NordPlant Scientific Progress Report 2018

NEW INSTRUMENT FOR NORDIC UNIVERSITY COOPERATION:

NORDIC UNIVERSITY HUBS

SCIENTIFIC REPORTING

1) Progress and research results

Short background NordPlant

NordPlant is a climate and plant phenomics university hub for sustainable agriculture and forest production in future Nordic climates. Climate change is a global challenge and new plant breeding and protection efforts are urgently needed. Novel methods in plant phenotyping and climate facilities, which is the core of NordPlant, will be central to better understand plant stress responses and to develop advanced and precise methods for rapid screening of plants to identify high-performing ones suitable for the future climate scenarios. Five Nordic universities with versatile and complementing research infrastructures have established NordPlant to promote education, research mobility and technological development to meet future challenges in Nordic agriculture and forestry. NordPlant is one out of a total of six Nordic University Hubs funded by NordForsk. More information at www.nordplant.org

Status compared to plan for cooperation

The first external funding of NordPlant was received in January 2018. A steering committee with 10 members (two from each university) was formed the same month and on the 25th April 2018 the first NordPlant Steering Committee meeting was held in Copenhagen, where also a deeper presentation of the participating partners was done and general outline was decided. During the formation process information about NordPlant was spread within the five universities and additional researchers with potential interests in NordPlant identified, which together with the formation of the steering committee met **Milestone 1.1**. A coordinator Erik Alexandersson (SLU; 20% from 1 March 2018) and an administrative coordinator Svante Resjö (SLU; 20% from 1 December 2018) have been assigned to manage the joint parts of the project, teaching and outreach.

Milestone 1.2 was met to 80 % by the formation of focus groups, described in detail in the paragraphs about milestone 4.1 to 4.4 below. The formation of the fifth focus group is delayed (see the section about deviations from the original plan below).

An Agreement of Cooperation between SLU and the other participating universities was taken forward in February-May and signed by all parties on the **5th of June 2018**.

During the late spring and autumn NordPlant was promoted more widely and in June the NordPlant webpage www.nordplant.org was launched. The first newsletter came

out in December 2018. A NordPlant GitHub for projects has also been established, which fulfills **Milestone 1.3**.

As a part of meeting **Milestone 1.4**, a NordPlant information brochure has been designed and printed and distributed at a number of venues such as the NordPlant kick-off in Helsinki, 24-25 October 2018.

We presented and explained our mission to European networks within the area (**Milestone 1.5**) and have met the leaders of EPPN2020, EMPHASIS and 6p2/NPPN. We have also presented NordPlant to and interacted with NordGen.

NordPlant held its kick-off meeting as promised part of **Milestone 2.1** on 24-25 October in Helsinki. Approximately 70 scientists joined the meeting including representatives from all five funding universities. More information on the meeting can be found here: https://www.nordplant.org/2018/12/18/nordplant-has-officially-started/ In conjunction to this meeting a second steering committee meeting was held. The next annual meeting for is planned for November 2019.

At the board meeting in Helsinki on 24th of October, the board decided to make an initial site visit with the steering committee on 20-22 March 2019 at INRA Montpellier with demonstrations of their phenotyping facilities and computational solutions. This visit will mean that the first part of **Milestone 2.3** has been met.

During the kick-off meeting we also established the focus groups 1-4 (**Milestone 4.1-4.4**) and these held their first meeting during the second day. These focus groups are open to anyone in the Nordic countries and they have set up different objectives.

The focus groups formed are:

1. Phenotyping methods in field, greenhouse, and cell physiology (UHEL): This group expressed an interest in a survey of needs from end users (farmers, breeders, students), with the goal of sharing knowledge and meeting educational needs. On the university level, a long-term goal would be to establish phenomics as a new discipline, where the students would study the topics that are already needed in the field. In addition, a research need is to establish a shared technological infrastructure.

2. Data handling and integration related to phenotyping and modeling by integrated climate and phenomics data (UCPH/LU): The participants identified a need to educate Nordic scientists and students already today using plant phenotyping in their research and discussed how this should be done. The group agreed that it needs to be an iterative process where users and developers have an active dialogue. It was also considered whether there were some specific needs for the Nordic countries with regard to standards, but the conclusion was that it foremost was important to align and link Nordic plant phenotyping research to already on-going pan-European and global efforts in the area. In line with these thoughts, NordPlant is hosting an INRA-led workshop on plant phenotyping standards in Lund 29-30 April 2019.

3. Emerging and increasing plant pathogens and pests in the Nordic countries (SLU): The group members have discussed the possibility to write a review/summary article related to their respective subject area. The focus groups shall report back to the WP1 leader (Erik Andreasson) regarding activities, dissemination of findings and results. Possible subjects are emerging and increasing plant pathogens and pests in the Nordic countries, with the goal of collate, translate and compare recommendations from the respective authorities in each country.

4. Abiotic stress relevant for future climate change in the Nordic countries (UiT): The participants in focus group 4 are primarily interested in cereals, grain legumes and other broad-leaved crops. One planned potential activity is to use the broad spectrum of expertise in the group to gather interested parties to write an opinion or review paper about the most abiotic stresses with a Nordic/Baltic focus with Physiologia Plantarum as a possible target journal. The group also discussed a PhD course/workshop combining environmental stress and phenotyping at Tromsö focusing on transportable phenotyping methods, as well as a workshop on metabolomics along with morphological phenomics with a special focus on how to integrate the various omics.

Focus group 5 will be established later (see Deviations from original cooperation plan)

We have joined forces with the NOVA PhD course series NOVA PhD Course "Phenotyping Technologies in Plant-environment Interactions" with the first course given 11-15 June at SLU Alnarp specifically targeting integrated analysis of omics data. The next course in the series will be given in Helsinki June 2019.

To promote mobility, training and interactions between the NordPlant universities we have established an internal online collection of Collaboration Opportunities where the members can post ideas.

Deviations from original cooperation plan and possible budget implications

It took longer than expected to establish the Agreement of Cooperation, and for that reason some of the partners were only able to start using the budgeted project funds as late as August 2018. This is the main reason why not the whole budget planned for 2018 was spent, but we are aiming to spend the rest of the 2018 budget in 2019 or at the latest 2020.

After discussions during the second NordPlant steering committee meeting it was decided that the established homepage and newsletter will be NordPlant's platforms for internet-based outreach. The meeting also decided against establishing NordPlant on its own social platforms because of the high maintenance time and large effort to "break through the noise" on Twitter, Facebook and Instagram. Instead NordPlant will use other established accounts such as the participating universities and PlantLink's to spread information in social media.

Focus group 5 has been postponed. One reason is that the 6p2 program was granted a prolongation by three years from the end of 2017 and here several companies within the breeding sector participates and interacts with several of the NordPlant universities. However, contacts with some innovation offices have been taken and a discussion is on-going on establishing a discussion forum of tech companies with interest in this area as the Nordic countries have strong actors in this area.

Main results including publications

Publications from NordPlant projects

Alexandersson, E., M. Keinanen, A. Chawade, and K. Himanen. 2018. 'Nordic research infrastructures for plant phenotyping', *Agricultural and Food Science*, 27: 7-16.

Chawade, A., R. Armoniene, G. Berg, G. Brazauskas, G. Frostgard, M. Geleta, A. Gorash, T. Henriksson, K. Himanen, A. Ingver, E. Johansson, L. N. Jorgensen, M. Koppel, R. Koppel, P. Makela, R. Ortiz, W. Podyma, T. Roitsch, A. Ronis, J. T. Svensson, P. Vallenback, and M. Weih. 2018. 'A transnational and holistic breeding approach is needed for sustainable wheat production in the Baltic Sea region', *Physiologia Plantarum*, 164: 442-51.

Koc, A., T. Henriksson, and A. Chawade. 2018. 'Specalyzer-an interactive online tool to analyze spectral reflectance measurements', *Peerj*, 6.

Roitsch, Thomas, Llorenç Cabrera-Bosquet, Antoine Fournier, Kioumars Ghamkhar, José Jiménez-Berni, Francisco Pinto, and Eric S. Ober. 2019. 'Review: New sensors and data-driven approaches—A path to next generation phenomics', *Plant Science*.

Submitted manuscripts

Pavicic M., Wang F., & Himanen K. High throughput in vitro seed germination screen identified two novel ABA response RING-type ubiquitin E3 ligases in Arabidopsis thaliana. Under revision at the Plant Cell, Tissue and Organ Culture (SCI: 2,0).

Pavicic M., Heino F., Niemelä T. & Himanen K. Image-based phenotyping of dwarfing Bzh spring turnip rape population allowed dissecting plant architecture. Submitted to MDPI Agronomy (SCI: 1.5)

Aakash Chawade, Joost Jelle van Ham, Hanna Blomquist, Oscar Bagge, Erik Alexandersson, Rodomiro Ortiz. High-throughput field phenotyping tools for plant breeding and precision agriculture *submitted to Frontiers in Plant Sciences*

NordPlant representation at international conferences

NordPlant together with NaPPI: Pavicic, M. & Himanen, K., 2018. Using chlorophyll fluorescence to discover resistance genes against necrotrophic pathogens in Arabidopsis thaliana. 29th International Conference on Arabidopsis Research (ICAR 2018). Turku, Finland. (MP poster presentation on NaPPI pathogen detection assays (NordPlant project)

NaPPI, EPPN: Himanen K., Wang F., Pavicic M. 2018. Fine tuning phenotypic responses to perturbations. 29th International Conference on Arabidopsis Research (ICAR 2018). Turku, Finland. (KH oral presentation on NaPPI in vitro assays)

EPPN: Pavicic M., Hautsalo J., Lehtilä L. & Himanen K. 2018. Fine tuning phenotypic responses to perturbations. COST FA1306, 22.3.2018, Leuven Belgium (KH poster presentation on NaPPI assays).

Participation in Baltic Wheat Network: Network discussions 22-23.10.2018 in Helsinki, Finland. Led by NordPlant partner Dr Aakash Chawade.

Participation in Horizon2020 project planning meeting 21-22.10.2018 in Helsinki, Finland. Led by NordPlant partner Dr Aakash Chawade. Project proposal submitted 23.1.2019.

NordPlant has been presented more extensively at the following meetings to increase awareness:

-Meeting Promoting Plant Research in Sweden, 14-15 March 2018, Lund, Sweden

-PlantLink Day and Phenomics theme, 12th September 2018, Lund, Sweden

-BalticWheat meeting, Lithuania, 23-24 October 2018 Helsinki, Finland

New scientists recruited through international advertising

At UHEL, Sylvain Poque has been recruited as a postdoc in Jari Valkonen's research group. He will study virus infection of sweet potato, and intend to use the NaPPI facility to measure chlorophyll fluorescence to characterize uninfected plants and plants infected with two types of virus.

Chandana Pandey is a new postdoc with Thomas Roitsch at KU. She is fully funded by NordPlant since December 1, 2018, and will work with pathogen infection of barley, with future planned collaboration with Aakash Chawade at SLU.

Alexander Koc has been accepted as a PhD student, with Aakash Chawade at SLU as his main supervisor. Kristiina Himanen (UHEL) and Rodomiro Ortiz (SLU) will be his co-supervisors. Alexander Koc will work with phenotyping of wheat in collaboration with Kristiina Himanen and other scientists at the University of Helsinki.

Joost Van Ham has been masters student from LU supervised by Erik Alexandersson at SLU in the project EnBlightMe! which uses field phenotyping to detect disease in the field.

Novel research projects initiated by NordPlant

A collaboration between SLU and KU-PLEN on phenotyping of potatoes in the PhenoLab (with help of an EPPN grant) to estimate possible fitness costs of plant defense

and plant resistance inducers. In 2019 this collaboration will expanded around drought tolerance together with UHEL and its NaPPI facility.

A new project between SLU and UiT around potato plasticity by comparing metabolomics and proteomics data, quality and yield between Northern and Southern Scandinavia.

A collaboration between LU and SLU on proximal, remote and satellite sensing of potato disease and drought stress by handheld devices, drones and satellites. A post doc position will be announced in March-April 2019 in this project.

A collaboration between Thomas Roitsch and Kristen Krause at UiT on Cuscuta reflexa.

Collaboration with new partners

Project title: Brassica rapa dwarf breeding project (Kristiina Himanen (UHEL), Mirko Pavicic (UHEL), Tarja Niemelä (UHEL))

Short description: Turnip rape (Brassica rapa L. ssp. oleifera) is an important oil seed crop in the northern hemisphere. Here, we report phenotypic characterization of Turnip rape breeding population for the dwarf gene BREIZH (Bzh) INRA derived from Brassica napus by crossing. The BZH protein is Brassica DELLA ortholog and involved in Gibberellic acid signaling with major impact in elongation growth. The segregating Turnip rape BC_4F_2 population for bzh mutation was analyzed for growth and morphological parameters as well as for physiology using imaging-based phenotyping technology in standardized growth conditions.

Project title: Utilizing chlorophyll fluorescence for plant pathogen disease scoring (Kristiina Himanen (UHEL), Mirko Pavicic (UHEL))

Short description: In this study, the RING-type ubiquitin E3 ligase genes were screened for their transcriptional responses upon the necrotrophic fungal pathogen Botrytis cinerea infections. As a result, a collection of 16 RING-type ubiquitin E3 ligases were identified among which were known actors of stress signaling (such as AIP2) and pathogen responses (such as BOI). In the first part of this project a phenotyping platform was established utilizing chlorophyll fluorescence to evaluate lesion size and infection severity in dissected Arabidopsis leaves. Using this method three susceptible and two resistant E3 ligase genes were identified and are being further characterized.

A new collaboration between UiT and the University of Helsinki related with a PhD thesis project of Susanna Simovaara. The collaboration considers a project on cranberry (Vaccinium macrocarpon L.) cultivation and will contain controlled experiments at the Climate laboratory in Tromsø, Norway.

A new collaboration between UiT and prof. Markku Keinänen (UEF, partner of the University of Helsinki phenotyping Hub). We invited M. Keinänen for a visit to Tromsø

for planning a PhD course on Novel Imaging Methods in Plant Stress Research to be held in Tromsø in 2019 or in spring 2020.

Project title: Proximal, remote and satellite sensing of potato disease and drought stress by handheld devices, drones and satellites. A post doc position will be announced in the beginning of 2019 in this project, which is a collaboration between SLU and LU.

Nordic added value NordPlant brings 1) scientifically, 2) for the consortium 3) for stakeholders

Inside the consortium, we have found very good interaction and several new collaboration possibilities. In addition, several additional Nordic academic institutions and breeding companies are part of the four started focus groups.

The majority of the new main results and collaborations with new partners are between the Nordic countries. During the kick-off at least four additional Nordic universities, five Nordic companies and several Baltic partners were represented.

The NordPlant Nordic University Hub brings very exciting new possibilities in scientific collaboration. Already established connections between UiT with University of Helsinki and University of Eastern Finland have been expanded and UiT and SLU have started discussions about research collaboration related to a potato project which among other things will take the special light conditions in Northern agriculture into account. SLU and UCPH have also deepened their collaborations and new collaborations with UHEL around wheat and potato are being developed.

We have only been working together one year (effective time less), nevertheless, there has been good amount of knowledge change and new interactions, in addition to good discussions how to effectively share the possibility to use the different infrastructure in the project. The concrete added value for stakeholders will demand a bit more time to be accomplished.

Gender aspects of the research and the organization of NordPlant

It is one of NordPlant's goals to have equal representation and give equal opportunities to both genders. The NordPlant steering committee is composed of four men and four women. The country coordinators for Sweden and Denmark are men while the country coordinators for Finland and Norway are women. Out of the scientists fully funded by NordPlant that where recruited in 2018, two are men and one a woman. The core groups at the participating universities are also mostly balanced with regard to gender.

2) Researcher mobility

Please specify research stay abroad as well as visits by foreign researchers. Here mobility is defined as a stay abroad of at least five days duration.

Name, job title, organisation	Site of work	Purpose of visit	Duration of visit	Comments, output of the visit
Amos Samkumar, PhD student, UiT	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Kristiina Himanen	SLU	Teaching in NOVA: Phenotyping course	One week	Teaching experience
Mirko Pavicic	SLU	Teaching in NOVA: Phenotyping course	One week	Teaching experience
Miia Mänttäri, UHEL	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Eva Ortvald Erichsen, UCPH	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Guangxun Fan, UHEL	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Javier Andrés Jiménez, UHEL	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Most Champa Begum, NMBU	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Kati Knuutila, UHEL	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Daniel Wasonga, UHEL	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Thayna Mendanha, NMBU	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Espen Sannes Sørensen, Graminor	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer
Alye Tefera, NMBU	SLU	Attending NOVA: Phenotyping course	One week	Nordic Knowledge transfer

Joost Van Ham, LU/ Radboud Universiteit	SLU	MSc project work	4 months	Advance-ment o
Total number of visiting months: 7.25				
Total number of visiting researchers: 14				

6 people from UCPH, 9 from SLU, 24 from UHEL, 2 from LU and 5 people from UiT, attended the kick-off meeting in Helsinki in October 2018.

MEETINGS AND NETWORKING

NordPlant kick-off meeting on the 24-25 October in Helsinki around 70 researchers joined the meeting with representatives from all five funding universities. More information on the meeting can be found here: https://www.nordplant.org/2018/12/18/nordplant-has-officially-started/

In conjunction to the NordPlant kick-off demonstration of the NaPPI phenotyping facility was done: For demonstration 75 wheat plants were grown in large plant NaPPI facility. Plants were potted in September, and programmed for automated watering and RGB imaging during the demonstration visits at the facilities 22-25.10.2018.