SLU EkoForsk

A programme for organic agriculture and horticulture, coordinated and financed by the Swedish University of Agricultural Sciences (SLU).

These projects were initiated in 2005 and most of them will continue until 2007

Results from the projects are published in Swedish on http://Ekoforsk.slu.se
Updated 051213. Compiled by Ullalena Boström, coordinator.

Residual effects of various systems for the use of green manure crops

Project manager: Birgitta Båth, Department of Crop production Ecology, SLU, P.O. Box 7043,
SE-750 07 Uppsala, Sweden. *Phone:* 018-672310 *E-mail*: Birgitta.Bath@evp.slu.se

Due to uneven and weak crop emergence it was not possible to evaluate the first project described below.

Planned but not implemented trial:
Green manure crops with nitrogen-fixing leguminous plants adds locally produced nitrogen to the cropping system. This is an important element in crop rotations on farms with organic production of vegetables.

Different ways to handle the nitrogen fixated by green manure crops and how this influences the delivery of plant nutrient, population dynamics of pests and their predators and also the product quality were investigated in a project financed by FORMAS "The ecology of cultivation systems. Green manure crops as a multifunctional tool in vegetable growing".

In one of the field-trials, situated south of Ultuna at Krusenberg, four green manure strategies were studied during the growth-season 2004: direct incorporation, mulching, digestion and composting, in an experiment with leek for sale. Three different amounts of green manure were added by mulching, digested residue and compost. The amounts were based on the treatment with direct incorporation: 1. the same amount of nitrogen 2. the same amount of carbon 3. the estimated amount of available nitrogen. In the mulch treatment, an amount based on a practical point of view was also included.

In order to get an overall picture of the different strategies to use green manure crops, the residual effects will be studied during the cropping season 2005. Fresh- and dry weights of biomass and uptake of nitrogen will be measured at two times in a cereal crop or in ryegrass.

Symbiotic nitrogen fixation in clover-rich leys - quantification of nitrogen in the entire plant and in rhizodeposits

Project manager: Sigrun Dahlin, Department of Soil Sciences, SLU P.O. Box 7014
SE-750 07 Uppsala, *Phone*: +46 18 67 1229, *e-mail*: Sigrun.Dahlin@mv.slu.se

A nitrogen budget is a tool for assessing utilization efficiency in a cropping system, as well as for assessing the risk of losses to the external environment. It is also a tool for evaluating the effects of different management options. To make reasonable budgets, reliable data are needed on nitrogen inputs and outputs. Inflow of nitrogen through symbiotic nitrogen fixation is often a weak point, which means that budgets may become unreliable. This is particularly evident in organic production systems where the primary inflow of nitrogen is largely through symbiotic fixation in pastures and fodder or green manure leys, or in other leguminous crops.

We have currently very little field data on below-ground amounts of nitrogen fixed in leys and how these are affected by management practices such as trimming regime. Our own results from a model experiment indicate that the relative proportions of above-ground and below-ground plant-derived nitrogen are substantially affected by trimming. In contrast to fodder leys, the trimmings are left on

the ground in green manure leys. Very little is known about how this affects further nitrogen fixation, stabilization of nitrogen in the soil or residual nitrogen effect.

In this project, we are aiming to: 1) Quantitatively determine symbiotic nitrogen fixation in red clover in a green manure ley in the field; 2) determine the proportion of the fixed nitrogen in roots; and 3) determine the proportion of the fixed nitrogen in rhizodeposits. We are also investigating 4) how trimming of the ley affects symbiotic fixation, recycling of nitrogen in the system, residual nitrogen effect and losses to the external environment. The project is co-funded by Formas.

The nitrogen mineralization process after application of organic fertilizers at different times of the year

Project manager: Sofia Delin, Department of Soil Sciences, SLU, Division of Precision Agriculture, P.O Box 234, SE-532 23 Skara. *Phone*: +56 511 67 235, *e-mail*: Sofia.Delin@mv.slu.se

To achieve high nitrogen efficiency with maximized yields and minimized nitrogen losses to the environment, the availability of nitrogen from organic fertilizers must be synchronized with crop uptake. By documentation of the course of mineralization under field conditions, it is possible to estimate when nitrogen that has not yet been mineralized should become plant available in relation to the time of fertilization. This information is necessary in order to decide when to fertilize to achieve maximum nitrogen use efficiency.

This project aims to study the course of nitrogen mineralization under natural temperature conditions after fertilization at different times of the year. This is done through incubation of organic fertilizers mixed with soil in plastic bottles. The ammonium and nitrate nitrogen are hereby kept within the system being studied and the changes with time can be calculated.

The bottles are placed in the topsoil at different times of the year, simulating times of fertilization. They are aerated through a pipe emerging at the soil surface. The soil temperature is measured continuously.

The fertilizers being studied in this project are meat and bone meal, dairy slurry, dairy farmyard manure, broiler manure and a by-product from yeast production.
On all occasions when bottles are placed in the field, a treatment with only soil is added to determine how much the soil organic material contributes to the mineralization.

The soil in the bottles is a sandy soil and the bottles (3 replicates) are placed in a field in south-west Sweden (Västergötland) at 2-4 different times of fertilization depending on the type of fertilizer being tested. These different times of fertilization are autumn, early spring, spring (at sowing) and early summer. Bottles are taken up for analysis of NH_4-N and NO_3-N on 3-7 occasions depending on time of fertilization. In this way, the contents of ammonium and nitrate are used to describe the course of mineralization from the time of fertilization until late autumn after the end of the growing season.

Nitrogen supply to organic winter oilseed rape - nitrogen sources, time of application and incorporation techniques

Project manager: Maria Stenberg, Department of Soil Science, SLU, Division of Precision Agriculture, P.O. Box 234, SE-532 23 Skara.
Phone: +46 511 67 274. *E-mail*: Maria.Stenberg@mv.slu.se

Project group: Lena Engström, SLU, Ingemar Gruvaeus, the Rural Economy and Agricultural Societies - Skaraborg; Ann-Charlotte Wallenhammar, The Rural Economy and Agricultural Societies – Örebro; Per Johan Lööf, the Swedish Farmers Supply and Crop Marketing Association

The shift from 95 to 100% organically grown fodder for ruminants will further increase the need for organic oilseed products. The nitrogen (N) demand of a winter oilseed crop is large. Oilseed plant growth starts early in spring and during stem elongation in April and beginning of May, the net N mineralization in the soil is usually small. Low yields in organic oilseed cropping may in most be related to low plant nutrient supply. It is important that organic fertilizers are added to the crop at a time when N utilization and N supply are optimal. The efficiency of commercial organic fertilizers needs to be investigated when these are added at low temperatures. There is a risk of slow N delivery and weak effect unless the fertilizer is incorporated and good soil contact can be provided, which is the case when organic fertilizers are added in spring to winter crops.

The aim of this study is to present sustainable strategies for N supply to winter oilseed rape with organic fertilizers at farms with or without animal production, and thereby increase the sustainability of crop production. Two hypotheses will be tested:

- N delivery of organic fertilizers is improved by inter-row incorporation by cultivation immediately after addition compared to broadcasting.
- Broadcasting early in spring before the start of crop growth (1- 15 March) increases the N delivery from organic fertilizers compared to broadcasting after the start of crop growth (1-15 April).

These hypotheses will be tested by investigation of several commercial organic fertilizers applied by different techniques in different plant densities. The correlation between organic fertilizer and conditions at spreading will be studied to analyse possibilities to influence factors that improve N delivery from the organic fertilizers and thereby increase their utilization efficiency.

The project will be conducted in three field experiments per year over two years, the first experiment was established in August 2005.

Cultivation systems on organic arable farms – improvement of plant nutrient management

Project manager: Maria Wivstad, Department of Crop Production Ecology/Centre for Sustainable Agriculture, SLU, P.O. Box 7047, SE-750 07 Uppsala.
Phone +46 18 67 1409 *Fax*: +46 18 67 3571 *E-mail*: Maria.Wivstad@evp.slu.se

The project is a synthesis study involving collaboration between a number of actors, including farmers, advisors and researchers. The project is divided into three parts:

Part 1. Analysis of plant nutrient balances. Inventory of the current situation regarding plant nutrient management where, in general, existing plant nutrient balances are critically appraised and complemented. The analysis also includes international publications.

Part 2. Method development for determination of nitrogen fixation in green manure crops at farm level.

Part 3. Case studies of cultivation systems. A collaboration in Skania between farmers, advisors and researchers in practitioner-driven research with the aim of improving plant nutrient management on farm level.

There is currently a lack of knowledge about plant nutrient management on organic farms with arable production systems in various regions of Sweden. A good factual foundation is very important in allowing potential improvements to be identified. From the side of society, there is also an express aim to increase organic production and thereby the biological diversity in rural areas dominated by arable farms. For organic arable farms, plant nutrient management, especially the nitrogen fixed by leguminous plants, is very important.

The overall aim of the project is to generate recommendations from an overall view on farm cultivation systems regarding crop sequence, fertilisation intensity, management of green manures and other fertilisers, use of catch crops and soil tillage strategies. These components are all critical for plant nutrient utilisation on organic arable farms.

Establishment and weed management in organic growing of white clover, red clover and grass seed

Project managers: Lars Andersson[1], Department of Crop Production Ecology, SLU P.O. Box 7043, SE-750 07 Uppsala; Ann-Charlotte Wallenhammar[2], the Rural Economy and Agricultural Societies – Mitt, Box 271, SE-701 45 Örebro.
Phone: +46 18 67 3366[1], +46 19 603 2718[2]
E-mail: Lars.Andersson@evp.slu.se, AC.Wallenhammar@hush.se


Foto: A.-C. Wallenhammar

Certified seed for organic leys has to meet the same demands for purity and germinability as seed for conventional farming. This calls for very efficient weed control. *Matricaria perforata* and *Rumex longifolius* constitute serious problems that must be dealt with by expensive manual weeding. An improved method for establishment of the crop might offer better possibilities to control the weeds. Today, most farmers use a row distance of 12 cm, which does not allow the use of weed hoeing. In this project we will study the establishment of white clover (*Trifolium repens*) at

different row distances, and the effect of weed hoeing.

The establishment of white clover for seed production has been little studied. Cutting of the crop in the seeding year has been tested by farmers as a weed control measure. The effect of mowing might have great importance for the degree of weed infestation and thus for the purity of the seed. Studies are being conducted on the effect of cutting at different development stages and cutting heights, in both red clover (*Trifolium pratense*) and white clover.

When establishing grass crops for seed production, sowing in pure stands in spring/early summer or in a green crop fallow makes it possible to cut the crop in summer. Summer cutting reduces the weed emergence in autumn and the number of over-wintering weeds. Different establishment routines and sowing dates are being investigated in timothy (*Phleum pratense*) and meadow-fescue (*Festuca pratensis*). The crop is harvested the first seeding year.

Winter oilseed rape established in a living mulch of white clover

Project managers: Göran Bergkvist[1] and Desirée Börjesdotter[2], Department of Crop Production Ecology, SLU, P.O. Box 7043, SE-750 07 Uppsala.
Phone: +46 18 67 2910[1], +46 18 67 1425[2]
E-mail: Goran.Bergkvist@evp.slu.se, Desiree.Borjesdotter@evp.slu.se

The aim is to contribute knowledge to the development of an organic cropping system where winter oilseed rape can be grown successfully and where the need for specific green manure crops is lower than in common organic cropping systems. We aim to test whether winter oilseed rape produces higher yields and takes up more nitrogen when a preceding white clover-dominated ley crop is only partly killed before sowing of the rape.

We will also test different methods of establishment of winter rape and the effect of reducing grass/clover and weed biomass mechanically in the rape on biomass production and nitrogen uptake of the rape and a succeeding winter wheat crop.

Development of organic ley seed production using participatory methods

Project manager: Johanna Björklund, Department of Rural Development and Agroecology, SLU, Centre for Sustainable Agriculture , P.O. Box 7047, SE-750 07 Uppsala, Sweden
Phone: +46 18 67 1422 *Fax*: +46 18 67 3571 *E-mail*: Johanna.Bjorklund@cul.slu.se

For the future development of organic agriculture it is important to increase organic ley seed production, especially in the view of the increased EU requirements on the use of organic seed. The interest from farmers is great, but only a few have any prior experience of this kind of production. The production places special demands on e.g. harvest and post-harvest treatment. Moreover, to grow seed organically there is need for weed regulation, nutrient supply and harvest with partly new methods. Today the rejection percentage is higher in organic production compared to conventional, due to higher amounts of weed seeds, which are complicated to separate out. With many new growers involved, the preparedness to solve problems has to be high for farmers as well as advisors and researchers.

The main objective with this project is therefore to improve the situation for organic ley seed growers. A participatory approach is used to increase the feedback between research and farming and to test knowledge and new ideas in real situations to improve the development of organic seed production. In a participatory research group the main problems in relation to the production of major ley seed species will be identified, as will appropriate methods to deal with such problems.

The results of inquiries will be analysed and evaluated in the group and will bring about changes on the participating farmers' own farms, as well as changes in policy. The group consists of about 15 farmers, advisors and researchers from eastern Sweden. The project started in 2004 and will run for three years.

Investigation of new presprouting techniques to achieve faster emergence and tuber development in organic potato farming

Project managers: Jannie Hagman[1], Department of Crop Production Ecology, SLU, P.O. Box 7043, SE-750 07 Uppsala. Björn Andersson, Department of Forest Mycology and Pathology, SLU, P.O. Box 7026, SE-750 07 Uppsala.
Phone: +46 18 67 1423[1] , +46 18 67 1617[2]
E-mail: Jannie.Hagman@evp.slu.se Bjorn.Andersson@evp.slu.se


Foto: Jannie Hagman

Organic growing of potatoes is very difficult and the acreage of organically grown potatoes has decreased during the last two years. The biggest problem is *Phytophthora infestans* (potato leaf blight), which causes the crop foliage to wilt and thus stops tuber growth. There are no really effective methods for protecting the potato crop against *Phytophthora infestans* allowed in organic potato farming in Sweden. The best methods to achieve a reasonable yield are use of varieties tolerant or resistant to *Phytophtophora infestans* and actions to give the crop a quick and early start, for example presprouting.

The aim of this project is to investigate new presprouting techniques that can shorten the time span between planting and emergence to achieve earlier tuber development. The methods promote the development of roots on the seed tubers.

Weed control in organic farming - a study of perennial sow-thistle

Project manager: Anneli Lundkvist, Department of Crop Production Ecology, SLU, P.O. Box 7043, SE-750 07 Uppsala.
Phone: +46 18 67 2712 *Fax*: +46 18 67 2909 *E-mail*: Anneli.Lundkvist@evp.slu.se

Regulation of perennial weeds like sow-thistle (*Sonchus arvensis* L.), creeping thistle (*Cirsium arvense* (L.) Scop.), and common couch (*Elymus repens* (L.) Gould) is one of the greatest challenges in organic farming. In northern parts of Sweden in particular, *S. arvensis* has become one of the most difficult perennial weeds to control on organic farmland. Several studies have been performed on how to control *C. arvense* and *E. repens*. However, fewer experiments have been performed on *S. arvensis* and much research remains to be done in this area, for example detailed studies in a

controlled environment on the influence of competition from crops in combination with mechanical control on the growth and development of *S. arvensis*.

In the experiments planned here, we are therefore going to study how *S. arvensis* is affected by various crops, cultivation techniques and mowing.

The aim is to develop more efficient weed control methods for *S. arvensis* in organic farming.

Management of the soil-borne disease corky root in organic tomato production through the use of compost

Project manager: Paula Persson, Department of Crop Production Ecology, SLU,
P.O. Box 7043, SE-750 07 Uppsala.
Phone: +46 18 67 2358 *E-mail*: Paula.Persson@evp.slu.se

Tomato is the dominant crop in organic greenhouse production in Sweden. The soil-borne disease corky root, caused by the pathogenic fungus *Pyrenochaeta lycopersici*, is the most serious production problem. In intensive production systems or when the soil is reused for three to four years, the yield reduction can reach 30 to 40%.

Earlier research has shown that compost can suppress disease development.

The idea of this project is to investigate the possibility to suppress corky root through adding composts produced from local on-farm resources.

- We will study composts from green manure (red clover), horse manure and garden waste and initially test the suppressive effect in a 10-week bio test together with full-scale experiments with tomato plants and *Pyrenochaeta*.
- We aim to identify physical, chemical and microbiological parameters that indicate disease suppression by the compost.
- We will also study the possibility to strengthen the antagonistic effect of the composts by adding fungivorous nematodes previously studied *in vitro* and known to have a preference for the corky root fungus.

The project is a PhD study with MSc Hasna Mabuka Kaniz as postgraduate student.

Influence of application technology on the pest control effect of oil and/or soap in fruit and berry production

Project manager: Sven Axel Svensson, Department of Landscape Management and Horticultural Technology, SLU, P.O. Box 66, SE-230 53 Alnarp.
Phone: +46 40 41 5145 *Fax*: +46 40 46 4085 *E-mail*: Sven-Axel.Svensson@lt.slu.se

Oils and soaps could be used against pests in organic farming and they therefore represent potential means to reduce the use of chemical pesticides. However, their application requires total coverage of the pest, as these substances act directly through inhibiting the respiratory organs or through damaging the skin. The application methods currently in use are inadequate, resulting in an unreliable and non-uniform biological effect.

The purpose of this project is to study means and methods to improve the application technology and by this guarantee the effect.

During year 1, investigations were carried out on biological effect, tank agitation and technical application methods. These will continue during years 2 and 3, combined with field experiments, implemented against important pests in raspberry, strawberry and fruit (in cooperation with growers and advisors).

Tanniferous forage for improved nitrogen efficiency in organic dairy production

Project manager: Torsten Eriksson, Department of Animal Nutrition and Management, SLU, Kungsängen Research Centre, SE-753 23 Uppsala.
Phone: +46 18 67 1643 *E-mail*: Torsten.Eriksson@huv.slu.se

Starting from 2008, rations in organic dairy farming must consist of 100% organic feeds. This requirement will create a great challenge for the protein supply of high-yielding cows. Important protein crops like soybeans and sunflowers are not suitable for growing in Sweden. A key factor in organic dairy farming is successful utilization of homegrown forage. Forage from leys dominated by legumes such as red clover, white clover or lucerne already forms the basis of rations for organic dairy cows in Sweden. The nitrogen-fixing ability of legumes supports high forage yields without artificial fertilizers. Their high crude protein content should theoretically be sufficient to cover most of the cow's protein requirement.

Unfortunately, crude protein from legumes is generally not well utilized by the ruminant. The protein is rapidly degraded in the rumen to ammonia, which is taken up by the bloodstream and subsequently excreted as urinary urea. A lower ruminal degradation rate of forage protein would allow more of the degraded protein to be recycled as microbial protein. Furthermore, a larger proportion of undegraded feed protein would escape the rumen and be absorbed in the small intestine. Both these alterations would contribute to an improved protein supply.

Certain legumes such as birdsfoot trefoil and sainfoin contain condensed tannins, which decrease ruminal protein degradation by binding to proteins. The protein-tannin complex is dissolved when exposed to the lower pH in the abomasum and the protein may then be digested and absorbed in the small intestine. Despite the relatively low tannin content of birdsfoot trefoil grown in Sweden, previous experiments have demonstrated varietal differences in ruminal *in vitro* degradation of protein.

The objective of the experiment is to examine whether a ration with silage from birdsfoot trefoil grown in Sweden has the capacity to improve protein supply and nitrogen utilization in dairy cows. Silage from a birdsfoot trefoil-perennial ryegrass ley will be compared to silage from a white clover-perennial ryegrass ley and fed to dairy cows in early lactation. Milk production and nitrogen excretion from faeces and urine will be measured. Microbial protein production will be estimated by analyses of urinary allantoin and total purines in rumen contents. Nitrogenous compounds such as peptides, amino acids and ammonia will also be monitored in the rumen to define the extent of protein degradation.

These measurements will allow us to study the proportion of intake protein excreted in milk, faeces and urine and also to estimate differences in microbial protein production.

Locally produced protein feeds and vitamin supply for dairy cows

Project managers: Birgitta Johansson[1] and Elisabet Nadeau[2], Department of Animal Environment and Health, SLU, P.O. Box 234, SE-532 23 Skara.
Phone: +46 511 67 293[1], +46 511 67 142[2] *E-mail*: Birgitta.Johansson@hmh.slu.se, Elisabet.Nadeau@hmh.slu.se

Project group: Søren Krogh Jensen, DJF, Research Centre Foulum, Denmark. Karin Persson Waller, National Veterinary Institute of Sweden.


Foto: Annika Arnesson

New EU regulations are forcing organic dairy producers to find 'new' protein sources. In 2000, the use of hexane-extracted feed was prohibited in organic dairy production, which ended the use of protein meals. The aim of organic farming is to compose a diet of 100% organic feed. It can be difficult to find high-quality organic protein feeds, since there is a shortage of organically produced feed with a high AAT-content. It would be convenient and economical to be able to produce protein feed locally. Cold pressed rapeseed cake is an excellent protein source in organic dairy production and results of our new study will hopefully show that field beans, peas and lupin are also useful protein sources.

There is a general ban on the use of synthetic vitamins in organic production in the whole EU but currently there is an exemption from this ban. It is of great interest to find new solutions.

The study will be performed at Tingvall Organic Dairy Research Farm (the Rural Economy and Agricultural Societies - Väst) and will run for two lactations.

Peas will be compared to field beans during the first lactation and to lupin during the second lactation. Both groups will be fed minerals without synthetic vitamins. Half the cows in each group will be fed semi-natural vitamin E for 3-4 weeks before calving to 2-3 weeks after calving.

Blood and milk samples will be analysed for vitamins to examine the effects of adding semi-natural vitamin E during the critical time around calving. Milk yield, milk composition, health and fertility will be registered to determine effects of protein source.

Protein value and fatty acid composition of hemp seed

Project manager: Kjell Martinsson, Department of Agricultural Research for Northern Sweden, SLU – Forage Research Centre, P.O. Box 4097, SE-904 03 Umeå. *Phone*: +46-90-786 8740. *E-mail*: Kjell.Martinsson@njv.slu.se

The objective of this project is to investigate the protein value and fatty acid composition of organically grown hemp seed (Finola, Fin-314).

The possibility of ruminants and other farm animals increasing their use of locally produced protein feeds, e.g. protein from hemp seed, and the way in which the essential fatty acids in hemp might be used most efficiently in organic feeding need to be further investigated. Consequently a first step should be to estimate the protein quality and fatty acid composition of hemp seed.

Hemp seed for chemical analysis will be collected from ongoing crop production experiments. The hemp seed will be harvested after 100 days of growth.

- At harvest, appropriate amounts of seed material will be collected for further analysis.
- Hemp oil will be produced from the seed by cold pressure.
- The remaining hemp cake will be analysed separately.

Increased feeding of organically grown hemp seed will result in increased use of locally produced feeds and more healthy products (milk and meat). The overall result of the project should be improved protein/fat-utilisation in organic animal production.

Field beans/spring wheat as whole crop silage in dairy production

Project manager: Kjell Martinsson, Department of Agricultural Research for Northern Sweden, SLU – Forage Research Centre, P.O. Box 4097, SE-904 03 Umeå. *Phone*: +46-90-786 8740 *E-mail*: Kjell.Martinsson@njv.slu.se

In organic dairy production there is a great need for locally produced protein crops as a complement to clover/grass-silage. Increased cropping of intermediate crops as an alternative to cereals is also very desirable. High quality clover/grass-silage is a prerequisite to increased use of locally produced protein/starch crops, for instance field beans.

Thus, the possibility of high-yielding dairy cows meeting their feed requirements on 100% organic feeds, e.g. field beans, and ways in which field beans could be most effectively used in dairy cow production need to be further investigated.

Crop production experiments using field beans and with spring wheat as a bi-crop, conducted in the counties of Värmland and Västerbotten, have resulted in a harvest of 9000 kg DM/ha compared to 6000 kg DM/ha for pea/oats as bi-crop. The main objective of this project is to investigate the production potential of field beans as whole crop silage in dairy cow feeding.

A further objective is to produce extension service material. In the experiment a feeding experiment will be conducted, including feed intake, feed utilization, milk production, N-efficiency and milk composition. Four different clover-grass-silage/field beans rations will be compared. All forages will be fed *ad lib*, while the concentrate will be fed at a constant level.

Optimization of diets in organic poultry production

Project manager: Lotta Waldenstedt, Department of Animal Nutrition and Management, Funbo-Lövsta Research Centra, SE-755 97 Uppsala.
Phone: +46 18 67 4531 *Fax*: +4618 67 4501 *E-mail*: Lotta.Waldenstedt@huv.slu.se

Poultry has higher requirements for sulphur-containing amino acids (especially methionine and cysteine) than any other food-producing animals due to the plumage protein. This is a minor problem in conventional poultry production, where diets are supplemented with pure (synthetic) amino acids. In organic animal production, however, such additions are not allowed, giving a dependence on special methionine/cysteine-rich protein sources.

Fish meal is used as a protein source in feed in organic production but there is public opinion that fish should be left for human consumption. Today there is no KRAV-approved fish meal and the situation will become even more complicated if the requirement to permit only diets with 100% approved feed raw materials comes into force, before there is an alternative to fish meal.

Mussels (*Mytilus edulis*) are a potential 'new' animal protein feed source in poultry feeds, regarding protein level and quality, as well as having the potential to be KRAV-approved. Mussels could be an alternative to fish meal. In Sweden we produce about 1 800 tonnes of mussels every year. Mussel cultivation has positive environmental effects and could make it possible to remove nitrogen from waters on the west coast of Sweden. However, after hot summer periods, mussels may be temporarily contaminated with toxins caused by bloom events of toxic algae. This is the largest threat to the development of financially viable mussel farming in Sweden. In a pilot study, laying hens were fed mussels containing toxins. No negative effects on the birds were observed.

The aim of the study is to evaluate mussel meal (with and without algae toxins) as a protein source in feed for poultry. Traditional methods for feed evaluation will be used in both conventional and organic production systems. The study will also include hens of different genotypes.

This project is a co-operation with Kristineberg Marine Research Station.