

# NordGen Annual Review 2018



NordGen

NordGen Annual Review 2018  
Compiled by NordGen staff.

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Layout: Sara Landqvist

Front page photo: Pixabay. *The drought was hard on the Nordic farmers in 2018. Fodder for the animals was scarce in all countries except Iceland. This put focus on NordGen's field of work.*

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## **NordGen**

The Nordic Genetic Resource Centre (NordGen) is the Nordic countries' gene bank and knowledge center for genetic resources. NordGen is an organisation under the Nordic Council of Ministers and works with the mission of conserving and facilitating the sustainable use of genetic resources linked to food, agriculture and forestry.

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## FOREWORD

**As the Nordic knowledge center for genetic resources, it is NordGen's overall goal to conserve and facilitate the utilization of genetic resources for food, agriculture and forestry in the Nordic countries. It's an immensely important task. During 2018, we achieved many great results thanks to a joint team effort across the organization - and we also managed to celebrate a little.**

Much alike a plant's life cycle, each year at NordGen is following roughly the same pattern. In order to promote genetic diversity through all our sectors, we plan, inform and arrange. We sow, harvest and characterize and we apply, administer and secure. But in 2018, a few activities differed from our normal activities.

It started in February, as the sun at Svalbard once again reached the mountain tops after the long, dark winter. More than 150 researchers, journalists and gene bank managers from about 30 different countries arrived in Longyearbyen to attend the marking of Svalbard Global Seed Vault's first 10 years of operation.

In collaboration with the Norwegian Ministry of Agriculture and Food and the Crop Trust, NordGen arranged a much-appreciated programme for the participants.

In Svalbard, climate change is happening faster than anyone could have anticipated. But in 2018, the seriousness of the matter became evident also to the rest of the Nordic population as the worst

drought in years hit most part of the region. The poor harvest and the lack of roughage lead to a wake-up call, and the urgent need to put the Nordic seed collection into play became obvious.

New and more resistant plant varieties, resilient forests and well-maintained livestock can contribute to a sustainable future. This was also the main message when NordGen participated in a side-event at COP24 in the Nordic Council of Ministers' pavilion in Katowice in December 2018.

The work done by NordGen will benefit generations to come. 2018 was the year we created a solid platform for our operations of the coming years. We put even more focus on gaining capacity in the propagation of new fresh seeds with the establishment of several isolation cages, more training and hiring of staff in the seed laboratory and the garden.

Furthermore, NordGen's IT platform was reviewed, and a robust platform for the future work has been created.

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As the majority of the season's seeds had been harvested, we invited partners, colleagues and former employees to celebrate NordGen's 10<sup>th</sup> anniversary in our garden.

With eight Nordic birthday cakes, quizzes, guided tours and information concerning our mission, we taught the guests about the importance of preserving genetic diversity. Although the Nordic cooperation regarding genetic resources span over many more years than ten, it was in 2008 the three sectors Plant, Forest and Farm Animals merged to NordGen.

During the years, NordGen has been highlighted as one of the Nordic flagships in terms of creating Nordic benefits. However, a continued investment in NordGen requires a supply of more funds.

Therefore, it was gratifying that the Nordic ministers at their meeting in Haparanda in June 2018 agreed on the importance to safeguard the future of NordGen.

Particularly gratifying was the commitment from Sweden to financially support a new building for NordGen at Alnarp Campus. A building with great perspectives for safeguarding our important work as a genetic resources center for decades to come.

With this, NordGen ends a busy year which has contributed to a solid platform for the future work and look forward to a productive and successful 2019.

**Lise Lykke Steffensen**  
Director, NordGen

*All employees prepared and attended NordGen's 10-year anniversary on the 7<sup>th</sup> of September.*



*At COP24 in Katowice, Poland, NordGen arranged a well-attended seminar called "From Emergency Slaughter to Svalbard Global Seed Vault: How can Genetic Diversity offer Solutions for Climate Change".*



*During 2018, we have put even more focus on gaining capacity in the propagation of new fresh seeds.*



*The Nordic Ministers for Agriculture and Food and the Director General for the Nordic Council of Ministers, met for a Ministers Council in Haparanda in June, 2018.*





## 2018 - A YEAR OF CELEBRATIONS

**In 2018, NordGen arranged two large receptions celebrating two different 10 year anniversaries. In February, we defied the rain and unusual warm temperatures of the Arctic and marked the Svalbard Global Seed Vault's first 10 years of operations. In September, we celebrated ourselves as invited guests joined us in Alnarp to highlight our first decade as a Nordic Genetic Resource Centre.**

**It was decided already** in 2017 that Svalbard Global Seed Vault's first 10 years of operations ought to be marked in some way. NordGen was given the responsibility to, in collaboration with the Norwegian Ministry of Food and Agriculture and Crop Trust, arrange the anniversary. Today, we can look back on a successful few days gathering more than 150 journalists, researchers and gene bank managers in Longyearbyen, Svalbard.

The program consisted of a scientific workshop with the title *Towards rational conservation and sustainable use of plant genetic resources*, an evening soirée including a dance performance and seed deposits by 23 gene banks. The 10-year anniversary coincided with seed sample number 1 million being carried into the Seed Vault.

In conjunction to the celebrations, the Norwegian government announced a 100 million NOK grant for a technical upgrade of the Seed Vault. The news about this and the 10-year anniversary, echoed around the world under and after the arrangement in Svalbard, creating great attention.

**Some six months later**, NordGen once again arranged a well-attended event. Our own informal anniversary was attended by collaboration partners, former employees and stakeholders, all interested in the mission and welfare of NordGen. The dedicated staff arranged for guided tours of our office, the laboratories, our freezers, the greenhouse and our garden. It was a day when a great deal of people learnt more about the importance of conserving genetic resources and using them in a sustainable way.

NordGen was formed in 2008 as the Nordic Gene Bank, the Nordic Gene Bank Farm Animals and the Nordic Council for Forest Reproductive Material merged. The Nordic cooperation and the work done within the three areas has a much longer history than merely 10 years. 2008 was, however, the year when we for the first time saw a joint genetic resource centre for the Nordic countries – NordGen.

That's a decade worth celebrating!



NordGen

## PLANTS

**NordGen Plants works in different projects, in our laboratories, greenhouses and fields to conserve and facilitate the sustainable use of our Nordic collections of seeds. These seeds are precious, carrying in their genes solutions to many of our future challenges for agriculture and food production. 2018 was a busy but rewarding year for NordGen Plants.**

NordGen Plants cooperates with companies, universities, and others to ensure the conservation and utilization of plant genetic resources. The working groups are a central part of NordGen's network, providing expert advice from Nordic stakeholders as well as initiating many projects on NordGen's plant material.

Organized conservation of plant genetic resources is a prerequisite for future generations in order to participate in environmentally friendly farming systems, better quality and resistance properties, and especially to meet the climate changes we are facing. NordGen Plants takes part in several projects and activities. These are examples of ongoing projects:

### **Virus cleaning, evaluation and characterization of older Nordic heirloom potato varieties**

The objective of the project is to increase the interest and utilization of older Nordic heirloom potato varieties. Specifically, the project will result in virus-free material of 15 potato accessions not previously preserved as *in vitro* clones at NordGen.

Then the accessions will be characterized and evaluated in two different field trials and several laboratory tests.

The morphology, cooking quality, content of glycoalkaloids and nitrates as well as resistance to *Phytophthora infestans* will be evaluated in the project. In co-operation with the National Gene Bank in Alnarp a few accessions will be highlighted and marketed under the trademark Grönt kulturarv®. The resulting information about the potato varieties included in the project will be published in NordGen database SESTO and social media as well as in a popular scientific article in a journal.

The project has started in 2018 and will be completed in 2021. It is conducted in collaboration with Svensk Potatis AB, Boda-holms gård, Larsvikens lantbruks AB and Programmet för odlad mångfald. Money for the project has been granted by the Swedish Board of Agriculture.



*The CarrotDivers project will identify which traits are affected by environmental variables.*

### **ECPGR Carrot Divers**

Wild carrot (*Daucus carota* L.) is the closest wild relative of cultivated carrot, and is a potential source of useful traits for crop improvement. There are over 900 accessions of *D. carota* described as wild in European genebanks, however associated phenotypic and genotypic characterisation data are sparse.

The influence of environment on phenotype is also not well understood in this taxon. In this study, named CarrotDivers, we have during two years performed a collaborative project in which wild *D. carota* accessions are undergoing detailed phenotypic and morphological characterisation in parallel at three sites of varying latitude across Europe located in Portugal, France and Sweden.

This will allow us to understand which traits are affected by environmental variables. Furthermore, resistance screening to *Alternaria* species and polyacetylene profiling will be included in the evaluation. A Genotyping by Sequencing approach will be used to generate knowledge about

genetic background and trait associations. The project will result in a significant dataset which will facilitate the use of crop wild relatives in carrot breeding and improvement.

Ten accessions were selected for the study and one of them originating from Norway. The ten accessions were qualitatively assessed for a number of traits including petiole anthocyanin colouration, homogeneity at rosette stage, rosette leaf growth habit, rosette leaf dissection, petiole hairiness, homogeneity at flowering stage and stem hairiness.

Quantitatively assessed traits included petiole thickness, width of the first umbel, total number of umbels at harvest, seed weight, lifespan (days to bolting and flowering as a percentage of total plants in each plot). Traits were scored according to published descriptors for carrot (IPGRI 1998).

The results are reported and under collation in France.



*Field trial in Tromsø, Norway, within the project Arctic Pea.*

### **Arctic Pea**

In the Arctic region the low temperatures and long summer days require specifically adapted crops. Taking climate change into account, increasing temperatures will partially allow cultivation of crops not earlier possible to grow at these locations.

In a three-year Nordic cooperation project funded by Nordregio's Arctic cooperation program, pea accessions from NordGen are evaluated with the goal to find a possible future protein crop for the Arctic regions.

Besides identifying accessions suitable for future cultivation (or plant breeding) in the Nordic regions the project will gain increased knowledge which will lead to enhanced use of the Nordic pea accessions conserved at NordGen.

Finding accessions with suitable traits and resistance genes possible to cultivate in these regions will favour local protein production in the long term and thereby strengthen Northern culture communities and reduce the import of plant protein.

A sustainable Nordic protein production will also promote cooperation between companies, organizations, and researchers in the Nordic region and additionally strengthen food safety.

Pea accessions will be identified through field trials supplemented with the use of resistance markers. During 2018, the second project year, 50 accessions were selected and cultivated at four Nordic locations, Norway - Tromsø, Sweden - Umeå, Finland - Jokioinen, and Denmark - Copenhagen.

Traits of importance for successful cultivation in northern regions such as flowering time and maturation time were evaluated in addition to height, yield, protein content etc. DNA extraction and resistance screening were continued. Even if no accession reached dry maturity at the northernmost trial site this year a number of accessions developed a good harvest of green pods and peas and turned out to be promising. The trials will be repeated in 2019.



### **Wild Genetic Resources – a tool to meet climate change**

A major future challenge of humankind is to adapt agriculture to climate change, increase efficiency to assure food security, and at the same time minimize its environmental and climatic impact. One of the tools available to achieve this goal is to develop new, well adapted plant cultivars and cultivation systems. Wild plant genetic resources are one piece of the puzzle to achieve this goal.

The overall objective of the project is to contribute to environmentally friendly and more climate adapted agriculture by strengthening the Nordic countries' work with wild relatives of the cultivated plants, known as Crop Wild Relatives (CWR).

The specific goals are to develop a coordinated Nordic approach for conservation and use of our CWR and to improve cooperation, knowledge exchange, and communication on CWR.

There is an increasing threat to wild wild-life populations in the nature, and measures are therefore needed to protect

these important resources. The project is a continuation of the project "Ecosystem Services: Genetic Resources and Wild Cultural Species" and it is funded by the Nordic Council of Ministers' COP21 cooperation program.

Selected project outcomes:

- Nordic homepage dedicated to CWR ([www.nordgen.org/CWR](http://www.nordgen.org/CWR)), maintained and updated. A total of 23 plant portraits publishes here (published monthly with notice on Facebook)
- A priority list of Nordic CWR, published and made publicly available: Fitzgerald H, Aronsson M, Asdal Å, Endresen D, Kiviharju E, Lund B, Palmé A, Rasmussen M, Weibull J, and Þorbjörnsson H (2017) The Nordic priority crop wild relative gene pool and distribution dataset. Available at: <https://doi.org/10.6084/m9.figshare.5688130>
- A scientific paper published on Nordic in situ conservation: Fitzgerald H, Palmé A, Asdal Å, Endresen D, Kiviharju E, Lund B, Rasmussen M, Þorbjörnsson H, and Weibull J (2019) A



regional approach to Nordic crop wild relative in situ conservation planning. Plant Genetic Resources: Characterization and Utilization., 1-12 DOI.:10.1017/S147926211800059X

- Climate change analysis finalized for three example CWR species
- Ex situ conservation gap analysis finalized and suitable locations for complementary sampling of prioritized CWR identified
- A popular science article published: Fitzgerald H, Palmé A, Weibull J, and Kiviharju E (2017) Viljelykasvien suojelusuunnittelu. GeeniVarat 14. Available at: <https://jukuri.luke.fi/handle/10024/539195>

### Regeneration

Regeneration at NordGen's facilities included mainly open pollinated species in 2018 and other time-consuming species. In total NordGen harvested seeds of 338 accessions. In addition, NordGen had agreements with many different external partners to have accessions regenerated

at different locations. In total 858 accessions were regenerated externally.

### Greenhouses, seeds, and laboratory

2018 was a busy year in the green house and in the field. The development from 2017 continued and additional isolation cages were installed, so NordGen now has 30 isolation cages in total. Strategies for fertilization and pest management were developed, new and appropriate machines were purchased and used in the daily work.

During 2018 the irrigation system was expanded and improved as well. The staff went on study visits and field trips which all gave inspiration to optimize the daily work and improve the regeneration work.

In the seed laboratory, new staff were employed and a lot of effort was done to train and upgrade the staff both in purity, seed identification and germination test. In this way the quality of the seed in the freezers can be ensured. The back-up storage in Denmark will close in 2019 and requirements to a new back up storage have been described.



## FOREST

**NordGen Forest addresses conservation and sustainable use of forest genetic resources, by being a forum for researchers, practitioners and managers working on forest genetics, seeds, planting stock and regeneration. We also facilitate the flow of scientific information and knowhow between these groups. In 2018, NordGen Forest arranged three events and granted eight scholarships.**

The main activities arranged by NordGen Forest are our conferences and thematic days. Each year, they attract hundreds of professionals and students within forestry.

The first thematic day in 2018 was held on 11 April, in Akureyri, Iceland. The thematic day was back-to-back with the annual conference of Icelandic professional foresters, Fagráðstefnu 2018.

More than 150 participants working with forestry took part in the two events. During the thematic day, speakers from Denmark, Norway and Iceland gave different perspectives on the topics of seed production and breeding. The session after lunch included an excursion to Iceland's biggest indoor seed orchard for hybrid larch (*Larix sukaczewi* x *Larix decidua*).

In September 2018, the second thematic day was held on the forest school of Nødebo in Denmark. The thematic day focused on development within establishment and management of forests. Development is driven by many different needs of forest utilisation as well as an uncertainty of

which climate we will have in the future. During the excursion to Gribskov, information about the Danish Nature Agency's considerations concerning creating biodiverse forests and seize traditional forestry, led to a lively debate. 75 people attended the event. Among those mainly Danish.

Each year the conferences and thematic days are held in a different Nordic country. NordGen Forest Conference 2018 was held in Finland on 18-19 September, in cooperation with the Finnish Ministry of Agriculture and Forestry.

The conference was titled "New forest for future needs - using advanced regeneration methods and techniques", presenting topics like the use of big data, new planting material for future needs and challenges for future seedling production.

With a fantastic view of the lake and forest in Gustavelund, 80 people from the Nordic countries and Latvia took part in the successful event, with an excursion to the surroundings north of Helsinki.



### **Organisation**

NordGen Forest consists of two bodies: the Forest Regeneration Council which meets twice a year, in relation to one thematic day and the Conference, and the Genetic Resources Working Group which meets once a year. In 2018, the Working Group arranged its meeting north of Copenhagen, and held a small seminar on climatic robustness and assisted migration, hosted by the Danish Nature Agency in Gribskov.

### **Scholarships**

In cooperation with Nordic Forest Research (SNS), NordGen Forest grants scholarships to enhance knowledge and competences in the area of seed, plants and forest regeneration. 17 candidates applied for the scholarship (11 men and 6 women) in 2018. Eight were granted a sum of maximum NOK 20,000 each.

### **Information and communication**

An important part of NordGen Forest's activities is distributing information and raising awareness of forest issues. News in this area can be found at NordGen's website and on our social media accounts.

### **Important with genetic diversity**

No matter which background and views upon forest we have, we can all agree that it is important to preserve a genetic diversity within the forest.

– Genetic diversity is important to form a resilient forest – a forest which can resist diseases, infestations and perhaps also a changed climate. Inbreeding leads to a wide variety of problems in forestry, says Ellinor Edvardsson, who works at the forest company Holmen in Sweden and is also part of the NordGen Forest Regeneration Council.

Øyvind Meland Edvardsen, another member of the council, agrees. He works as a seed manager at The Norwegian Forest Seed Center.

– Naturally, it's very important for us to secure a genetic diversity when we collect seeds.



*Above: More than 150 participants joined the discussions at the NordGen Forest Conference in Gustavelund.*



*The Genetic Resources Working Group met north of Copenhagen and held a small seminar on climatic robustness and assisted mitigation.*

*At the thematic day in Iceland, an excursion was arranged to an indoor orchard with hybrid larch.*





## FARM ANIMALS

**NordGen Farm Animals contributes to the conservation and sustainable use of Nordic farm animals. We actively distribute information about animal genetic resources and partake in international networks. The year 2018 has been a time of big challenges for the section, due to major changes in personnel. Former projects have been wrapped up, and traditional actions in the section haven been revitalized.**

Our farm animals are part of our history and culture and are important for our daily life by providing food for everyone and income to farmers. As a service and knowledge center, our activities target the conservation of genetic diversity within Nordic farm animals important for food production and agriculture. We actively distribute information about animal genetic resources and partake in international networks.

### **Brown Bee**

Saving the local honey bees, the Nordic Brown bees (*Apis mellifera mellifera*), from the edge of extinction is one of the focal points and long-term projects in NordGen Farm Animals.

This work started in 2011 by summarizing the current knowledge in a report and subsequently introducing an action plan for the conservation of the brown bees.

A Nordic Brown Bee network, which aims to gather knowledge and promote the conservation and utilization of the native brown bee in the Nordic countries, was established. The network focuses on

activities such as summarizing traditional knowledge on Brown Bee specific management, promoting collaboration between stakeholders, sharing and exchanging knowledge and breeding material.

Hybridization with other honey bee subspecies is one of the main threats to the Nordic brown bees. Ensuring the purity of the breeding stock is therefore essential for their successful conservation. Motivated by this, we conducted a molecular genetic study to compare molecular and morphological methods for monitoring and revealing possible introgression between honey bee subspecies. The underlying goal was to develop a solid procedure for beekeepers.

### **NordMeat**

Lack of comparative knowledge on meat quality is significantly hindering the promotion of native breeds. The purpose of the project "NordMeat" is to characterize the meat quality and carcass traits of different native cattle and sheep breeds in the Nordic countries.



*NordGen Farm Animals was part of a genetic diversity study of Kystgeit. Photo: Anna Rehnberg*

Differences in taste, texture and chemical properties may be useful for developing niche products from national breeds.

NordGen Farm Animals has established a research network with participants from the Nordic countries to stimulate and coordinate meat characterising activities. The outcome will be documented, and the use of the knowledge facilitated.

### **Kystgeit – Norwegian coastal goat**

Kystgeit is a rare Norwegian goat breed. It has a great regional importance for culture and the management of valuable coastal heathland, as well as for future value creation, including tourism.

Today, the coastal goats are considered threatened since there are only 400-500 individuals. Furthermore, the breed has been separated into a few isolated herds, with part of the population living on two islands.

The management and animal welfare issues of the feral herd on Skorpa island has been concerning local authorities. This

motivated experts in NIBIO (Norsk Institutt for Bioøkonomi) and Norwegian Genetic Resource Centre to initiate a genetic diversity study together with NordGen Farm Animals.

In this project we studied the population living at Skorpa island by field observations and genetic methods. The aim was to assess the fitness of the goats, herd dynamics, genetic variation and levels of inbreeding, to be able to give management recommendations to the local authorities .

### **Workshop on Genomic Selection in Small Populations**

Genomic selection is the most pivotal revolution in animal breeding since the introduction of artificial insemination.

The genomic selection approach has been developed for the mainstream breeds with large population sizes. Financial investments required for the introduction of genomic testing have precluded its prevalence amongst the noncommercial breeds.



*Above: At the workshop in Finland, a visit to Ahlman Vocational College was arranged. They keep Eastern, Western and Northern Finncattle. Right: Tuula Pehu of the Finnish Ministry of Agriculture and Forestry, opening the conference.*

However, genomic information has undisputed benefits in breeding schemes for traditional breeds, especially in managing population structure and controlling inbreeding.

This acted as a major stimulant for organizing a genomic selection workshop for minor breeds in Espoo, Finland from the 29th -30th of November 2018.

More than 50 participants benefited from invited lectures on genomic selection in small populations, commercial breeding and several case studies.

As a pre-conference excursion, participants had the unique opportunity to visit the living genebank for Western Finncattle, at Ahlman Vocational College located in Tampere.





## SVALBARD GLOBAL SEED VAULT

**For Svalbard Global Seed Vault, 2018 was an eventful year. Its 10-year anniversary was celebrated with a workshop, a symbolic seed deposition and guests attending from all over the world. Furthermore, as soon as the anniversary was finalized, a technical upgrade of the facility commenced. This, along with seed sample number one million being deposited, led to worldwide attention for the Seed Vault this year.**

As the back-up facility for the world's gene banks, Svalbard Global Seed Vault lies in a remote and safe place, yet well accessible for shipping and handling of seeds.

The seeds are safeguarded deep in the mountains of Svalbard, preserved in the frozen environment where cooling machines keep the temperature at minus 18 degrees centigrade.

In 2018, seeds were deposited at three occasions: by the end of February, in August and in October.

- A total of 92,638 new safety duplicates from 30 depositors were stored in the Seed Vault in 2018.
- The largest seed deposit event took place as part of the celebration of the 10 year anniversary of the Seed Vault. At this occasion 23 gene banks deposited 77,671 seed samples. Most of these gene banks were represented at the occasion.
- Six new institutions signed the Deposit Agreement in 2018, from Slovakia, Portugal, Chile, Thailand, United Kingdom and Latvia. Two of these were results of merging and reorganization of institutes that already had deposited seeds. In addition

to these two, three gene banks deposited seeds for the first time in 2018, located in Estonia, Thailand and United Kingdom.

- The Seed Vault International Advisory Panel (IAP) had its first meeting in Longyearbyen in February, back to back with the 10 year anniversary.
- A considerable number of representatives of media, politicians, and researchers were received in connection with depositing seeds and the IAC meeting in February.

NordGen staff has in 2018 given more than 20 lectures and presentations informing about the Seed Vault in different countries and audiences. In some cases, lectures have been given at gene bank visits, followed by discussions about future seed deposits.

The year has been characterized by a comprehensive upgrade of the Seed Vault construction, including replacing the former so called Svalbard tube, with a new watertight concrete tunnel and a service building outside the Vault facility. NordGen has taken part in numerous meetings related to the construction upgrade and development of improved routines for Seed Vault operations.



## PUBLIC-PRIVATE PARTNERSHIP

**Together we are stronger. That's the very essence of the Nordic Public-Private Partnership (PPP) for pre-breeding. Through the partnership, small plant breeding companies in the Nordic region are able to compete with large, multinational corporations. In the four different projects, the cooperation is of great value to all participants. But as breeding is long-term, persistence is needed to reach the goals.**

The Nordic Public-Private Partnership (PPP) for pre-breeding is a cooperation intended to strengthen plant breeding in the Nordic countries and through its work promote sustainable exploitation of genetic resources in the Nordic region with its unique climate, temperature, and daylight. The PPP is funded by the Nordic countries and plant breeding entities.

### **The PPP Secretariat**

The PPP Secretariat at NordGen started up 2018 with usual routines typical for a new three-year project period with requesting and gathering of consortium agreements from the four approved projects followed by contract writing and signing. One project has new partners, a new crop and a new project leader. This caused a delay in the projects start-up-phase. However, all projects are now up and running.

### **Evaluation of the PPP from 2014-2018**

In 2013 an evaluation of the PPP's first period was completed by an external team. A second evaluation team started their review in the end of 2018 and will present

their preliminary results in the beginning of April 2019. The present team constitutes of two persons from the academia and two persons from the industry and they represent the countries Denmark, Finland, Norway and Sweden.

### **First year of the third period**

In this three-year project period, all four projects are continuations of the projects from the previous PPP period. It is very pleasing to note that the cooperation is of great value to all partners as there is a great wish to continue the long-term cooperation. Plant breeding is long-term work and to reach the goal persistence is needed.

*Presentation of the four projects in the third period:*

### **Pre-breeding for future challenges in Nordic fruit and berries**

The focus in this project is to strengthen pre-breeding cooperation in line with the previous PPP-projects, validate available germplasm resources by genetic and phenotypic characterization in order to widen the parental pool aimed at genetic



*Apples infected with a storage rot, Penicillium expansum. Photo: Masoud Ahmadi-Afzadi.*

resources enhancement by increasing diversity for targeted traits. This project also concentrates on enhancement and development on the genetic competence as well as initiating the process of integration of modern genetic tools into the breeding programs.

The specially designed multipurpose cultivar panels well representing the genetic variation and novel technologies will serve as a first step towards transition in to the genome-informed breeding.

### **Combining Knowledge from Field and from Laboratory for Pre-breeding in Barley III**

The focus within the third period of the PPP barley project will be on the utilization of the MAGIC populations from the two first periods and the setup of genomics assisted pre-breeding using genome-wide association study and genomic selection in pre-breeding.

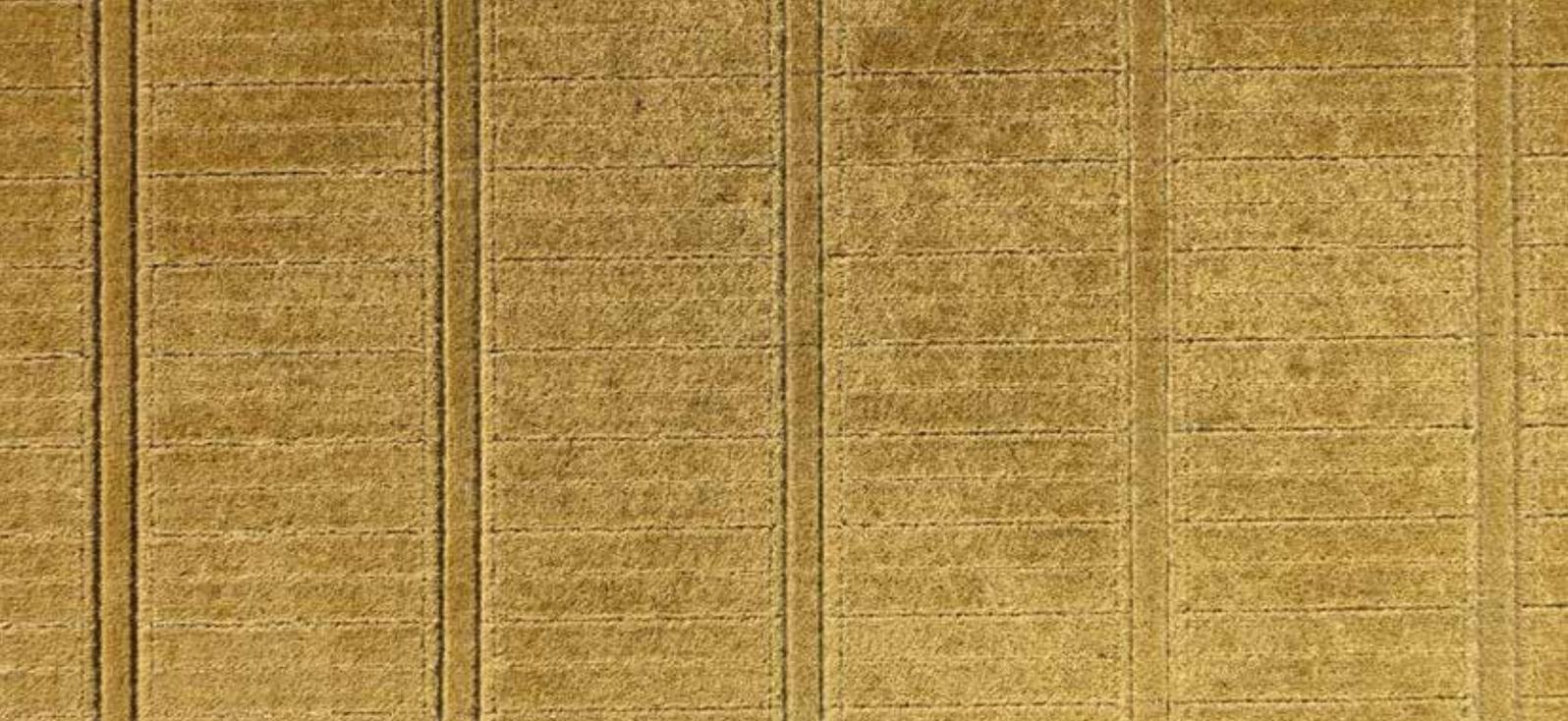
A spring barley core set from gene bank material will also be selected to be used for genomic assisted pre-breeding. For

this purpose, we aim to co-operate with NordGen for the selection of a spring barley core set suitable for phenotyping in Nordic countries and to find the best approach for genotyping gene bank materials for future needs.

In addition, we will optimize and use image analysis for phenotyping of seedling growth and perform field phenotyping of tillering, close to maturation.

### **PPP for pre-breeding in perennial ryegrass (*Lolium perenne* L.) Phase III 2018-2020**

The project aims at improving the winter hardiness, persistence and other important traits for perennial ryegrass in northern Europe. It will also make plant breeding in northern Europe more prepared to meet new demands due to climate change, political decisions or consumer demand. Growth conditions in northern Europe differ from other parts of the world due to a unique combination of day length and other environmental variables like temperature. Only breeders in the Nordic and Baltic countries can be expected to



*Drone picture of fields at Lantmännen in Svalöv. Photo: Jesper Cairo Westergaard.*

breed for these special conditions. With this project, these breeders will get better tools and genetic variation to make adapted varieties. Agriculture in these countries will, despite its northern location be more competitive compared to other countries.

### **Nordic Public Private Partnership Plant Phenotyping Project – Phase 2**

The main activities within 6P-phase 2 consist of two categories - Research & Innovation (R&I) and Networking. R&I activities will involve a continued focus on the use of unmanned aerial systems derived images and the integration of high-throughput phenotyping technology. The specifically targeted crops are barley, oats, wheat, ryegrass and potatoes.

The networking activities will effectively be a social platform to integrate ongoing research, strengthen cooperation and facilitate knowledge sharing between research institutions, technology providers, and plant breeders.

The benefit to the plant breeding industry arises from either making the current vi-

sual phenotype observations faster, more reliable and cost-efficient, or the introduction of new phenotyping traits not possible to score visually with the human eye.

In the first case, it is a matter of replacing or complementing the observations done manually by the breeder or co-workers. Automated field phenotyping may in some cases be faster or more precise than even an experienced breeder.

The second possibility in automated phenotyping is to use different sensors to rate phenotypic traits not possible to score with visual observations from RGB cameras. It opens to an array of phenotypic traits, some of which are correlated to interesting traits such as biotic and abiotic stress, or even yield.

The potential efficiency increases in later processes, such as quicker cultivar selection and relation to genomic markers adds further value. The long-term vision is to be able to use phenomics and genomics in combination, to build prediction models for selection of new candidate cultivars.



## COMMUNICATION

**Communication to our stakeholders concerning what NordGen does as a gene bank and genetic knowledge center is essential. This is done through several different channels with the aim to promote an effective Nordic cooperation on sustainable conservation of genetic resources. In 2018, NordGen leveled up within this area and increased the reach to both former and new supporters of our mission.**

Alike many of the other areas within NordGen, the communications department has had a busy year of 2018.

Many hours were spent in the beginning of the year at preparing the 10-year anniversary of Svalbard Global Seed Vault. This was an event leading to massive positive attention about both the Seed Vault and NordGen.

Furthermore, in cooperation with The Norwegian Ministry of Agriculture and Food and Crop Trust, NordGen has commenced a project to improve the Seed Vault communication from the three partners. The project continues during 2019. The Seed Vault now has several social media accounts as well as its own website: [www.seedvault.no](http://www.seedvault.no), which is updated on a regular basis.

In 2018, NordGen completed its communication strategy for 2019-2021. NordGen's communication strategy follows the guidelines for the Nordic Council of Ministers' communication strategy. The strategy is supplemented by a communication plan. The collaboration with the

Nordic Council of Ministers and the Nordic Communication Network is of great value to NordGen, and NordGen actively participates in this.

In 2018, the services in the webshop have been extended both in time- and stock scale. In connection with distribution of seed to hobby users, the webshop now offers books, educational kits and gift boxes with seed all year round.

Additionally, in 2018 the following activities have been executed:

- A strategy for social media is drafted.
- Successful organizing of NordGen's 10-year anniversary.
- Debate articles published in several, leading Nordic newspapers.
- Successful organizing of a side-event at COP24 in Poland.
- Regular posts on our website and social media accounts.
- 15 short video clips produced.
- Folder with stories describing the importance of genetic diversity produced.
- Promowear to the personnel designed and ordered.

## FACTS AND FIGURES

### Statement 2018

<i>(TSEK)</i>	Budget 2018	Result 2018
<b>Income</b>	<b>2017</b>	<b>2018</b>
Nordic Council of Ministers' ordinary budget	28,323	28,311
National contributions	3,136	3,319
Other income	45	285
Project funds, Nordic Council of Ministers	664	1,891
Other external project funding	6,304	5,813
Total income	<b>38,472</b>	39,619
<b>Costs</b>		
Staff costs	22,782	21,564
Goods and services	9,998	9,790
Contribution to external projects	100	100
Other costs	5,574	7,926
Total costs	<b>38,454</b>	39,380
<b>Result year</b>	<b>18</b>	<b>239</b>

## BOARD

The NordGen board and deputy members are appointed by the Nordic Council of Ministers and the Nordic Senior Official Committee for Agriculture and Forestry.

Board Members	Deputies
Norway: Geir Dalholt, chair Ministry of Agriculture and Food	Ivar Ekanger Ministry of Agriculture and Food
Sweden: Carina Knorpp, vice-chair Ministry of Enterprise and Innovation	Åsa Widebäck Ministry of Enterprise and Innovation
Denmark: Kim Boel Olesen (resigned in Oct. 2018) Ministry of Environment and Food	Birgitte Lund Ministry of Environment and Food
Finland: Tove Jern Ministry of Agriculture and Forestry	Ehro Pehkonen Ministry of Agriculture and Forestry
Iceland: Emma Eypórsdóttir Agricultural University of Iceland	Sæmundur Sveinsson Agricultural University of Iceland
Observers	
Kenneth Høegh Greenland	Birthe Ivars The Environment Sector
Rólvur Djurhuus Faroe Islands	Jan Svensson Staff Representative



## ABOUT NORDGEN

**It is NordGen's overall goal to ensure the conservation and utilization of genetic resources within agriculture, forestry, and farm animals in the Nordic countries. NordGen also has an important role in coordinating the field of genetic resources and contributing knowledge about genetic resources regarding both professional and policy issues to the Nordic countries. Furthermore, NordGen runs the daily operations at Svalbard Global Seed Vault.**

NordGen carries a unique collection of genetic material. Genetic resources that form the backbone of the development of agriculture, forestry, and bio-technology in the region and with a correspondingly large potential for strengthening green transformation and sustainable growth in the Nordic region. NordGen is responsible for unique Nordic genetic material, which as well as being part of the Nordic region's cultural history, also is very important as a basis for new climate and growth-oriented knowledge, bio-economy, and innovation. The potential to put NordGen's skills into play are large and there is a serious need for it now.

For decades NordGen has been highlighted as one of the Nordic flagships in terms of creating Nordic synergies. The Nordic countries show a solid interest and willingness in using NordGen's skills, and internationally NordGen is equally a reputable and confidence-building cooperation partner.

NordGen is located in Alnarp, Sweden (plants, gene bank), NiBIO Ås, Norway (farm animals and forest), and Årslev, Denmark (rooms for basic collection). Furthermore, greenhouses and agricultural areas are rented in Alnarp, Sweden.

