mechanical weed management. Concurrently, a central question on organic farms is how to cover the crop's demand for nitrogen.

Field trials are being carried out in which the effects of tine harrowing on weeds, nitrogen mineralisation and stand density are being investigated. Various soil tillage methods (crossboard roller, S-tine cultivator and weed harrow are being compared with untilled. Two trials are being carried out.

At surface pan breaking a superficial cultivation, to a depth of 2-3 cm , probably cause a significant mineralisation of nitrogen. The surface-soil layer usually contain more organic matter than deeper layers and therefore have a high potential for mineralisation.

The hyphotesis that the nitrogen mineralisation is significant after soil cultivation during the growth season is also supported by the fact that the mean temperature during early summer is high. That a soil cultivation is carried out during the fast growth stage of the crop means that the mineralised nitrogen can be utilized optimally unlike

Organic ley seed growing

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Since 2004, the EU requires that all seed used in organic production must be organically produced. Production of organic ley seed is a precondition for continued improvement and expansion of organic farming where leys and green manure crops are significant.

Traditional seed production currently comprises around 12 700 ha, with timothy as the dominant species. In Sweden, there is a long seed production tradition and we have a number of experienced growers. The conditions for pursuing organic seed production of our most common ley species (red clover, timothy and meadow fescue) are considered good. Seed growing is today often on a small scale and needs to expand rapidly to approx. 1 000-1 500 ha in order to meet the domestic demand for seed. Interest in organic seed production is great and courses within this subject area have been well attended since 2001.
However, organic seed growing places new demands to solve the problems of weed control, plant nutrient supply and yield in somewhat different ways. The crop has the potential to be very

profitable, but the risks associated with growing are high. In this project, the Rural Economy and Agricultural Societies of the main seed producing counties are working together to develop knowledge on how to produce organic ley seed areas of the dominant ley species timothy, red clover and meadow fescue

Red clover seed
There are two major problems, weed control and harvesting technique. Weeds must be managed so that the seed product maintains sufficiently high quality for certification. Here, weed harrowing at high intensity is being compared with row hoeing (24 and 36 cm row spacing), which is more effective on larger weeds and which also provides the potential to combat the weeds over a longer period. Yield, seed cleanliness and germinability are important parameters being measured.

Red clover is a late crop that often matures unevenly. In conventional growing, the crop foliage is routinely killed before harvest.

We are comparing cutting of the crop (field rowing) with direct combine harvesting and investigating the effects of aeration (turning with a hay rower). Yield, harvest losses, cleanliness and germinability are being measured. Three trials have been set up in each research series (R6-9112 and R6-9113).

Grass seed
Plant nutrient supply is of decisive importance for grass seed production. We are investigating the effects of two different plant nutrient sources, beef cattle manure and Bio Vinass, plus various establishment techniques (broadcasting and co-sowing at 24 cm row spacing) and various insown crops (barley and peas). Yield, cleanliness and germinability are being measured. Three trials have been set up in each research series (R6-9114 and R6-9115), of which two are timothy and one meadow fescue.

During the course of the project, contact is being made with several groups of farmers in accordance with the model for participatory research. These groups are providing valuable opinions on the results and through the combined experiences from the field research and their own experience they are suggesting refinements of the work for the future.

Organic oilseed growing – stand establishment, weed control and strategies against volunteer oilseed rape

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Organic production of oilseed crops (oilseed rape and turnip rape) in the past has been of modest proportions, with approx. 100 ha being harvested annually at the end of the 1990s. Cultivation has since increased, to 300 - 400 ha in 2000 and around 1 200 ha in 2001. Since autumn 1997, when the price of organically produced soya increased, market interest in organic oilseeds has been high. Since KRAV regulations require an increasing proportion of KRAV-approved feed, organically produced rapemeal will

continue to be of interest to both milk and pig producers. The need is estimated to be 2 000 tonnes for milk production alone, corresponding to a crop acreage of approx. 1 500 ha.

Growing of oilseed crops is associated with a range of difficulties, including the high N requirement of the crop, pest insects (particularly pollen beetle and rape beetle) and subsequent volunteer oilseed plants.

Documentation of growing in the period 1997-2001 revealed large variations in yield levels and cultivation technology problems. The yields measured varied between 200 – 3 200 kg/ha. The highest yield levels were obtained when slurry was supplied or when the pre-crop was a legume crop. Most cultivations were sown with 12 cm row spacing and no measures were taken to control weeds. Pollen beetle incidence was low in most cultivations. In parts of Östergötland and Västergötland where resistance to insecticides has been demonstrated, damage has increased in recent years.

Experiences from conventional cropping and research activities have provided advisory guidelines as regards e.g. seed drilling techniques. We are investigating the effects of various row spacings on weed incidence, N mineralisation and yield in organic winter oilseed crops in areas where winter oilseeds have reliable overwintering. Three trials (L7-818) are established annually in which the rape is sown at 12, 24 or 48 cm row spacing. Weed howing is being carried out in the 24 and 48 cm crops twice in the autumn and once in the spring.

Strategies for reducing the density of volunteer rape are being investigated in a separate trial (L7-819). Work begins in the spring in an existing winter oilseed crop through establishment of a catch crop. Thereafter winter wheat or spring cereal is sown. These trials are a valuable extension of project Dnr 25-5306/01, which aims to provide a more reliable basis regarding where the risk of winter dieoff exists each year.

During the course of the project, contact is being made with several groups of farmers in accordance with the model for participatory research. These groups are providing valuable opinions on the results and through the combined experiences from the field research and their own experience they are suggesting refinements of the work for the future.

Potassium dynamics in organic growing – with emphasis on ley

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Negative potassium (K) balances have been reported from ley-intensive organic cropping systems in both Sweden and other European countries. The reported negative K balances are often calculated for the entire crop rotation. When the K balance is calculated for the individual crops, it can be seen that for certain crops, e.g. cereals, K supply and removal are in balance or there is an excess of K. Ley crops on the other hand often have a large K deficiency.

In organic cropping systems, continual supply of K through mineral weathering is of great importance for maintaining long-term production capacity. We are studying this within the Formas-funded project 'Quantification of the Contribution of Mineral Weathering to Crop Potassium Supply for Sustained Long-term Production Capacity'. Since weathering is a slow process, the dynamics of the plant-available K fraction in the rootzone are of critical importance for crop K supply during the growing season. This is being investigated in this project.
In a ley crop where 2-3 cuts are made per year for 2-3 years, the interplay between crop requirements and uptake, the ability of the soil to deliver K, the timing of fertilisation and the

availability of the K in the fertiliser are decisive. The growth of the ley crop occurs during a short period of the year and the content of K in the crop is highly dependent on access to plant-available K in the soil. It is difficult to reserve fertilise with K because grass in particular has the ability to 'overconsume' K – i.e. if a certain amount of K is supplied in the form of manure at insowing and is intended to be sufficient for the insown crop and the ley for the whole of the first year, there can be problems with low K concentrations in the second and third cuts due to excessive K uptake in the first cut.

Potassium is seldom so limiting that it has a negative effect on ley yield, but it affects the feed value of the forage (K concentration in grass can vary from 0.5 % to 4-5 % and both too low and too high concentrations are undesirable). Low K concentrations also decrease the overwintering ability of the ley and increase its susceptibility to diseases/pests.

The aims of this project are to:

- Study K dynamics in organic ley crops and soil in existing cropping system trials during the growing season on three different soils in order to study the effects of supplying manure and to identify optimal times for manuring.
- Test various manuring strategies (timing and fertiliser, including animal manure/urine produced on-farm and other potential organic K-containing fertilisers) in field trials in existing leys.

In 2002, the project was run in cropping system trials around Kristianstad (three sites; Önnestad, Östra Ljungby and Bollerup) where there are three organic cropping systems (one pure plant system without animals and two with animals (manure), of which one is biodynamic, i.e. uses composted solid manure.

The trials include six-year crop rotations where all the crops are grown each year, which makes it possible within a season to sample the insown crop, Ley I, Ley II and Ley III (3-year leys only in Östra Ljungby) on the same soil and in the same climatic conditions.

Crop and soil samples are taken several times during the season to monitor K uptake dynamics (biomass growth and K concentration).

The results are being evaluated as time trends where the different cropping systems and crops are being compared. Based on the 2002 results and experiences from the literature and from commercial growing within and outside Sweden, field trials with various K manuring strategies for organic growing were established in the 2003 growing season. These trials are situated on documented K-deficient soils in existing ley crops and research is being carried out in collaboration with the Rural Economy and Agricultural Societies throughout Sweden and other actors.