Master Thesis Projects
Topics within Agroecology

Agro Environmental Management & Agrobiology MSc Programmes
2020-2021

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March 2020

Preface

Present catalogue of master thesis projects available in 2020-2021 has been prepared to help students in their decisions on selecting a topic for their thesis project. Proposals are presented in detail together with contact addresses as well as other practical information.

The project proposals presented in this catalogue are primarily intended for students of the **Master's Degree Programme in Agro Environmental Management**, and in **Agrobiology,** but will also be available for students of Biology, Geography, Geology and other master degree programmes within Natural Sciences, (e.g. International Master in Soils and global Change) and for bachelor thesis students as far as the students have the scientific prerequisites needed to accomplish a specific project.

If you intend to make a master or bachelor thesis project on a topic not mentioned in this catalogue, please contact and discuss it with one of the course lecturers.

Your thesis work can be performed at Department of Agroecology or one of the other research departments involved in the master's degree programmes (see also catalogues from these departments). During your thesis work you will be attached to the specific section within this department, where the main supervisor is situated.

Three thesis types are offered:

- **Thesis 30 ECTS credits**
  Theoretical thesis based on literature studies and/or analysis of issued and edited data sets.
- **Thesis 45 ECTS credits**
  Experimental thesis in which the student is responsible for collection and analysis of original raw data. The quality of the data collection, analysis and editing must be included in the overall assessment.
- **Thesis 60 ECTS credits**
  Experimental thesis in which the student is responsible for planning of trial design and methods as well as collection and analysis of original raw data. The quality and independence of own trial design, planning of data mining from original data bases or the development of new theories must be included in the overall assessment. The quality of the data collection, analysis and editing must also be included in the overall assessment.

The two Agroecology Master's Degree Programmes, Agro-Environmental Management and Agrobiology (see http://agro.au.dk) builds on components from multiple disciplines at Aarhus University. Therefore, studies in relation to both environmental, social and economic sustainability, and the interactions between agroecology, management, economy and environmental sciences are encouraged. You therefore get a broad education with specialized skills. The strong research base means that the teaching is undertaken by leading international scientists within the main study areas. During your studies you will get a holistic understanding of the impacts of agriculture on environment, nature and climate, and how these impacts can be managed.

With an **MSc in Agro-Environmental Management** you will be well equipped to seek a wide variety of jobs. With extensive knowledge and interdisciplinary expertise in the area of agriculture, nature, environment and climate interactions, there are job opportunities in, for example, regional environment agencies, municipal nature conservation offices, agricultural advisory services, consulting engineers, teaching, NGOs in nature and environment, EU institutions, ministries and other public authorities. Research is also an obvious career choice. Read more at**:** http://kandidat.au.dk/en/agro-environmental-management/

Read more about the **MSc i Agrobiology** at http://kandidat.au.dk/en/agrobiology/, and the MSc thesis catalogues from Department of Animal Science and Department of Food Science.

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1. Interactions among arbuscular mycorrhizal fungi, plant beneficial bacteria, and crop

Main supervisor
Sabine Ravnskov
Department of Agroecology – Crop Health
sabine.ravnskov@agro.au.dk
Fastnet: +4587158136
Mobil: +4522283313

Physical location of the project
AU Flakkebjerg and the Plant Health research department of Chr. Hansen located in Tåstrup.

Project start time
No specific time

Extent and type of project
45 or 60 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.

Main subject area
Plant-microbe interactions, biopesticide

Additional information
The master student will be conducting the project under supervision of Sabine Ravnskov (AU) and a scientist from Chr. Hansen

Short project description
The microbial community in the plant rhizosphere is extremely diverse and there are a lot of organisms that can have a positive effect on plant development. This master thesis project will focus on the interaction between arbuscular mycorrhiza and plant beneficial bacterial strains in the rhizosphere and their effects on plants. The student can choose to put the emphasis on the microbiology or plant part.

2. When do plants get heat stroke?

Main supervisor:
Professor Carl-Otto Ottosen
Department of Food Science
Faculty of Science and Technology
Aarhus University
coo@food.au.dk
Phone: 22903105

Physical location of the project:
Department of Food Science, Årslev (after Nov 1, 2019, AgrofoodPark, Skejby)

Project start:
No specific time

Extent and type of project:
45 or 60 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.

Main subject area:
Photosynthesis, plant adaptation, global change, stress, climate, temperature

Additional information:
The Master student are linked to a group of scientists, technical staff and PhDs, thus the student will make the project in an international working team. The experimental work is linked to ongoing research using state of art equipment for physiological analysis of plant reactions. This increases the possibilities of making a scientific paper in connection with the M.Sc-thesis.

We might be able to provide paid accommodation for a period during your project depending on availability.

Short project description:
Both in the greenhouse and outside plants might be subjected to short and long term stress by temperature. How does different species cope with this stress by changing growth habit, by changing photosynthesis or other methods? Experimental plants can be different cereals or soya or broad beans linked to current phenotyping project. We have a joint project with South African researchers screening for heat tolerance in different bean species.

3. Stress in wheat production under global change

Main supervisor:
Professor Carl-Otto Ottosen
Department of Food Science
Faculty of Science and Technology
Aarhus University
coo@food.au.dk
Phone: 22903105

Physical location of the project:
Department of Food Science, Årslev (after Nov 1, 2019, AgrofoodPark, Skejby)

Project start:
No specific time

Extent and type of project:
45 or 60 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.

Main subject area:
Photosynthesis, plant adaptation, global change, stress, climate, temperature

Additional information:
The Master student are linked to a group of scientists, technical staff and PhDs, thus the student will make the project in an international working team. The experimental work is linked to ongoing research using state of art equipment for physiological analysis of plant reactions. This increases the possibilities of making a scientific paper in connection with the M.Sc-thesis.

We might be able to provide paid accommodation for a period during your project depending on availability.

Short project description:
Ongoing studies of wheat aim to select and predict plant performance under various climate change condition especially focusing on high temperature effects linked to water stress of the photosynthesis reaction of plants in different stages of development and whether high CO_2 can make the plant less sensitive or whether combinations of stresses affect the plants differently using state of art technology to monitor plants reactions. The projects are part of an international project ModCarbostress aiming to improve models of plant reactions to climate change.

4. Cool plants - how do they react to cool conditions?

Main supervisor:
Professor Carl-Otto Ottosen
Department of Food Science
Faculty of Science and Technology
Aarhus University
coo@food.au.dk
Phone: 22903105

Physical location of the project:
Department of Food Science, Årslev (after Nov 1, 2019, AgrofoodPark, Skejby)

Project start:
No specific time

Extent and type of project:
45 or 60 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.

Main subject area
Photosynthesis, plant adaptation, global change, stress, climate, temperature

Additional information:
The Master students are linked to a group of scientists, technical staff and PhDs, thus the student will make the project in an international working team. The experimental work is linked to ongoing research using state of art equipment for physiological analysis of plant reactions. This increases the possibilities of making a scientific paper in connection with the M.Sc-thesis.

We might be able to provide paid accommodation for a period during your project depending on availability.

Short project description:
This project is dealing with how different plant species react to lower than normal temperatures and the idea to so the aim for the M.Sc. project could be to study effects of shorter or longer periods of lower than normal temperature on growth and physiology of the plants. This can be important to evaluate new crops potential in Denmark due to the sudden spells of cold conditions in the sowing period.

5. How does plant cope with high humidity?

Main supervisor:
Professor Carl-Otto Ottosen
Department of Food Science
Faculty of Science and Technology
Aarhus University
coo@food.au.dk
Phone: 22903105

Physical location of the project:
Department of Food Science, Årslev (after Nov 1, 2019, AgrofoodPark, Skejby)

Project start:
No specific time

Extent and type of project:
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Main subject area:
Photosynthesis, plant adaptation, global change, stress, climate, temperature

Additional information:
The Master student are linked to a group of scientists, technical staff and PhDs, thus the student will make the project in an international working team. The experimental work is linked to ongoing research using state of art equipment for physiological analysis of plant reactions. This increase the possibilities of making a scientfic paper in connection with the M.Sc-thesis.

We might be able to provide paid accomodation for a period during your project depending on availability.

Short project description:
This proposed project is dealing with how different plant species react to conditions when the water content of the air is high and we're interested in how the stomata is regulated by both humidity, but we can also include reactions to different spectral light compositions and other climate factors. Using high tech methods we can follow plants reaction to climate – such as humidity and water stress. The project can be done on species that is included in a joint project with commercial growers.

6. Does changes in light composition affect the plants?

Main supervisor:
Professor Carl-Otto Ottosen
Department of Food Science
Aarhus University
coo@food.au.dk
Phone: 22903105

Physical location of the project:
Department of Food Science, Årslev (after Nov 1, 2019, AgrofoodPark, Skejby)

Project start:
No specific time

Extent and type of project:
45 or 60 ECTS: Experimental thesis in which the student is responsible for collection and analysis of his/her own original data.

Main subject area:
Photosynthesis, plant adaptation, global change, stress, climate, temperature

Additional information:
The Master student are linked to a group of scientists, technical staff and PhDs. The experimental work is linked to ongoing research using state of art equipment for physiological analysis of plant reactions. This increases the possibilities of making a scientific paper in connection with the M.Sc-thesis.

Short project description:
Growing plants under different light spectral light composition can affect both plant shape, photosynthesis, growth rate and secondary metabolites, so you can be part of a team that works to improve the taste of herbs, make a more sustainable plant production and trying to developed the future plants production in urban multilayer farming. The Thesis can focus on physiology, plant growth and metabolites.

7. Legumes for the future

Main supervisor:
Professor Carl-Otto Ottosen
Department of Food Science, Aarhus University
coo@food.au.dk
Phone: 22903105

Physical location of the project:
Department of Food Science, Årslev (after Nov 1, 2019, AgrofoodPark, Skejby)

Project start:
No specific time

Extent and type of project:
45 or 60 ECTS: Experimental thesis in which the student is responsible for collection and analysis of his/her own original data.

Main subject area:
Photosynthesis, plant adaptation, global change, stress, climate, temperature, legumes

Additional information:
The Master student are linked to a group of scientists, technical staff and PhD. The experimental work is linked to on going research using state of art equipment for physiological analysis of plant reactions. This increases the possibilities of making a scientific paper in connection with the M.Sc-thesis if this should be of interest.

Short project description:
One of the challenges in agriculture is to get enough protein crops both for human consumption, so we focus on understanding of how we can find legumes (faba and soya beans) for the Danish climate, but also working on South African bean types adapted to high temperatures in collaboration with several South African universities. This can be done by studies of the physiological responses to cold and high light and nutrient deficiency. Part of the project might be made in South Africa if we can get student grants.

8. Designing cover crop mixtures to improve nitrogen cycling

Department and main supervisor

Main Supervisor: Diego Abalos Rodriguez; Co-supervisor: Søren O. Petersen
Department of Agroecology: Climate and Water, Soil Fertility
Mobile: +4520854336; email: d.abalos@agro.au.dk

Physical location of the project and students work

Department of Agroecology, AU Foulum, 8830 Tjele

Project start

Anytime

Main subject area

Plant biodiversity/climate change mitigation/cover crop mix/plant-soil interactions/nitrogen

Short project description

Agriculture is one of the greatest contributors to air and water pollution due to over-application of synthetic fertilizers. Current fertilization techniques aim to increase plant yield through application of mineral nitrogen (N) fertilizer, but plants retain only 50% of fertilizer N. The remaining N can be lost in the form of nitrous oxide, a potent greenhouse gas that contributes to ozone depletion, and as nitrate leaching, causing eutrophication of water bodies and dead zones. In this project, we will address this problem by identifying cover crop mixtures that reduce N losses while enhancing the provision of ecosystem services. The synergistic effect between different cover crop species (grasses, legumes, and brassicaceae) will be investigated in a set of greenhouse and field experiments. We will reveal the best cover crop mixtures, and explain why these specific mixtures reduce N losses based on their leaf and root traits. Measurements will include quantification of N losses (in air and water), N fixation, soil mineral N, and plant biomass and traits above- and belowground. Ultimately, the student will propose a promising strategy to steer the biological processes that underpin N losses and plant N retention in agroecosystems. This is a great opportunity for a young researcher to be involved in a project that will provide experience in the greenhouse or in the field, aiming for discovering new ways to reduce our impact on the environment by making agriculture more efficient. Active guidance from the main supervisor as well as from the PhD student in charge of the experiments will be provided in a collaborative environment. This increases the possibilities of making a scientific paper in connection with the MSc thesis.

Extent and type of project

45 ECTS: Experimental theses; responsible for collection and analysis of own original data
60 ECTS: Experimental theses; responsible for planning, trial design and collection and analysis of own original data

Additional information

[1] Abalos, D., De Deyn, G. B., Kuyper, T. W., & van Groenigen, J. W. (2014). Plant species identity surpasses species richness as a key driver of N_2O emissions from grassland. *Global Change Biology*, *20*, 265–275. [2] Abalos, D., van Groenigen, J. W., & De Deyn, G. B. (2018). What plant functional traits can reduce nitrous oxide emissions from intensively managed grasslands? *Global Change Biology*, *24*, 248–258. [3] Abalos, D., van Groenigen, J. W., Philippot, L., Lubbers, I. M., & De Deyn, G. B. (2019). Plant trait-based approaches to improve nitrogen cycling in agroecosystems. *Journal of Applied Ecology*, *56*, 2454–2466.

9. Botanical composition of organic clover-grass pasture

Department and supervisor
Department of Agroecology
Troels Kristensen, Senior scientist - troels.kristensen@agro.au.dk
Jørgen Eriksen, Professor - jorgen.eriksen@agro.au.dk

Physical location of the project and students work
Research center Foulum as daily working place and field registration at a commercial dairy farm located 45 minutes drive from Foulum.

Project start
Preferably may 2020 – alternative at the latest end of June 2020.

Main subject area
Pasture, grazing, herbage intake, herbage composition, animal preference

Short project description
In an on-going research and development project "Grassmilk" http://agro.au.dk/forskning/projekter/graesmaelk/ the aim is to produce organic certified milk from cows that are feed entirely with clover-grass, either as pasture during summer or as silage during the winter season. This raise the question, which botanical composition of the clover-grass mixture can balance the nutritional needs of the cows and at the same time insure a high dry matter net production per area over the season and over years maintain both botanical composition and productivity.
The aim of this MSc project is therefore to investigate how different clover-grass mixtures develop in productivity and quality over a grazing season and in addition to investigate the variation between the mixtures in intake preference when grazing with dairy cows.
The empirical material is one field (9 ha), with five different clover-grass mixtures established in 2018 with three replicates, in total 15 field plot. The herd of 100 dairy cows will be grazing the field – as part of other field – in a rotation grazing system with 3 to 5 weeks interval.
This gives possibilities for looking at productivity and botanical composition during a season, potentially in combination with difference frequency of grazing. The planning of this and the registration is part of the MSc project in close cooperation with the supervisor.
We expect that you can work intensively during the summer season with registrations in the field and during the following period make data analysis and literature review with focus on persistency of different clover-grass mixtures and the effect on livestock productivity.

Extent and type of project
45 or 60 ECT point

Additional information
(E.g. perquisites, conditions, useful reading, etc.....)

10. Weed dynamics in non-inversion tillage systems

Department and supervisor:
Bo Melander, Associate professor
Department of Agroecology
bo.melander@agro.au.dk
22 28 33 93

Physical location of the project and students work:
Research Centre Flakkebjerg, Forsøgsvej 1, DK-4200 Slagelse

Project start:
Whenever it suits the student

Main subject area:
Weed science

Short project description:
The student will extract data from two running field experiment with four different crop rotations combined with four primary tillage schemes: 1. Mouldboard ploughing, 2. Non-inversion tine tillage and 3. Direct drilling. The data are from a long-termed cropping history and can help explaining the weed dynamics associated with the omission of inverting tillage. There are many more data (crop yield, crop stand, soil physics, nitrogen and pesticide inputs etc.) to work with in addition to the weed related data. Conservation agriculture is very topical and the student will get a deeper insight into the cropping issues related to this practice.

Extent and type of project:
30 ECTS: Theoretical thesis based on literature studies and/or analysis of issued and edited data sets.

Additional information:
The student should have an interest in statistics and the analyses of data. The work can mostly be done from Aarhus and will only require a few trips to Flakkebjerg

11. Crop tolerance to automated weeding with a mechanical device

Department and supervisor
Bo Melander, Associate professor
Department of Agroecology
bo.melander@agro.au.dk
22 28 33 93

Physical location of the project and students work
Research Centre Flakkebjerg, Forsøgsvej 1, DK-4200 Slagelse

Project start
Spring, late summer or early autumn

Main subject area
Weed science

Short project description
Automatic weeding in the crop line of row crops is a new technology that is gradually being implemented in practice. It controls intra-row weeds that normally require manual removal and currently the method works satisfactorily in several transplanted row crops. However, a complete removal of intra-row weeds depends on the proximity to crop plants at which the automatic weeder can operate without injuring the crop plants severely. Hence, information about crop tolerance to mechanical impact in close proximity to crop plant centres is essential to determine the settings of automatic weeders including the amount of weeds that will remain after weeding. The project is based on experimentation in the laboratory using a mechanical kit for simulating hoeing at different distances from the centre of crop plants.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

OR

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
The student should have an interest in experimentation, data collection and the analyses of data. The experimental work needs to take place at AU-Flakkebjerg

12. Phosphorus dynamics on soils with high phosphorus status

Department and supervisors
Department of Agroecology
Gitte H. Rubæk, gitte.rubaek@agro.au.dk, tlf 87157686
Ingeborg Frøsig Pedersen, ifp@agro.au.dk

Physical location of the project and students work
Department of Agroecology, AU Foulum

Project start
Autumn 2020

Main subject area
Phosphorus fertilization, crop responses and soil phosphorus dynamics

Short project description
Crops grown on soils with high soil phosphorus (P) status should in principle be well-supplied with P from the soil P reserve. However, in some field experiments, we observe a clear growth response to P fertilizer on soils with high P status, indicating that the supply from the soil P reserve does not match the crop demand. We speculate, whether the geological origin of the soil affects the soil´s ability to release P to the soil solution, but this lacks proper documentation.

The project aims to link crop growth response after P fertilizer application to soil properties affecting P availability on soils with contrasting geological origin. In 2020 we are doing six field experiments with increasing P fertilizer application rates in Northern Jutland. In these trials, we will sample soil, determine in-season crop development and final yield at harvest in collaboration with Seges.

You can be a part of the project, and you will be involved in the laboratory work, where soil P dynamics will be studied including P binding and ion exchange capacity studies. You will also have the opportunity to be a part of the field-work during winter 2020/21, where soil properties related to root development will be studied. This is done in collaboration with technicians from AU.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
The experimental part of the project will carried out at AU-Foulum in collaboration with technicians and post docs. If you have any questions feel free to contact the supervisors.

13. Crop responses to long-trem fertilization with contrasting phosphorus sources - a lysimeter study

Department and supervisor
Department of Agroecology
Gitte H. Rubæk, gitte.rubaek@agro.au.dk, tlf. 87157686
Ingeborg Frøsig Pedersen, ifp@agro.au.dk, tlf. 27141009

Physical location of the project and students work
Department of Agroecology, AU Foulum, with possible visits to Askov Experimental Station

Project start
Any time.

Main subject area
Plant nutrition with focus on phosphorus availability, animal manure and inorganic phosphorus fertilizer

Short project description
Crops may respond differently to different sources of phosphorus (P), but the fact that soil P typically is the main source of P for a crop any given year makes it difficult to detect differences in P availability and crop response to contrasting P fertilizer sources in single year studies. Therefore, long-term studies of crop response to different P sources and P rates offer unique possibilities for in-depth evaluation of the importance of P fertilizer source.

The aim of this project is to evaluate whether P applied as liquid animal manure or solid animal manure are as valuable P sources as P given as inorganic P fertilizer based on a long-term ongoing lysimeter experiment at Askov Experimental station. Data on crop yield, crop P uptake have been collected each year since 1991, and these data will be made available for the student along with information on soil properties related to P availability such as Olsen P content and soil pH. It will be possible to supplement the already available data with some additional soil analyses made by the student.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

Additional information
The data you are going to work with is gathered from lysimeters since 1991 at Askov experimental Station. The project will include working with statistical models, which take into account repeated measurements. If you have any questions feel free to contact the supervisors.

14. Microbiomes of root-knot nematodes - implications for biocontrol

Department and supervisor
Postdoc Olivera Topalovic, otopalovic@agro.au.dk
Postdoc Susana Santos, suss@agro.au.dk
Researcher Mette Vestergård, mvestergard@agro.au.dk

Physical location of the project and students work
AU Flakkebjerg, Forsøgsvej 1, DK-4200 Slagelse

Project start
Anytime

Main subject area
Biological pest control, microbial ecology

Short project description
Root-knot nematodes (RKN) are the most severe plant-parasitic nematodes that are extremely difficult to control using conventional agricultural methods. Certain nematode-antagonistic fungal and bacterial strains were isolated from dead nematodes and soils with a low nematode survival rate, but their biocontrol effects *in situ* have not always met the desirable results. We believe that nematodes associate with microorganisms that protect the nematode against such antagonistic microorganisms. Therefore, we are interested to unravel which microbiomes associate with RKN on different susceptible host plants, expecting to find low functional differences between them and a high presence of nematode-promoting functions. In addition, we would like to see whether the composition of microbiomes that associate with RKN on different hosts is more dependent on the plant itself or on soil type in which plant grows. Finally, we would like to compare the microbial composition of different nematode stages and to compare our results over two nematode generations. This work will be important for unraveling nematode-promoting microorganisms, which could be targeted in an integrated management approach to consequently reduce plant susceptibility to RKN.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
In this project, you will have the opportunity to perform experiments at several levels of detail and complexity from nematode-microbial petri dish interaction experiments using microscopy to plant experiments, work with nematode/microbial culturing techniques, advanced molecular microbial methodologies, e.g. DNA extraction, amplification and high-throughput sequencing.

15. Drought tolerance in barly and wheat: effects of a candidate gene

Department and supervisor
Per L. Gregersen
Senior Researcher
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Physical location of the project and students work
Department of Agroecology
AU-Flakkebjerg
Forsøgsvej 1
4200 Slagelse

Project start
Flexible

Main subject area
Plant breeding and molecular genetics, abiotic stress tolerance in plants

Short project description
The expected climate changes with more frequent drought periods during the growth season of crop plants have made it even more important than ever to improve the abiotic stress tolerance of future crop plants through plant breeding. Thus, the discovery and introduction of effective genes in crop plants conferring drought tolerance is very important. In this project, a specific candidate gene for drought tolerance will be studied in barley and wheat. The gene is involved in the formation of water conducting vessels in plant roots. The main goal is to test whether down-regulation of the candidate gene in mutant plants will increase the drought tolerance of the plant. The experiments will be performed in greenhouses, outdoor growth facilities, and laboratories at AU-Flakkebjerg. The experiments will involve drought test experiments and molecular biology lab work to verify the presence of specific mutations in the experimental plants.

Extent and type of project
45 ECTS/60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

16. Medical cannabis and mildew resistance

Supervisors
Phd, academic researcher Christina Rønn Ingvardsen
Christina.ingvardsen@mbg.au.dk, phone: 8715 4982
Professor MSO Henrik Brinch-Petersen
hbp@mbg.au.dk, phone: 8715 8268

Physical location of the project and students work
Department of Agroecology, AU_Flakkebjerg, Forsøgsvej 1, 4200 Slagelse

Project start
Any time

Main subject area
Molecular cloning, genome editing, resistance, crops

Short project description
Medical Cannabis sativa is grown in closed environments making them highly vulnerable to powdery mildew. Today's available cultivars only have a limited resistance towards powdery mildew and new resistant cultivars are most wanted, as current means to control powdery mildew infections are time consuming and costly in terms of energy consumption and CO2 emission.

We are developing powdery mildew resistant Cannabis sativa utilizing the molecular method CRISPR/Cas9 to target Mildew resistance locus o (Mlo) genes in the plants. Genetic mutations in these genes will likely lead to mildew resistance, in line with what is seen in other species.

In the project, we use techniques such as PCR and cloning of genes into E. coli, tissue culture, CRISPR/Cas9 genome editing, transformation with Agrobacterium tumefaciens and infection studies with powdery mildew. Depending on the progress of the project and at which time point you might join our team, your master project will be designed in detail.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

17. Compost as a tool to improve soil fertility in vegetable production

Department and supervisor
Department of Food Science
Hanne Lakkenborg Kristensen, Associate Professor
Hanne.Kristensen@food.au.dk
Phone: 20 69 80 54

Co-supervisor: Margita Hefner

Physical location of the project and students work
Department of Food Science, Agro Food Park 48, 8200 Aarhus N

Project start
September 2020

Main subject area
Organic matter decomposition, soil fertility, plant production, carbon, nitrogen

Short project description
Producing vegetables tend to deteriorate the soil as it requires intense cultivation with many machine operations. This results in reduced soil quality and structure. Applying compost to the soil is one possible solution to improve soil quality, when at the same time contributing to the re-circulation of plant material and nutrients, and carbon storage.
The frame of this master thesis project is to conduct a pot trial in the greenhouse, including a combination of different compost and soil types to investigate their effect on nutrient uptake, plant growth, as well as soil biochemical status and soil microbiological activity.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
(E.g. perquisites, conditions, useful reading, etc.)
The master project will be linked to the European project SOILCOM 'Sustainable soils by quality compost with defined properties' granted by the Interreg North Sea programme (https://northsearegion.eu/soilcom/).

18. Reinventing Q - New breeding technologies for an ancient wheat gene

Department and supervisor
Claus Krogh Madsen, Ph.D.
ClausKrogh.Madsen@mbg.au.dk
Department of Agroecology, Section of Crop Genetics and Biotechnology (CGB)

Physical location of the project and students work
Research center Flakkebjerg
Forsøgsvej 1, 4200 Slagelse

Project start
Preferably August 2020 but this open for negotiation.

Main subject area
Crop plant biotechnology – CRISPR/Cas9

Short project description
The wheat gene variant Q emerged early in agricultural history and has been key to making wheat one of the most important crops in world. Wheats with Q have compact spikes and seeds that are easy to separate from the husks. In comparison, wheats with wild type q allele, called spelt, are very difficult to thresh and has lower yield and inferior gluten strength. Accordingly, the Q variant of the gene completely dominates in modern wheat.

Wheat has a complex genome made up of the genomes of three ancestor species. This means that most wheat genes are found in three almost identical copies. In the case of Q/q, only one copy has mutated to become Q. Another has maintained the original q sequence and the third as lost its function.

The current project will explore the possibility of converting the remaining q gene into a novel Q gene to create wheat with further enhancement of the attractive traits provided by Q. The tools will be the new breeding technologies CRISPR/Cas9 and *in silico* TILLING. CGB was the first lab in Denmark to apply these new technologies to cereals and both are used in other current projects.

Extent and type of project
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
In silico TILLING lines should be identified and ordered as soon as possible ahead of project start. This will require one or two working days with supervision in Flakkebjerg.

19. Starch biosynthesis and breeding for new starch functioinalities

Department and supervisor
Kim Hebelstrup, Associate Professor
kim.hebelstrup@mbg.au.dk, +4550387921

Physical location of the project and students work
Department of Agroecology, AU-Flakkebjerg, 4200 Slagelse

Project start
Any time

Main subject area
Crop Molecular and Cell Biology, Plant Breeding

Short project description
Starch is a major component of several crops species including cereals and potatoes. Starch is biosynthesized into small subcellular granules of a diameter size at 1 – 50 µm. How this is controlled at a cellular and molecular level is not yet fully understood. So in these projects, it is possible to study basic biosynthesis and well as breeding for specific purposes, e.g: 1) Crops with resistant starches for a more healthy diet, including collaboration with Aarhus University Hospital doing clinical research involving such crops. 2) Starches for new environmental friendly and biodegradable bioplastics including collaboration with companies in this field.

Extent and type of project
30 ECTS: Theoretical thesis based on literature studies and/or analysis of issued and edited data sets.

45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information (in Danish)
https://www.dr.dk/nyheder/viden/miljoe/danske-forskere-vil-dyrke-bioplastik-paa-marken
https://videnskab.dk/kort-nyt/dansk-forsker-laver-byg-plante-med-kun-sunde-kulhydrater

20. Crop evolution, history and domestication

Department and supervisor
Kim Hebelstrup, Associate Professor
kim.hebelstrup@mbg.au.dk, +4550387921
Henrik Brinch-Pedersen, Professor
hbp@mbg.au.dk

Physical location of the project and students work
Department of Agroecology, AU-Flakkebjerg
4200 Slagelse

Project start
Any time

Main subject area
Genetics, Crop Molecular and Cell Biology, Plant Breeding

Short project description
Crops have a fascinating evolutionary history. In these projects, it is possible to study how cereal crops or potatoes originated and how they continued to evolve since pre-history and when actual, breeding technologies emerged in the 20th century. This involves comparing crop species with their wild ancestors. However, may also involve studies of dried or charred historic and pre-historic grains through collaboration with museums.

Extent and type of project
30 ECTS: Theoretical thesis based on literature studies and/or analysis of issued and edited data sets.

45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data.

21. New technology for on-farm production of organic compost and mineral fertilisers

Department and supervisor
Hanne Lakkenborg Kristensen, Associate Professor, Department of Food Science, hanne.kristensen@food.au.dk, +45 20698054

Physical location of the project and students work
Department of Food Science (AU-FOOD), Agro Food Park 48, 8200 Aarhus N

Project start
Any time

Main subject area
Organic fertilisers and composts, plant biomasses, documentation of technology, nitrogen and carbon mineralisation

Short project description
A newly invented farm-scale composting technology enables recirculation of biomass into plant-based compost and mineral fertilizers. The new technology can improve resource use efficiency, soil fertility and carbon storage in organic vegetable production and outphase conventional nutrient sources. However, we lack understanding of the composting process. The aim of this master project is to investigate the use of the newly invented composting technology. How does biomass quality added to the machine influence the composting processes inside and the resulting quality of compost products and condensed nitrogen fertilisers? The focus will be on carbon and nitrogen mineralisation and microbial processes.

Extent and type of project
30 ECTS: Theoretical thesis based on literature studies and/or analysis of issued/edited data sets.

45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
The master project will be linked to the project ComCrop 'New Composting Technology for On-farm Nutrient and Carbon Recycling to Organic Soils and High-Value Crops' granted by the RDD5 programme. The student will collaborate with AU-FOOD staff and the technology company ComFerm ApS on the experimental work.

22. Sustainable intensification and plant-based fertilisers for production of vegetables: double-cropping, nitrogen recycling, and soil fertility.

Department and supervisor
Hanne Lakkenborg Kristensen, Associate Professor, Department of Food Science, hanne.kristensen@food.au.dk, +45 20698054

Physical location of the project and students work
Department of Food Science (AU-FOOD), Agro Food Park 48, 8200 Aarhus N

Project start
Any time

Main subject area
Organic vegetables, new intensive cropping systems, intercropping, nitrogen recycling, plant-based fertilisers, root growth, early indicators of carbon storage

Short project description
The global agenda asks for production of vegetables in a sustainable and efficient way. The organic farming agenda asks for less use of conventional manure in organic production. The aim of this project is to study new cropping systems for production of organic vegetables based on diversification, organic on-farm fertilisers and continuous plant cover to build soil fertility, avoid leaching of nitrate and increase carbon storage. This is done by use of intercropping, plant-based fertilisers and autumn-winter crops combined with tight nitrogen recycling in the plant-soil system. Two long-term field trials, DoubleCrop and SureVeg, are conducted at the Research Center Aarslev. They offer unique possibilities to study agronomic factors, crop and root growth, nitrogen uptake and soil fertility, and to test your own ideas in a new perspective.

Extent and type of project
30 ECTS: Theoretical thesis based on literature studies and/or analysis of issued/edited data sets.
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
The master project will be linked to one of two projects depending on interests & time of the year:

1) DoubleCrop 'Increased production by double cropping, plant-based fertilizers and reduced tillage' granted by GUDP under the RDD3 research program: https://icrofs.dk/en/research/danish-research/organic-rdd-3/doublecrop/
2) SureVeg 'Strip-cropping and recycling of waste for biodiverse and resource-efficient intensive vegetable production' granted by EU-CORE organic COFUND and InnovationFund DK: https://projects.au.dk/coreorganicco-fund/core-organic-cofund-projects/sureveg/

23. Trait improvement in crop plants using genome editing

Department and supervisor
Henrik Brinch-Pedersen, Professor MSO, Department of Agroecology,
hbp@mbg.au.dk, Phone: 45 87158268

Zelalem Eshetu Bekalu, postdoc, Department of Agroecology,
ZelalemE.Bekalu@mbg.au.dk, Phone: 87157682

Michael Panting, postdoc, Department of Agroecology,
mpanting@mbg.au.dk, Phone: 87158245

Physical location of the project and students work
AU Flakkebjerg, Forsøgsvej 1, DK-4200 Slagelse

Project start
As soon as possible before summer 2020

Main subject area
Cereals

Short project description
The recent advancement of genome editing like CRISPR/Cas9 has substantially contributed to the improvement of several beneficial traits in plants.

In the current project, specific genes known to be responsible for specific traits in plants will be edited in barley using CRISPR/cas9 and base editors. Our group has already identified genes responsible for Fusarium head blight (FHB) disease resistance and protein digestibility traits in cereals, mainly in barley. Different mutant lines for the specific genes will be produced and genotyped, and the resulted lines will be analyzed for the specific trait (FHB or protein digestibility), both in the laboratory and greenhouse settings.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
Candidate students are expected to have basic molecular biology background. The section of Crop Biotechnology and Genetics has well-established facilities to perform advanced plant molecular biology experiments.

24. Bio-berry

Department and supervisor
Supervisor: Associate Professor Merete Edelenbos
Co-supervisors:
Post-docs: Thayná Mendanha and Alexandru Luca
Department of Food Science
Agro Food Park 48, Skejby
tm@food.au.dk
Phone: +45 2224 6647

Physical location of the project and students work
Department of Food Science, Agro Food Park 48, 8200 Aarhus N

Project start
Any time

Main subject area
Post-harvest, shelf life, fruit quality, growing media

Short project description
The master project will investigate how different sustainable alternatives to peat based growing media can affect strawberry fruit quality and its shelf life. The student will be responsible for conducting post-harvest experiments. Fruits will be evaluated by their visual appearance (size/colour/glossiness), physical quality (firmness, water content), chemical quality (sugar/acid content, volatile aroma compounds or other relevant constituents), physiological quality (respiration rate) and shelf life performance (water loss/physical and chemical quality/decay/sensory quality). The master student will be associated with the BioSubstrate project from GUDP. The project aims to evaluate different growing media to replace peat (sphagnum). Selected substrates originating from **biomasses** (miscanthus, willow, meadow grass, straw, fodder grasses, wood chips) or residual products from **bio-based productions** (fiber fractions from biogasification and protein juice production) will be tested in the strawberry production together with Hunsballe nursery.

Extent and type of project
45 or 60 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.

Additional information
The Master student will be part of an international working group of scientists, technical staff and PhDs. The experimental work is linked to an ongoing research project using state of art equipments and new facilities at Agro Food Park. This increases the possibilities of making a scientific paper in connection with the M.Sc-thesis.

25. Are lime and gypsum effective means to improve soil structural quality and reduce risk fo phosphorus loss on degraded soil?

Department and supervisor

Department of Agroecology
Lars J. Munkholm, lars.munkholm@agro.au.dk, phone +45 25152716
Goswin Heckrath, goswin.heckrath@agro.au.dk, phone +45 51435035

Physical location of the project

Department of Agroecology, Research Centre Foulum

Project start

Summer/Autumn 2020

Extent and type of project

45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Main subject area

Degraded soils, Soil structural quality, Soil physical properties, Soil friability, Wet stability.

Short project description

The aim of this project is to quantify the long-term effect of liming and gypsum amendment on soil physical quality and surface runoff risk. Under Danish conditions poor topsoil structure is a problem on loamy soils with low organic matter content. They may in the worst case develop into so-called "hardsetting" soils that are very difficult to manage. Hardsetting soils display low strength in wet conditions and a large risk of clay dispersion. This may cause problems in crop production (poor seedbed quality and crop establishment) and for the environment (increased loss of phosphorus (P) and pesticides by surface runoff). The effectiveness of lime or gypsum for mitigating the problems remains to be tested under Danish conditions. This may be supplemented with controlled surface runoff experiments testing the effect of gypsum application in a hilly field. There will be special focus on soil erodibility and friability. The latter will be determined both in the field (visual assessment, drop shatter) and in the laboratory (tensile strength).

Additional information

Experiments will be carried out on long-term liming trials in Denmark together with SEGES.

Useful reading

Blomquist, J., Simonsson, M., Etana, A., Berglund, K., 2018. Structure liming enhances aggregate stability and gives varying crop responses on clayey soils. Acta Agriculturae Scandinavica, Section B — Soil & Plant Science 68, 311-322.
Ekholm, P. et al. 2012. Gypsum amendment of soils reduces phosphorus losses in an agricultural catchment. Agricultural and Food Science 21, 279-291.
Materechera,S.A., 2009. Aggregation in a surface layer of a hardsetting and crusting soil as influenced by the application of amendments and grass mulch in a South African semi-arid environment. Soil and Tillage Research, 105, 251-259.
Obour, P.B., Jensen, J.L., Lamandé, M., Watts, C.W., Munkholm, L.J., 2018. Soil organic matter widens the range of water contents for tillage. Soil and Tillage Research 182, 57-65.

26. Cover crops and straw incorporation: Impact on soil physical conditions and relation to soil organic carbon

Department and supervisors:
Department of Agroecology
Lars J. Munkholm, lars.munkholm@agro.au.dk, phone +4525152716
Johannes L. Jensen, jlj@agro.au.dk, phone +4526360847

Physical location of the project:
Department of Agroecology, Research Centre Foulum

Project start:
Flexible

Extent and type of project:
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

Main subject area:
Soil quality, Soil management, Soil degradation and recovery, Soil organic carbon, Soil structural stability, Soil pore characteristics

Short project description:
Loss of soil organic carbon (SOC) is a major threat to sustained soil functions and services globally. Further, the climate crisis demand us to focus on mitigating greenhouse gas emissions in agriculture. One strategy is to sequester CO_2 from the atmosphere by e.g. incorporation of straw and the use of cover crops (increase biomass input into the soil). However, the effect of increasing rates of straw incorporation and cover crops on both soil functions and C sequestration are limited since long-term field experiments are required. The project exploit a unique long-term field experiment from Askov starting in 1981 with varying amounts of straw incorporation (0, 4, 8, 12 t/ha/year) and +/- ryegrass as cover crop in a spring barley monoculture. The **aim** of this project is to quantify the effect of straw incorporation and ryegrass as a cover crop on soil structural stability (SSS), pore characteristics and SOC as well as their interrelationships.

Additional information:
Undisturbed soil cores and bulk soil will be sampled in spring 2020 after which the experiment will stop. Pore characteristics will be measured shortly afterwards on the soil cores, whereas bulk soil will be stored at 2°C until required. The student will receive data on SOC and soil pore characteristics, and in collaboration with the supervisors plan SSS and strength measurements on bulk soil. Further, the student may use archived soil samples and carry out SSS measurements on them, which makes it possible to investigate the development of SSS and SOC as a function of time (1981 to 2020).

Useful reading:
Thomsen, I.K., Christensen, B.T. 2004. Yields of wheat and soil carbon and nitrogen contents following long-term incorporation of barley straw and ryegrass catch crops. Soil Use and Management, 20, 432-438.
Jensen, J.L., Schjønning, P., Watts, C.W., Christensen, B.T., Obour, P.B., Munkholm, L.J. 2020. Soil degradation and recovery – Changes in organic matter fractions and structural stability. Geoderma, 364, 114181.

27. Exploring impact of climate change on germination of weed and/or crop species

Department and supervisor
Johannes Ravn Jørgensen, Associate Professor, jrj@agro.au.dk. Tlf.: 8715 8314
Peter Kryger Jensen, Senior Scientist, PKJ@agro.au.dk. Tlf: 8715 8195

Physical location of the project and students work
Department of Agroecology, AU Flakkebjerg, Forsøgsvej 1, 4200 Slagelse

Project start
Any time, experimental work can also be conducted at any time.

Main subject area
Weed/crop/seed biology

Short project description
Changes in the climate and new management practices influences sowing time of the cereals. However, a good establishment of cereals is an important starting point both for a high yield and a high level of competitiveness against weeds. With the restrictions to control weeds, all relevant options to prevent and reduce the weed development utilized. The foremost possibility to prevent weeds is a fast germinating and developing crop to restrict the weeds chance to germinate and become established. Moreover, the desire to increase cereal yield have in recent years lead to great focus on exploiting the optimum growing season. This has led to renewed focus on timely and optimal establishment of spring as well as winter cereals.

A temperature gradient table is available at AU Flakkebjerg. The temperature gradient table allows the germination of seeds at 8 different temperatures. The temperature can either be kept constant or with a daily cycle. Counting germinated seeds regularly during the germination process gives a dataset with combinations of percentage germination at different temperatures. From the dataset models describing germination according to temperature sums can be fitted. Such models are available for a number of important weed and crop species. Interested students can select their own favourite species for the investigation. The study could include investigation of interaction between sowing depth, seed size, seed vitality and temperature, which is of great importance for successful establishment of seed crops.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
You are welcome to contact one of the supervisors to discuss the opportunities for designing the project to fit your ideas.

28. Factors driving the climate impact of milk from dairy cows

Department and supervisor
Troels Kristensen, Senior Scientist, Troels.Kristensen@agro.au.dk
Jesper Overgård Lehmann, Postdoc, JesperO.Lehmann@agro.au.dk
Department of Agroecology.
Maike Brask, Sustainability Specialist, Maike.Brask@arlafoods.com

Physical location of the project and students work
Department of Agroecology, AU Foulum. A few days per month can be spent at Arla's head-quarters in Aarhus.

Project start
Summer 2020, can be decided individually.

Main subject area
Greenhouse gas emission, dairy farming systems, lifecycle assessment, modelling.

Short project description
Greenhouse gas (GHG) emissions from dairy farming is largely dependent on the ability of the farm to utilize resources efficiently including feed, manure and energy. Several models exist that can calculate the emission from a particular dairy farm based on a number of farm-specific input. The dairy company Arla Foods has created such a model and used it to estimate the GHG emission from a large number of individual farms from mainly Denmark but also other European countries where Arla sources milk. These climate accounts show a large heterogeneity in terms of farm types including breed, size and intensity, with a resulting large heterogeneity in estimated GHG emission per kg of milk produced.

The main objective of this project is to investigate the factors that drive the final GHG emission per kg of milk produced based on the climate accounts that Arla has collected over the years. The project can include specific investigations into emissions from feed production, model build-up and inclusion of various technologies to reduce on-farm emissions. Finally, the project can include strategies for reducing GHG emission from various farm types.

Extent and type of project
45 ECTS.

Additional information
The student should have strong analytical skills and be capable of handling large datasets in excel and preferably R.

Useful reading
Kristensen et al., 2011. Livestock Science 140, 136-148.

29. Testing a new methodology for measuring aggregate stability

Department and supervisor
Mathieu Lamandé, mathieu.lamande@agro.au.dk, +45 8715 7694
Co-supervisors: Emmanuel Arthur

Physical location of the project and students work
Department of Agroecology, AU Foulum, 8830 Tjele, Denmark
Department of Environment and Natural Ressources, Norwegian University of Life Sciences, 1462 Ås, Norway

Project start
Any time

Main subject area
Soil quality, aggregate stability, methodology

Short project description
Aggregate stability is an important physical property of soils. Soil aggregates are the elemental bricks of the macroscopic structure of soils. Modification of aggregates arrangement or destruction of aggregates have important consequences on soil ecosystem services, as soil aeration, plant available water, root growth, access of nutrients, filtering of pollutants, erosion, etc. Classical methods for determination of aggregate stability require specific equipment, are time consuming, and often need a noticeable amount of soil. A newly developed quick and inexpensive method shows great potential for accurate determination of aggregate stability in the field. However, this method should still be tested against classical methods and for a range of soil conditions. That is what we propose to do in the present project. We intend to determine aggregate stability using the new methodology and a classical rain simulator for a range of soil types and land uses, and to compare results from the new method against the reference method.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data
or
60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

Additional information
Fajardo M., McBratney A.B., Damien J.Field D.J., Minasny B., 2016. Soil slaking assessment using image recognition. Soil and Tillage Research 163, 119-129.
Amézketa E., 1999. Soil aggregate stability: a review. J. Sustain. Agric., 14, 83-151.

30. Impact of climate change on soil traffic ability and workability in Northern Europe

Main supervisor
Mathieu Lamandé, mathieu.lamande@agro.au.dk, +45 8715 7694
Co-supervisors: Lars Munkholm, Per Schjønning

Physical location of the project and students work
Department of Agroecology, AU Foulum, 8830 Tjele

Project start
Optional

Main subject area
Soil tillage, soil mechanics, climate change, modeling, decision support.

Short project description
To qualify the suitability of soils for tillage and traffic, the term readiness has been introduced. The readiness of a soil for an operation is a combination of the workability (soil conditions are optimal for a given field operation as tillage or sowing) and trafficability (soil-machine conditions allow sustainable traffic in the field, i.e. without subsoil compaction), both of which are influenced by the soil properties, the weather, the crop, the operation and the machinery used. The time a field is in a state of readiness for an operation is then the window of opportunity for the farmer to enter the field and perform this operation with an optimal use of resources. In the present project, the state-of-the-art knowledge on machinery-soil-climate interactions for planning of field operations at the farm scale will be utilized to evaluate the impact of a range of climate change scenario on soil readiness for different field operations. Output from the simulations will be in form of, for specific production systems we believe will be used in Nothern Europe in the coming decades, the number of days of soil readiness for specific operations depending on different climate change scenario. Results from the project will help identifying the coming challenges for mechanized agriculture in Northern Europe.

Extent and type of project
30 ECTS, 45 ECTS, or 60 ECTS: The student will be able to decide on the extend of the study and on the number of scenarios to be tested (for example: comparison of past, present and expected climate).

Additional information
Lamandé, M., Greve, M.H., Schjønning, P., 2018. Risk assessment of soil compaction in Europe - rubber tracks or wheels on machinery. CATENA 167, 353-362.
Obour P.B., Jensen J.L., Lamandé M., Watts C.W., Munkholm L.J., 2018a. Soil organic matter widens the range of water contents for tillage. Soil Tillage Research 182, 57-65.
Obour P.B., Kolberg D., Lamandé M., Børresen T., Edwards G., Sørensen C.G., Munkholm L.J., 2018b. Effect of compaction and sowing date on soil physical properties and crop yield of a loamy temperate soil. Soil Tillage Research 184, 153-163.
Obour P.B., Keller T., Lamandé M., Munkholm L.J., 2019. Pore structure characteristics and soil workability along a clay gradient. Geoderma 337 1186-1195.

31. The soils of Greenland

Main supervisor: Professor Lis Wollesen de Jonge, lis.w.de.jonge@agro.au.dk, 24940550 or Senior researcher Mogens H. Greve, mogensh.greve@agro.au.dk, 20726734
Co-supervisor: Researcher Maria Knadel, maria.knadel@agro.au.dk and post doc Trine Nørgaard trine.norgaard@agro.au.dk

Physical location of the project and students work:
Department of Agroecology, AU Foulum, Blichers Allé 20, 8830 Tjele. Possibility for participating in excursion to southern Greenland

Project start:
The optimal start is August where the Greenland expedition takes place

Main subject area:
We have a number of possible thesis topics: 1. Mapping of carbon stock of soils in Greenland, 2. Soil water retention and plant available water of Greenlandic soils, 3. Micro and macro nutrient content, pH and CEC in Greenlandic soils, 4. Water repellency of Greenlandic soils, 5. Physical and chemical effects of adding glacier flour to Greenlandic soils, 6. Landuse mapping using drone images (requires good technical, software and hardware skills), and 7. You may formulate your own project idea within the described frame

Short project description:
The rapid climate change taking place in Greenland has serious repercussions for animal and plant life throughout the country. The rising temperatures can, however, offer better conditions for a future agricultural production in Greenland. The natural soil resources available for such a production in South Greenland are scantily mapped. Hitherto, our investigations in parts of South Greenland have shown that soils are typically sandy with wind-blown silt (loess) and high organic matter contents that have, as yet, not resulted in a well-developed soil structure. This is most likely because of the influence of temperature on biological activity and the tendency of organic matter to induce hydrophobicity in certain drought conditions. In addition, the soil profile down to the rock base is in many places quite thin, which together with said hydrophobicity is likely to make plant-availability of water the most limiting factor for good and healthy plant growth. Besides these pilot studies, the terrestrial resource is completely uncharted territory with regard to characteristics and suitability for agricultural production.

We will map key soil properties for the sustainable use of the land for growing crops and for grazing livestock for South Greenland. We will focus on an area located in Vatnahverfi, one of the two major agricultural catchment areas in South Greenland, in the direction from Igaliku down to Qaqortoq. We will examine the soil (organic matter, texture and soil depth), water conditions (bound water, plant-available water and how particularly the more organic soils repel water during drought) as well as nutrient content, pH and CEC. The scientific survey will be carried out by remote sensing complemented by a massive field and laboratory campaigns of sampling and measurements on soil samples. We use a number of newly developed, fast and

accurate soil physics methods for water, texture and carbon measurements (such as water adsorption methods and near-infrared spectroscopy).

By measuring and mapping key soil properties we can contribute to estimating the extent and location of the most suitable, robust and sustainable soil resources for summer grazing for livestock and specialty crop productions in South Greenland.

To improve the productivity of the soils we test the effects of adding glacier flour to the soils. Glacial flour is formed by the glaciers crushing the underlying rocks and stones to a particle size of very fine sand and silt. The material is washed out under the glacier and is then deposited in lakes and fjords. The material is available near the cultivated fields in South Greenland. Some of the world's most fertile soils have a high content of silt hence the grain size of glacial flour may result in much higher fertility and content of plant-available water if it is added to the coarse soils in Greenland. Glacial flour contains a wide range of minerals and a spectrum of trace elements. Glacial flour may help to neutralize acidity, improve soil structure, promote microbial activity, and slow down soil depletion. The material can be a ready source of calcium, iron, magnesium and potassium as well as other trace elements. This material is present in the fjords of South Greenland, and it can relatively cheaply be pumped up from coastal areas. The effect of glacial flour on soil-water retention, plant available water, nutrient content, pH, CEC and more can be investigated.

Extent and type of project:
45 or 60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data.

32. Ecological modelling: Open project

Department and supervisor
Niels Holst, Senior Scientist, Department of Agroecology
E: niels.holst@agro.au.dk – M: 22 28 33 40

Physical location of the project and students work
Anywhere.

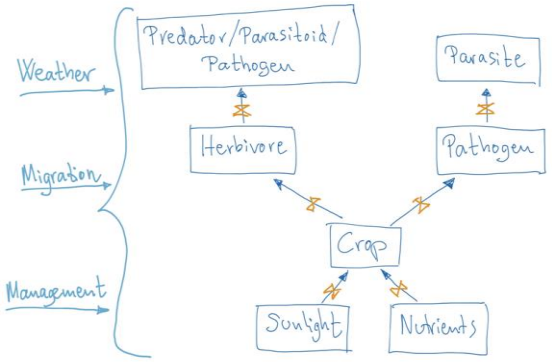
Project start
Any time.

Main subject area
Ecological Modelling

Short project description
Ecological models are most useful when they help us to formulate and test theory, and to manage ecosystems in an environment-friendly manner. – AP Gutierrez.

You are free to pick the biological system (natural or managed) and the theoretical or applied question you want to create a simulation model for. You develop the model based on an initial literature study. You will not need to carry out any empirical work as part of the project. Your final model will be open-source and readily available on the web. It will remain there as a future resource for yourself and others.

The components of the model could be drawn from physics (*e.g.*, light), chemistry (*e.g.*, nitrogen), physiology (*e.g.*, respiration), behaviour (*e.g.*, predation), population dynamics (*e.g.*, reproduction), integrated pest management (*e.g.*, invasive species), biological control (*e.g.*, parasitoids), conservation (*e.g.*, endangered species), economy (*e.g.*, yield), climate (*e.g.*, CO_2), engineering (*e.g.*, greenhouse design), *etc*. In any case, I will supervise you on the proper choice of a subject that will be suitable for the extend of your study (ECTS).



A student's first brainstorm outline of a model.

Extent and type of project
30, 45 or 60 ECTS: Thesis based on literature studies and analysis of existing data sets. Independent development of a simulation model and exploration of theoretical questions or real-world scenarios.

Additional information
Former experience with coding (*e.g.*, R) will be a benefit but is not required. Mathematical skills are not required beyond the basics. Models are developed in the Universal Simulator open-source tool found at www.ecolmod.org. All students with a background in science or engineering, together with students wanting to cross disciplines, are welcome. We will meet on the web and occasionally in person should our paths cross in Aarhus, Copenhagen or elsewhere.

33. Determination of soil surface properties with a fusion of spectroscopic techniques

Supervisors:
Lis Wollesen de Jonge, professor, lis.w.de.jonge@agro.au.dk
Maria Knadel, researcher, maria.knadel@agro.au.dk
Cecilie Hermansen, postdoc, cecilie.hermansen@agro.au.dk

Physical location of the project and students work:
Department of Agroecology, AU Foulum, 8830 Tjele

Project start:
Any time

Extent and type of project:
30 ECTS: Thesis based on analysis of issued and edited data sets.

Main subject area:
Spectroscopy, water repellency, surface area

Short project descriptions:
Soil surface properties such as specific surface area (SSA) and water repellency (WR) are crucial for agronomic processes including water retention and movement, pesticides and nutrients leaching, soil aggregation and erosion. Due to their importance, there is a worldwide interest and need for their accurate determination. However, most of the techniques used for their estimation are cumbersome and expensive. Infrared spectroscopy has showed potential as an alternative method for their fast and accurate estimation.

A data set consisting of a range of soil samples with reference SSA, WR as well as basic soil properties is available at AGRO. For each soil spectra using near-infrared (NIRS) and mid-infrared spectrometer (MIR) were collected.

Aims: (i) to conduct qualitative analysis of both NIR and MIR spectra in relation to the corresponding reference data, (ii) to develop calibration models for SSA and WR individually using NIR or MIR, (iii) to fuse NIR and MIR data in the modelling phase for the estimation of SSA and WR.

Reading materials:
Knadel, M. (2016): Journal of the Near Infrared Spectroscopy, 24, 215-224. doi: 10.1255/jnirs.1188

Knadel, M. (2018): Soil Sci. Soc. Am. J. 82: 1046-1056, doi:10.2136/sssaj2018.03.0093
Hermansen, C. (2019): Soil Sci. Soc. Am. J.83:1616-1627, doi:10.2136/sssaj2019.03.0092

34. Microplastics in the soil - occurance, transport, and estimation

Main supervisor, co-supervisor:
Researcher Maria Knadel, postdoc Trine Nørgaard
maria.knadel@agro.au.dk

Physical location of the project:
Department of Agroecology, Research Centre Foulum

Project start:
Summer 2020

Extent and type of project:
60 ECTS: Two experimental theses in which the student is largely responsible for data collection and analysis. Optionally, the project could be arranged corresponding to 45 (or 30) ECTS.

Main subject area:
Environmental Sciences, Near-infrared spectroscopy (NIRS), soil chemistry

Useful reading:
Piehl, S. et al. 2018. Sci Rep-Uk 8. doi: ARTN 17950 10.1038/s41598-018-36172-y, Corradini, F. et al. 2019. Sci of the Tot Enviro 650. doi: 10.1016/j.scitotenv.2018.09.101

Background:
Microplastics (MP) defined as plastic particles <5 mm present new global environmental challenges. Due to their size they may be taken up by biota and accumulate in the food chain or sorb pollutants on their surface and facilitate the transport of these through the soil. The actual levels, however, in various soil ecosystems, the type of MP polymers and their transport in the soil are largely unknown. The scarce knowledge on MP in soil is also attributed to the lack of standardized analytical methods to isolate and detect MP in soil samples. The most powerful techniques for potential MP estimation and polymer characterization in soil include application of infrared spectroscopy.

Aims:
(i) to collect soil samples, analyse MP by conventional methods and perform laboratory experiments to determine the fate of MP, (ii) to obtain and analyse near-infrared (NIR) spectra of the soils with added MP and develop relationships for MP estimation.

Approach:
One project focusses on sampling and MP characterisation to estimate MP levels in different soil ecosystems as well as laboratory experiment to determine MP transport through soil. Bulk soil samples and soil columns will be sampled in or from the vicinity of various soil ecosystems. Basic soil characteristics will be determined, MP isolation and quantification will be carried out and MP transport will be estimated in a leaching experiment. The other project deals with testing NIR spectroscopy for MP determination in man-made samples. Spiking experiments including the

addition of different amounts and types of MPs to a range of soil types will be conducted. All soils from the spiking experiment will be scanned with a NIRS sensor. To assess the predictive capability for MP determination NIRS will be coupled with multivariate data analysis.

35. Plant physiological and thermal responses to drought

Department and supervisor

Mathias N. Andersen, professor, AU-AGRO, MathiasN.Andersen@agro.au.dk, 87157739
Kirsten Kørup, PhD, academic employee, KirstenKoerup@agro.au.dk, 87157752
Kiril Manevski, PhD, postdoc, Kiril.Manevski@agro.au.dk, 93522142

Physical location of the project and students work

AU-AGRO, 8830 Tjele and/or AU-main campus, 8000 Aarhus

Project start

June 2020 (or any time)

Main subject area

Crop production and physiology, drought stress, remote sensing

Short project description

Drought becomes a challenge for crop production even in humid temperate climates, such as in Denmark (e.g., the 2018 pan-European drought). To prevent yield loss and also to efficiently use water and prevent nutrients leaching out of the root zone, it is necessary to irrigate in the correct time and amount. Most crops close their stomata to minimize water loss in times of drought, which in turn increases their leaf/canopy temperature. The associated physiological changes such as in stomata response and leaf water potential are variable but can be measured on the field. In addition, field measurements may correlate with measurements obtained by other means such as thermocameras mounted on unmanned aerial vehicles or available even on satellite scale. These relatively novel "telemetry" methods become increasingly popular for scientists and agro-environmental managers, due to their ease for operation and ability to cover larger areas.
AU-AGRO has conducted several field experiments on different crops (mainly potato and wheat) in relation to drought by employing telemetry and this MSc project will compile and analyse existing physiological and telemetry data on crops in Denmark. The main aim is to test whether there is a robust and explanatory relationship between field measurements of crop and soil variables (soil water content and stomatal conductance, among others) and telemetry variables (indices, inertias) by employing statistics and geostatistics. Support to the analysis by process-based energy/water balance model is also possible to facilitate the project.

Extent and type of project

30 ECTS: Theoretical thesis based on literature studies - analysis of issued/edited data sets.
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data

Additional information

The candidate is expected to have basic/medium knowledge in MS Excel and GIS software (ArcMap or similar) and is willing to learn new platforms such as R to ease data processing. The actual work will be performed together with a team of students, technicians and researchers with great possibilities to work independently.

36. Sheep feeding strategies under Artic conditions

Department and supervisor
Jesper Overgård Lehmann, Postdoc, Department of Agroecology,
JesperO.Lehmann@agro.au.dk

Martin Riis Weisbjerg, Professor, Department of Animal Science

Physical location of the project and students work
Department of Animal Science or Department of Agroecology, AU-Foulum

Project start
Summer 2020 or as agreed with the student

Main subject area
Feed quality and sheep nutrition

Short project description
Extensive sheep farming is an important part of the agricultural sector in the Arctic and Subarctic areas of the north. These areas are characterized by harsh conditions, sparse settlements and long distances between farms and villages as well as between farms and the outer part of grazing areas. In Greenland, sheep mainly graze permanent nature areas with a rich plant community during summer where they raise their lambs that are born in spring. Weaning and slaughter of lambs occur in late autumn after which the ewes are kept indoors and fed hay, wrap silage, barley and concentrate. Farmers grow some of the forage for winter-feeding themselves whereas the remaining forage, barley and concentrates are imported from mainly Europe.

The main objective of this project is to develop winter-feeding strategies for ewes housed indoor in the Arctic and Subarctic areas of the north that maximizes the use of homegrown forage and ensures maximum survivability of the lambs. To support this objective, we have sampled a number of homegrown forages on 10 farms in southern Greenland, which should be included in the project. Furthermore, the project can include feeding strategies for increasing the growth of lambs just prior to slaughter.

Extent and type of project
30 ECTS: Theoretical thesis based on literature studies and/or analysis of issued and edited data sets.

Useful reading
- Lehmann et al., 2020. Open Agriculture 5, DOI: 10.1515/opag-2020-0009.
- Ross et al., 2016. Ambio 45, 551-566.
- Westergaard-Nielsen et al., 2015. Science of the Total Environment 512-513, 672-681.

37. Advanced processing techniques for mapping artificially drained agricultural areas using UAV Imagery

Department and supervisor
Dept. Agroecology, Associate Professor Bo Vangsø Iversen, +45 93508045
bo.v.iversen@agro.au.dk

Physical location of the project and students work
Aarhus University Foulum, Blichers Allé 20, 8830 Tjele

Project start
Any time

Main subject area
Digital soil mapping (DSM)

Short project description
Artificial drainage installations (popularly known as "tile drains") are a common practice in poorly drained agricultural areas to drain the excess water and enhance crop productivity. Knowledge of the location of the drainpipes is important for developing eutrophication mitigation strategies as drain lines act as shortened pathways for solute transport to the aquatic environment. In recent years, studies showed that UAV imagery (visible, multispectral and thermal infrared) proved to be a suitable technique for subsurface drainage mapping as drain lines show up as linear features due to difference in spectral reflectance and thermal inertia between dry and wet soil. In this project, the student will investigate advanced processing techniques such as decorrelation stretch, minimum noise fraction and/or principal component transforms on an existing dataset for suppressing the noise components thereby enhancing the drainage pipe response. In addition, supervised machine learning algorithms will be developed and employed to differentiate the drain line response from the linear features produced from field operations. The student is expected to be good at R or Matlab.

Extent and type of project
Master thesis 30, 34, or 60 ECTS

Additional information
Thayn, J. B., Campbell, M., & Deloriea, T. 2011. Mapping tile-drained agricultural lands. Institute for Geospatial Analsyis and Mapping (GEOMAP). Illinois State University.
Allred, B., Martinez, L., Fessehazion, M. K., Rouse, G., Williamson, T., Wishart, D., Koganti, T., Freeland, R., Eash, N., Batschelet, A., Featheringill, R. 2020. Overall results and key findings on the use of UAV visible-color, multispectral, and thermal infrared imagery to map agricultural drainage pipes. Agricultural Water Management 232.
Allred, B., Martinez, L., Fessehazion, M. K., Rouse, G., Williamson, T. N., Wishart, D., Koganti, T., Freeland, R., Eash, N., Batschelet, A., & Featheringill, R. (2020). Overall Results and Key Findings on the Use of UAV Visible-Color, Multispectral, and Thermal Infrared Imagery to Map Agricultural Drainage Pipes. Agricultural water management

38. Predicting the suitability of GPR for sub-surface drainage mapping using gprMax

Department and supervisor
Dept. Agroecology, Associate Professor Bo Vangsø Iversen, +45 93508045
bo.v.iversen@agro.au.dk

Physical location of the project and students work
Aarhus University Foulum, Blichers Allé 20, 8830 Tjele

Project start
Any time

Main subject area
Digital soil mapping (DSM)

Short project description
Artificial drainage installations (popularly known as "tile drains") are a common practice in poorly drained agricultural areas to drain the excess water and enhance crop productivity. Knowledge of the location of the drainpipes is important for developing eutrophication mitigation strategies as drain lines act as shortened pathways for solute transport to the aquatic environment. While traditional methods such as tile probing and trenching equipment are time-consuming and exceedingly invasive, GPR proved to be a suitable alternative for noninvasive mapping of the drainpipe locations. However, a major limitation for this technique is high signal attenuation in highly electrical conductive areas causing limited penetration of the electromagnetic signal. In this project, the student will simulate the GPR forward modeling using gprMax software for a variety of scenarios including different antenna bandwidths; soil electrical conductivities; dielectric permittivities; etc. to determine ideal configuration and conditions for drainpipe mapping. This project aims at providing guidelines for the use of GPR technology for subsurface drainage mapping.

Extent and type of project
Master thesis 30, 34, or 60 ECTS

Additional information
Koganti, T., Van De Vijver, E., Allred, B. J., Greve, M. H., Ringgaard, J., & Iversen, B. V. (2019). Evaluating the Performance of a Frequency-Domain Ground Penetrating Radar and Multi-Receiver Electromagnetic Induction Sensor to Map Subsurface Drainage in Agricultural Areas. In The 5th Global Workshop on Proximal Soil Sensing (pp. 29-34).

39. Driving variables of soil hydraulic properties

Department and supervisor
Dept. Agroecology, Associate Professor Bo Vangsø Iversen, +45 93508045, bo.v.iversen@agro.au.dk

Physical location of the project and students work
Aarhus University Foulum, Blichers Allé 20, 8830 Tjele

Project start
Any time

Main subject area
Hydrology, soil physics

Short project description
Measurements of soil hydraulic parameters are both expensive and time-consuming and are often practically impossible in modelling studies. It is therefore imperative that the required hydraulic properties can be obtained from other available predictors such as soil texture, bulk density, and other easily measured soil variables. Based on a comprehensive, Danish database on soil hydraulic properties (hydraulic conductivity, soil water characteristics) this study will focus on studying the influence of soil properties (soil texture, organic matter) on soil hydraulic properties. The study can contain different aspects such as developing pedotransfer functions and modelling of water transport in the vadose zone of the soil.

Extent and type of project
Master thesis 30, 34, or 60 ECTS

Additional information
Kotlar, A.M., I. Varvaris, Q. de Jong van Lier, L.W. de Jonge, P. Moldrup, and B.V. Iversen. 2019. Soil hydraulic properties determined by inverse modeling of drip infiltrometer experiments extended with pedotransfer functions. Vadose Zone Journal 18:180215.
Iversen, B.V., M. Lamandé, S.B. Torp, M.H. Greve, G. Heckrath, L.W. de Jonge, P. Moldrup, O.H. Jacobsen 2012. Macropores and macropore transport. Relating basic soil properties to macropore density and soil hydraulic properties. Soil Science 177(9):535-542.

40. Strategies for implementing dam-rearing on Danish dairy farms

Department and supervisor
Mette Vaarst, Senior Scientist, Department of Animal Science, Mette.Vaarst@anis.au.dk
Jesper Overgård Lehmann, Postdoc, Department of Agroecology,
JesperO.Lehmann@agro.au.dk

Physical location of the project and students work
Department of Animal Science or Department of Agroecology, AU Foulum.

Project start
Summer 2020, can be decided individually.

Main subject area
Dairy farming, farming strategy

Short project description
Dairy farmers throughout Europe have during the past one-two decades begun trials with letting the newborn calf stay with its dam for longer than the traditional 0-48 hours practiced on the majority of farms. Several research projects have investigated or are investigating various consequences and various ways of implementing this change in management, which is termed dam-rearing or mother-bonded calf rearing.

The main objective of this project is to develop potential implementing strategies for 10-15 different organic dairy farms in Denmark that will serve as cases. The three aims of this project is to 1) conduct a literature review required management changes and consequences, 2) Interview 10-15 organic dairy farmers about their concerns and reservations about implementing a dam-rearing system and 3) devise potential concrete implementation strategies and their potential consequences including barn layout on these farms.

Extent and type of project
45 ECTS: Experimental theses in which the student is responsible for collection and analysis of his/her own original data.

Additional information
The student should be sufficiently fluent in Danish for communicating with farmers and hold a valid driver's license.

Useful reading
- Johnsen et al., 2016. Applied Animal Behaviour Science 181, 1-11.
- Kälber and Barth, 2014. Applied Agricultural and Forestry Research 64, 45-58.
- Weary and von Keyserlingk, 2017. Animal Production Science 57, 1201-1209.

41. Mapping of peat soil properties using digital technologies

Department and supervisor
Department of Agroecology
Main supervisor: Senior researcher Mogens H. Greve, mogensh.greve@agro.au.dk , 2072 6734
Co-supervisor: Postdoc Amélie Beucher, amelie.beuche@agro.au.dk, 8715 7712

Physical location of the project and students work
Aarhus University Foulum, Blichers Allé 20, 8830 Tjele

Project start
Any time

Main subject area
Digital Soil Mapping (DSM); Proximal and remote sensing; Machine learning

Short project description
Peatlands can store a large amount of soil organic carbon and thus constitute crucial areas to investigate for climate change predictions. In particular, the assessment of key peat soil properties, such as the extent, thickness (depth to mineral layer) and bulk density, is highly relevant to estimate the amount of stored soil organic carbon. This project will focus on the use of Digital Soil Mapping methods and different sensor techniques (proximal and remote geophysical sensors, as well as satellite imageries) to map peat extent and thickness at different scales.

Extent and type of project
Master thesis 30, 45 or 60 ECTS

Additional information
Altdorff, D., et al (2016). Mapping peat layer properties with multi-coil offset electromagnetic induction and laser scanning elevation data. Geoderma 261, 178-189. doi: 10.1016/j.geoderma.2015.07.015.

Minasny, B., et al (2019). Digital mapping of peatlands – A critical review. Earth-Science Reviews 196. doi:10.1016/j.earscirev.2019.05.014.

42. Soil water repellency

Main supervisor:
Professor Lis Wollesen de Jonge, lis.w.de.jonge@agro.au.dk, 24940550 Senior researcher Mogens H. Greve, mogensh.greve@agro.au.dk, 20726734
Co-supervisor:
Senior researcher Mogens H. Greve, mogensh.greve@agro.au.dk, 20726734 and post doc Trine Nørgaard trine.norgaard@agro.au.dk

Physical location of the project and students work
Department of Agroecology, AU Foulum, Blichers Allé 20, 8830 Tjele.

Project start
The optimal start is August

Main subject area
Determining the occurrence and severity of soil water repellency in Danish soils and linking it to soil physico-chemical properties, organic matter quality and content, vegetation and land-use, and soil microbiology.

Short project description

Soil water repellency is a transient soil property, which can severely alter soil functions. Certain species of plants, fungi and microorganisms create hydrophobic material that can cover soil particles and aggregates partly or completely with a hydrophobic skin. The hydrophobic material decreases the surface free energy of the soil and renders the soil resistant towards wetting. It is well-documented that water repellency can increase overland flow and surface erosion reduce the infiltration rate, induce finger flow and decrease the filtering capacity for nutrients and chemicals. Some indirect consequences hereof are reduced crop productivity and a higher risk of groundwater contamination. Little is know about its occurrence and severity in Danish soils and it is not clear how water repellency is linked to organic matter quality and soil microbial communities.

We will collect surface soil samples in the Danish National Square grid. Vegetation and land-use will be registered. Climatic data will be made available. Soil texture, total organic carbon, hot- and cold-water extractable carbon, pH, EC, microbial activity and soil microbial DNA will be determined. Soil water repellency will be determined by both the Molarity of an Ethanol Droplet and the Water Drop Penetraion Time methods. Pedotransfer functions to predict water repellency will be developed based on the measured data, and the potential water repellency of Denmark mapped.

Extent and type of project:
45 or 60 ECTS: Experimental theses in which the student is responsible for planning, trial design and collection and analysis of his/her own original data

43. Filter systems for removing phosphorus from agricultural drainage water

Main supervisor
Associate Professor Goswin Heckrath, goswin.heckrath@agro.au.dk; Department of Agroecology

Physical location of the project
Department of Agroecology, Research Centre Foulum

Project start
Summer 2020

Main subject area
Environmental Sciences, Soil Chemistry; sedimentation; drainage water quality.

Short project description
Background. Nutrients and sediment in agricultural drainage waters contribute to eutrophication of surface waters. A new approach towards mitigating drainage water phosphorus (P) losses focuses on drainage filter systems for high risk areas. Aarhus University and partners have setup a full-scale pilot system near Aarhus to develop the technology. While soluble P can be retained by various reactive filter materials through sorption, removal of sediment and particle-bound P from drainage waters remains a practical challenge. Therefore, the overall goal of the MSc project is to explore adaptations to the existing drain filter system to improve sediment retention and overall P retention.

Aim. The aims of this MSc project are i) to study sediment properties in relation to P transport and retention in the filter system and ii) to test the effectiveness of flocculants for sediment retention. Approach. Drainage water samples are collected continuously and automatically in different units of the drainage filter system during the runoff season. The student will contribute to analyzing the samples for different P fractions and sediment quality at the Department of Agroecology. This involves wet chemical analyses and determination of particle size distributions by laser diffraction. The data is used for investigating the dynamics of P retention and retention efficiency. During autumn, the effect of adding a salt as flocculant to drainage water before it enters the sediment filter will be monitored over several weeks. The project will be actively supported by technical staff at the Department of Agroecology and the student has access to monitoring data from previous years.

Extent and type of project
60 ECTS: Experimental thesis. Alternatively, 45 ECTS.

Additional information
This MSc project is closely linked to NSR Interreg project NuReDrain. https://northseare-gion.eu/nuredrain/news/video-about-phosphorus-removal-filters-for-drainage-water-in-agricultural-fields/

Useful reading

Vandermoere, S. et al. 2018. Reducing phosphorus losses from drained agricultural fields with iron coated sand filters. Water Research 141, 329-339.

44. Response of wheat to combined cold and waterlogging

Department and supervisor
Rong Zhou, Assistant Professor, rong.zhou@food.au.dk
Carl-Otto Ottosen, Professor, coo@food.au.dk

Physical location of the project and students work
Department of Food Science, Agro Food Park 48

Project start
No specific time

Main subject area
Climate change, Plant physiology, Nutrient absorption, Transcriptome sequencing

Short project description
Waterlogging stress is one of the abiotic stress caused by climate change, which adversely affected crop growth and decreased crop yield. Wheat is one of the most important crop in the world, the production of which is seriously affected by waterlogging. More importantly, the abiotic stresses happen concurrently especially in the field, such as waterlogging and cold stress. We aim to clarify the physiological and molecular response of wheat genotypes to single waterlogging, single cold and their combination. This will help us to improve the wheat resilience to future dynamic climates.

Extent and type of project
45 ECTS or 60 ECTS: Experimental theses in which the student is responsible for data collection and original data analysis

Additional information
The student will be linked to a group of scientists, technical staff and PhD. This will make the students to learn and get help from the seniors and technicians. The experimental work is linked to ongoing studies and will be cooperated with international partners especially for the section of transcriptome sequencing. The crosstalk between plant physiological and genetic response to combined stress will make an interesting story. This increase the possibility of making a scientific paper in association with the thesis.