PP and 6P Experiences – from a Private Partner point of View

Christian Sig Jensen

PPP – American style…

Public Private Partnerships

What's in it for me?

PUBLIC

1. Response to societal needs:

Varieties for a changing climate

Varieties that fits national regulations

Varieties that fulfill political agendas

(ex. protein self sufficiency)

2. Access to proprietory material and tools
3. Transfer science into solutions (buyers)
4. Turn science into business
5. Prepare for the future (together)

PRIVATE

1. Do stuff you would not do yourself

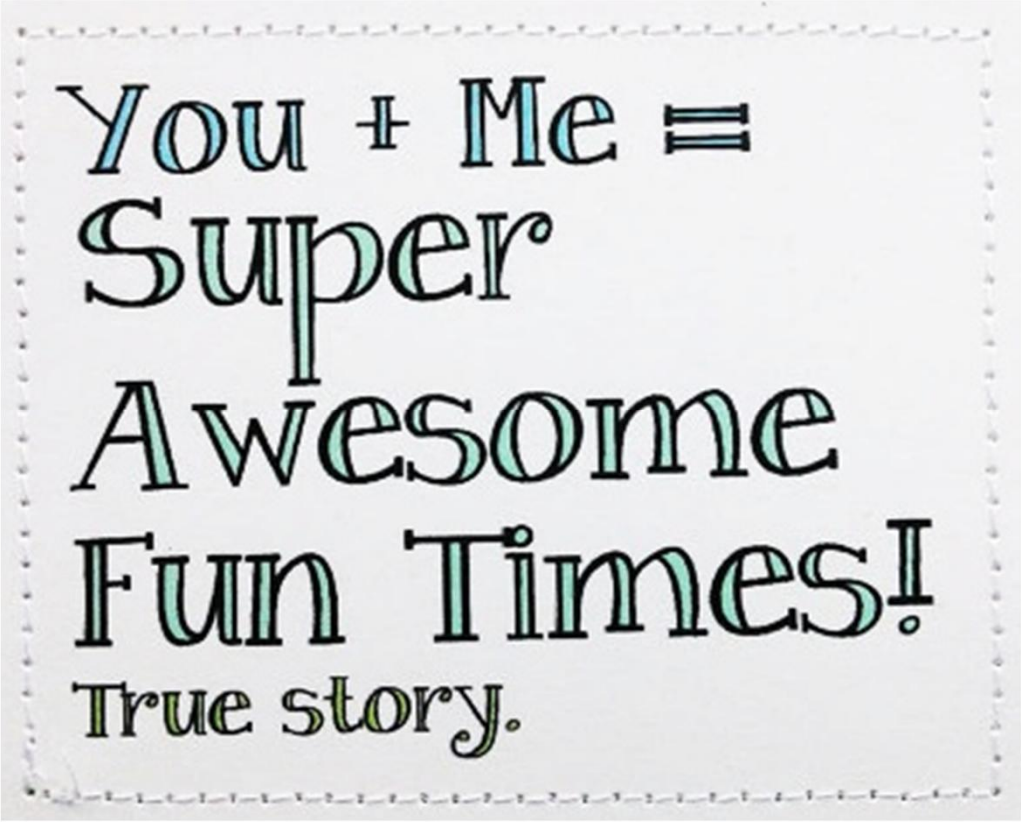
Stuff that is too expensive

Stuff that is too complicated (lack of expertise, or equipment)

Stuff that is too risky

2. Access to proprietory methods and tools
3. Transfer science into solutions (sellers)
4. Turn science into business
5. Prepare for the future (together)

OK, so how has it been for DLF to paticipate in PPP?



Awsome…


PlotCut - D:\D_Pix4D DATA\DK\OUTPUT\Forage\2015_2016_2017_sowing\01 - Boelshoej\...17-11-21-RGB-a-BL_2015_2016_2017_transparent_mosaic_group1_cropped.jpg
File
Edit
Rotate
Zoom
Help
Rows: 6
Cols: 416
Draw plot frame
Add plot to frame
Zoom In
Zoom Out
Extract and calculate

Fun…

Times...

DLF in Public Private Partnerships

Why?

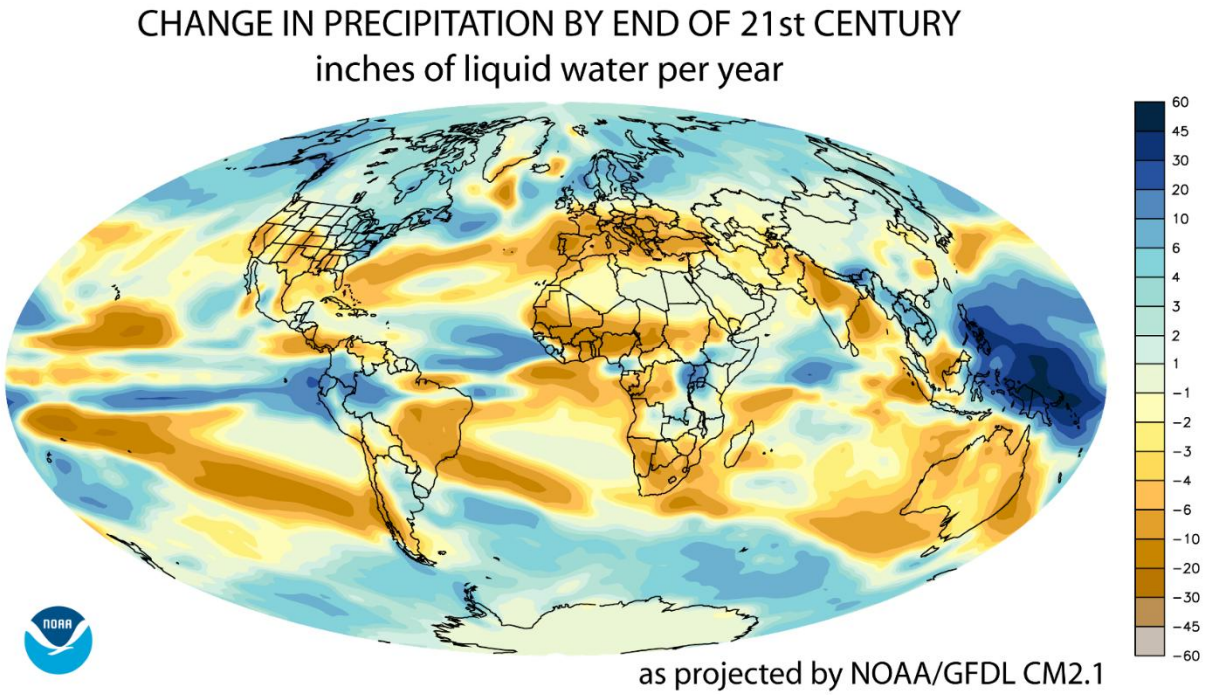
3P – Ryegrass prebreeding

1. Competition is tough
   = no room for maybees
2. More partners = more locations
3. Breeders love variation (future)
4. The material was genotyped

6P – a new (phenotyping) tool

1. New tool in town – good or bad?
2. What we do today – we should do better tomorrow
3. Breeding is a numbers game:
   Ý efficiency = Ý numbers = Ý sucess
4. Improve accuracy

Climate changes – good or bad for DLF?



Source: NASA Earth

Remember 2012?

Table 1.1.Yield changes in 2012 due to the drought

% changes between this year's (observed yields) and last year's *Outlook* (projected yields without drought)

	Coarse grains	Oilseeds	Wheat	Barley	Maize	Oats	Soyabeans	Sorghum
Kazakhstan	-28	-10	-53					
Russian Federation			-19					
Ukraine	-6	-5	-15					
United States					-25	-1	-9	-23

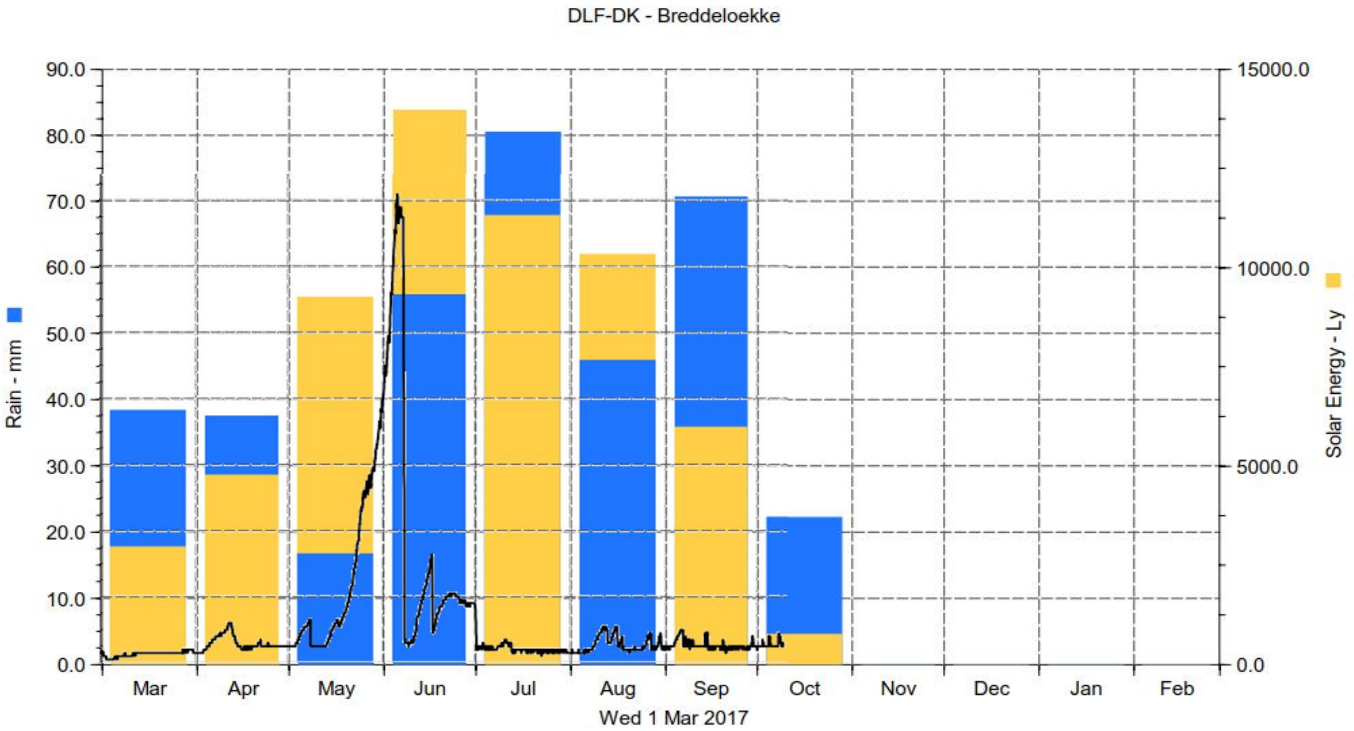
Source: OECD and FAO Secretariats.

Wheat field 2012, Neftekumsk in Russia

Corn field 2012, Mid-west, USA

Turf Trials Les Alleuds 2017

Challenges DK 2017?



Nordic PPP

Report on development of PPP for Plant Breeding

After the delivery of the report Measures to promote Nordic plant breeding to NMR the Ministers of Agriculture in the respective countries discussed the report briefly at their summer meeting in Iceland 2009. It was decided to give a specific working group the task to prepare the implementation of the proposed PPP for Plant Breeding, based on the delivered proposals. At the summer meeting certain issues related to the strengthening of NordGen were also discussed.

A working group has thereafter been appointed and given the tasks to prepare the establishment of the PPP and to consider certain issues regarding the future organization and operation of NordGen. The working group is composed of one representative from each of the Ministries of Agriculture and one from NMR. The group has had its first meeting in December 2009 and is due to deliver its proposals and considerations in early March 2010 in order to make it possible for the respective Ministry of Agriculture to incorporate relevant budget implications in their budgets for 2011.

According to information we have received from the discussions of the working group the issue of the PPP is progressing, even if it is somewhat overtaken by issues related to the development of NordGen. Thus, it is very timely now for the plant breeding companies and other plant breeding entities to contact the respective representative of the Ministries of Agriculture in the working group. It would be valuable if the companies could express their needs and support to the PPP concept as presented in the report Measures to promote Nordic plant breeding.

Alnarp, January 13, 2010

Roland von Bothmer Anders Nilsson

PPP for pre-breeding in perennial ryegrass (Lolium perenne L.)

Project partners:

2011 - 2020

Plant breeding entities:	DLF, Denmark Lantmännen ek för, Sweden Graminor AS, Norway Boreal Plant Breeding, Finland
Academic institutions:	Aarhus University, Denmark Agricultural University of Iceland, Iceland Norwegian University of Life Sciences (NMBU), Norway
Baltic institutions:	Estonian Crop Research Institute, Estonia Lithuanian Research Centre for Agric and Forestry,Lithuania
Project leader:	Prof. Odd Arne Rognli, NMBU, Norway

PPP – Perennial ryegrass for future Nordic climate

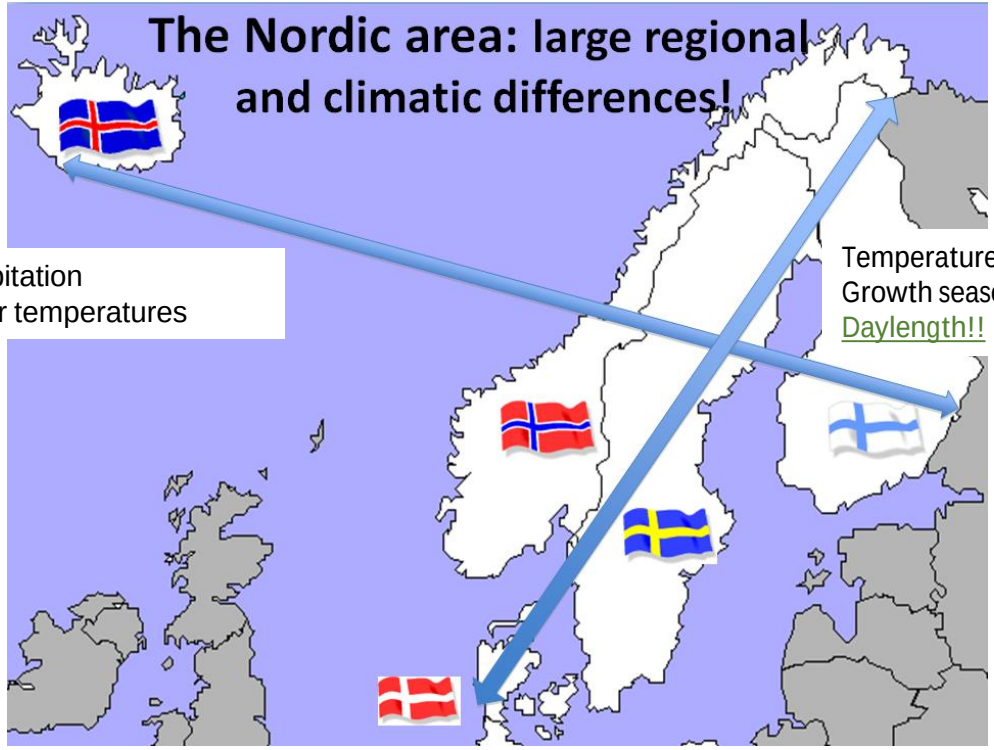
OBJECTIVES

Identify and select new plant materials for development of cultivars with a suitable adaptation to future climates

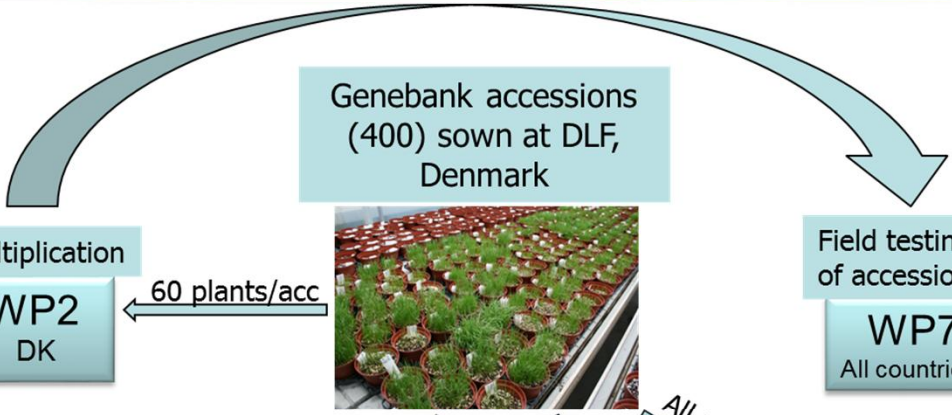
Recombine exotic materials with existing germplasm to create new genetic resources

Establish genome-wide associations for important traits

An ideal partner distribution

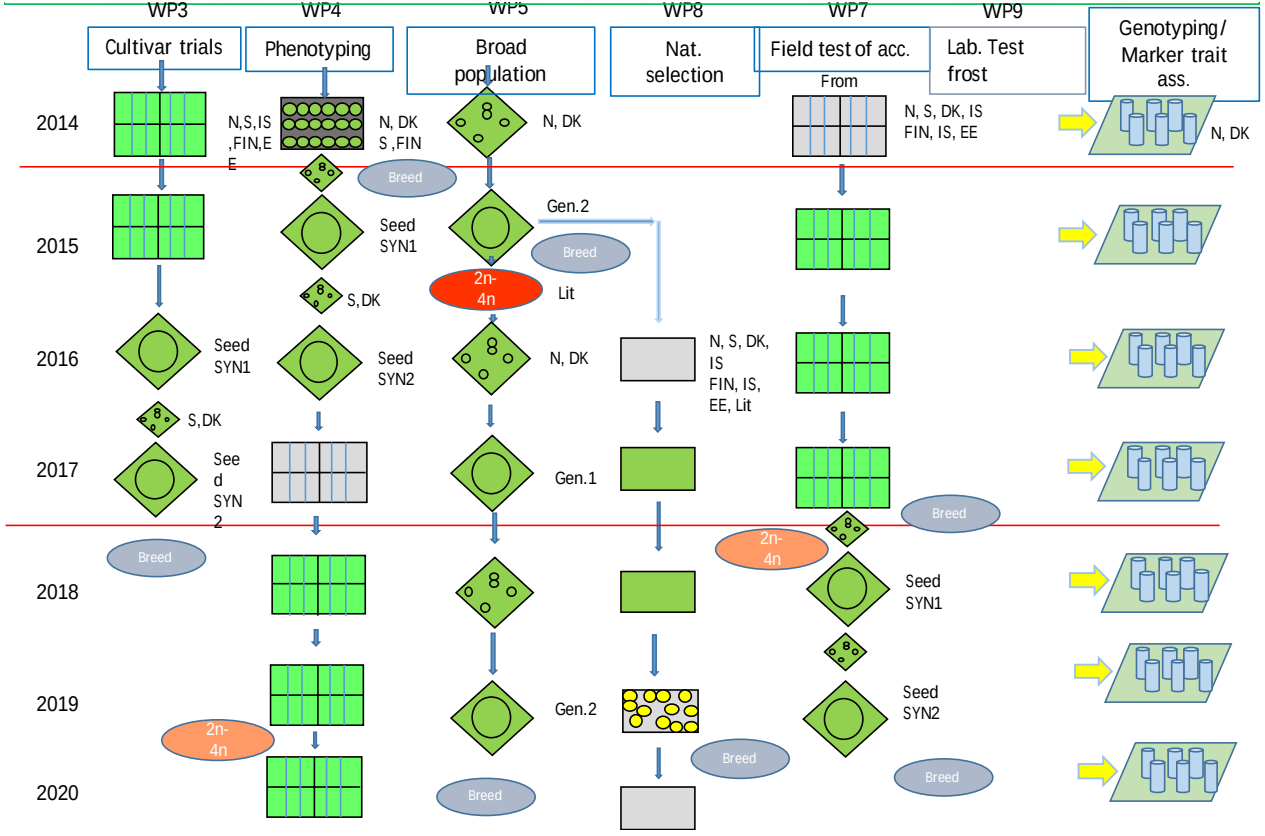


Work Packages

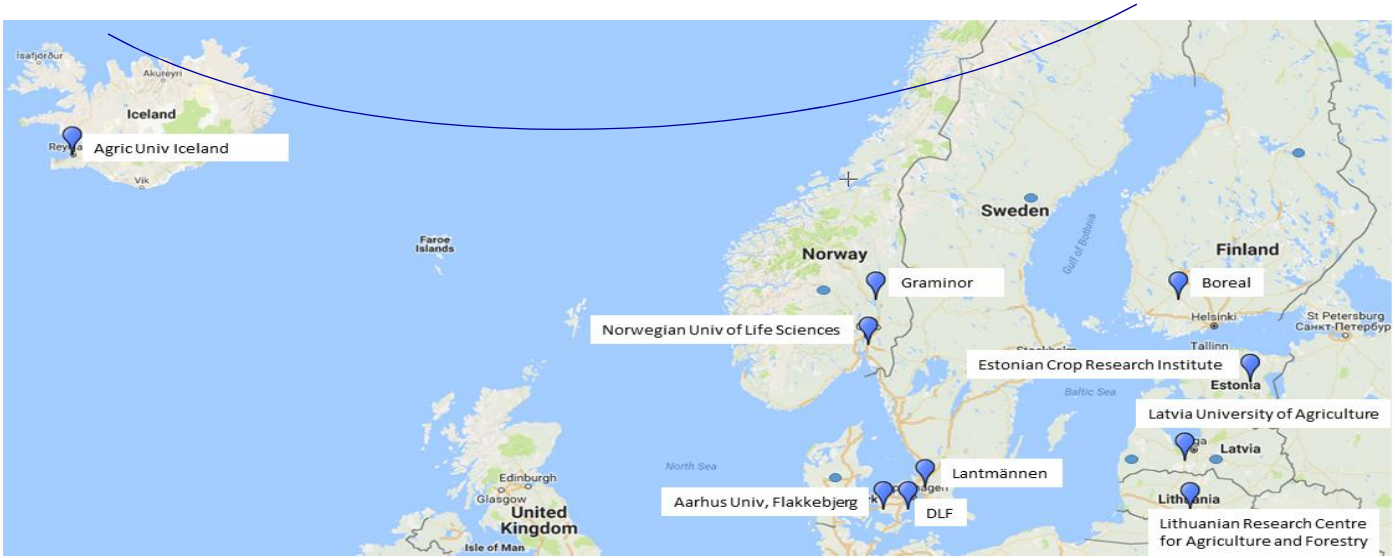


Original partners:
Denmark (DK)
Estonia (EE)
Finland (SF)
Island (IS)
Norway (NO)
Sweden (SE)

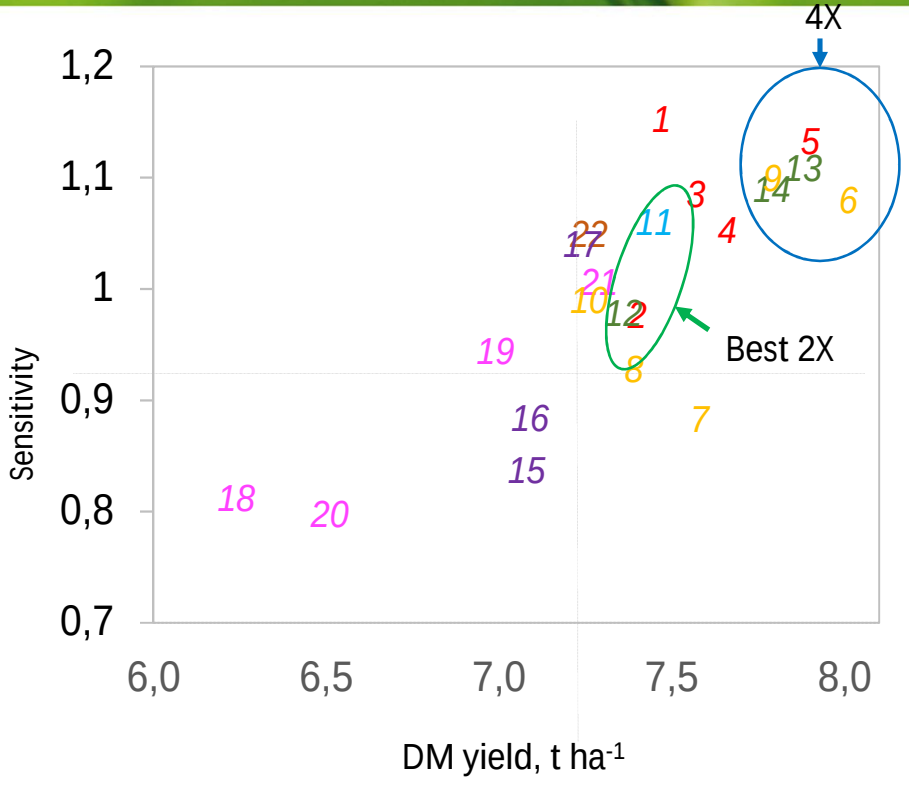
New partners 2015=>
Lithuania (LT)
Latvia (LV)


WP3
Cultivar trials
WP4
Phenotyping
WP5
Broad population
WP8
Nat. selection
WP7
Field test of acc.
WP9
Lab. Test frost
Genotyping/ Marker trait ass.
2014
2015
2016
2017
2018
2019
2020
N,S,IS ,FIN,E E
N, DK S ,FIN
N, DK
From
N, S, DK, IS FIN, IS, EE
N, DK
Breed
Seed SYN1
Gen.2
Breed
2n-4n
Lit
S,DK
Seed SYN1
Seed SYN2
N, DK
N, S, DK, IS FIN, IS, EE, Lit
S,DK
See d SYN 2
Gen.1
Breed
Breed
2n-4n
Seed SYN1
Seed SYN2
2n-4n
Gen.2
Breed
Breed
Breed

Partners and locations for field testings



GxE interaction – Finlay & Wilkinson test



No	Cultivar	Country	Ploidy
1	Einar	NO	4X
2	Fagerlin	NO	2X
3	Falk	NO	2X-4X
4	Fjaler	NO	4X
5	Trygve	NO	4X
6	SW Birger	NO	4X
7	Gunne	SE	2X
8	SW Irene	SE	2X
9	Leia	SE	4X
10	Svea	SE	2X
11	Riikka	SF	2X
12	Raidi	EE	2X
13	Raite	EE	4X
14	Spidola	LV	4X
15	Premium	NL	2X
16	Ivana	DE	2X
17	Pionero	DE	4X
18	Arvella	CH	2X
19	Arvicola	CH	4X
20	Cavia	CH	2X
21	Salamandra	CH	4X
22	Norlea	CA	2X

Outcome

Phenotypic data for 8 traits on ~8,000 single plants per location, 4 countries

Passport data updated and ploidy of accessions checked by flow-cytometry

Genotypes on single plants (~2,000 from Norway and ~2,000 from Sweden)
=>association studies

23 synthetic populations (14 NO, 8 SE, 1 SF) created by selection for specific traits

Syn-2 and parents sequenced (GBS)

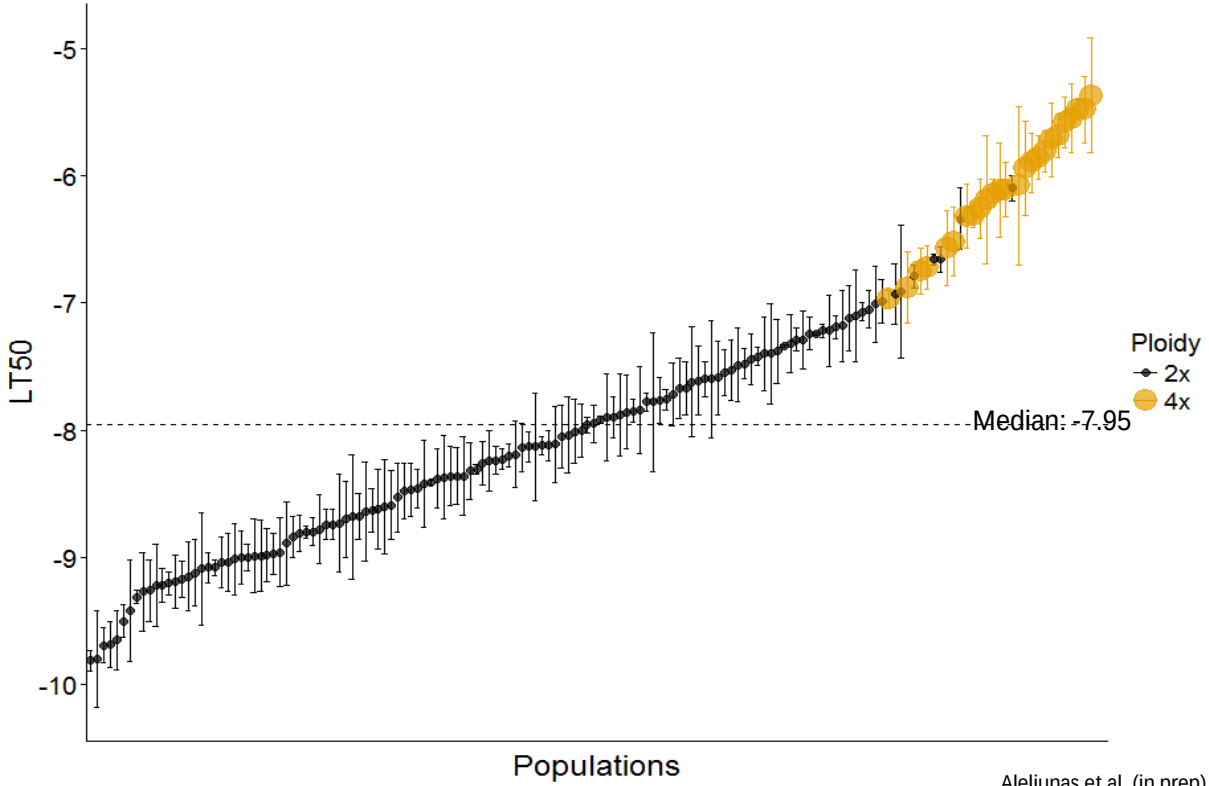
283 Parental populations sequenced – 3.1 M SNPs

Ongoing:

Field tests of created Syns

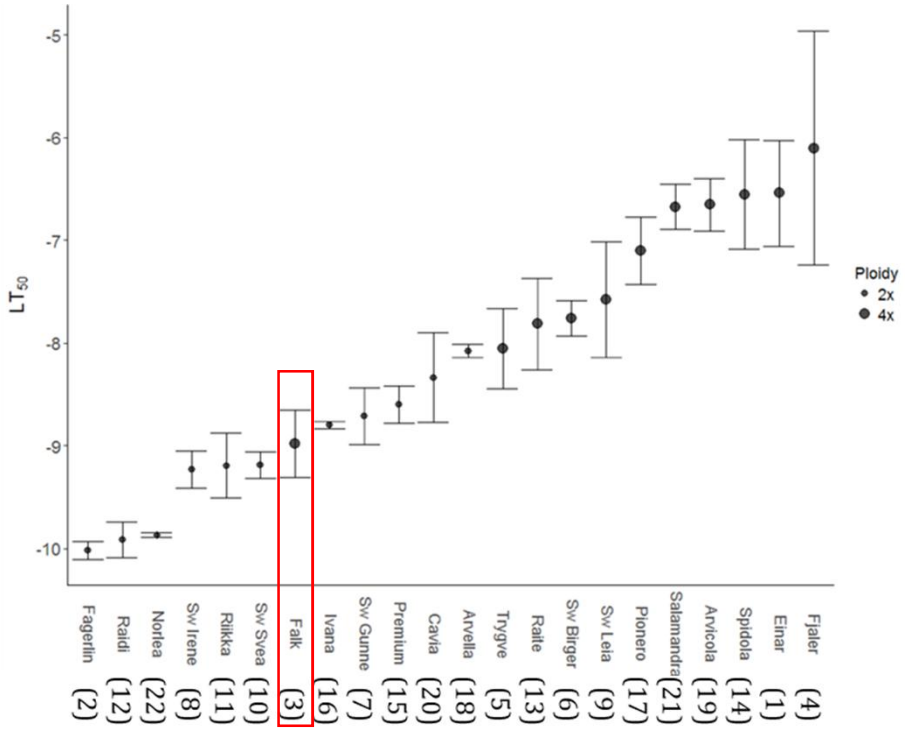
Broad base adaptation

Freezing test - 154 genebank accessions



Aleliunas et al. (in prep)

Artificial freezing test of 22 varieties



Conclusions

Low dry matter yields of diploid genebank accessions

Poor rust resistance among accessions

Winter survival not better than the best adapted cultivars

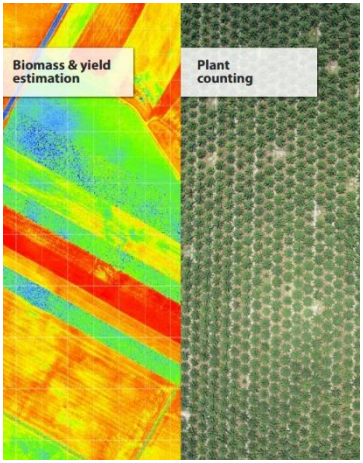
Extensive GXE interactions across the Nordic region

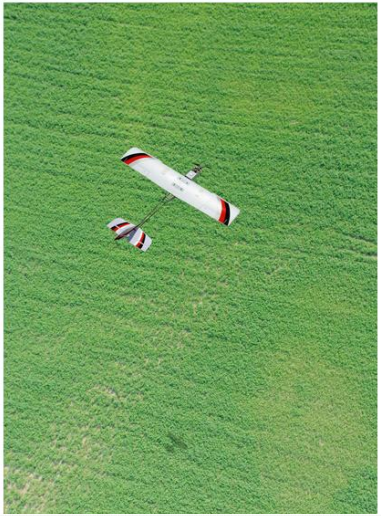
Most promising germplasms from the Baltic region

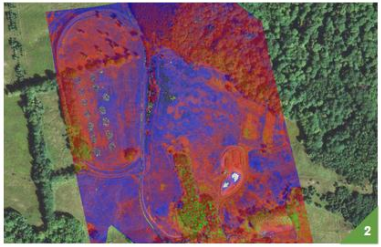
The broad breeding population will be a key resource

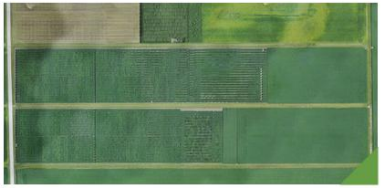
A similar broad tetraploid population (next phase of the project)

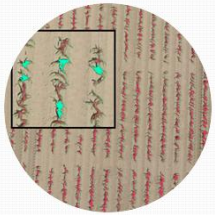
6P – The new tool in town











AGRICULTURE

+ Crop type
+ Plant count
+ Canopy cover
+ Leaf area index
+ Soil type
+ Soil moisture
+ Growth stage
+ Plant Height
+ Nitrogen deficiencies
+ Plant health
+ Detasseling
+ Yield Monitoring

1 The PrecisionHawk UAV uses its onboard intelligence to determine the quality of the images that it collects. If the images are collected with a high confidence level the UAV will upload the data to the cloud automatically.

2 The multispectral view overlays the visual imagery showing a normalized vegetation index that depicts vegetation in near infrared light detecting chlorophyll in plants.

Which UAV to choose? Which camera?

Phenotyping Investment Balance

Response $R_t = h^2 S = \frac{i\, r\, \sigma_A}{L}$

$i = Selection\ intensity$

Population size •	expense •
Discard size •	expense •
Selection speed •	expense •

$r = Selection\ accuracy$

Rep size •	expense •
Precision •	expense •
Speed •	expense •

Visual Scoring, 3000 plots

Activity	Handheld	Drone
Preparation	10	20
Scoring	120	20
Data management	10	180
Phenotyping Unit Time (PUT)	2.3 s	4.4 s
Phenotyping Unit Costs (PUC)	0.35 DKK	0.55 DKK
Investment	-	UAV + software

1. Fast recognition of field layout
2. Fast determination of Check position
3. Fast determination of image quality
4. Automatic conversion into values

Does it pay off?

- Yes if it:

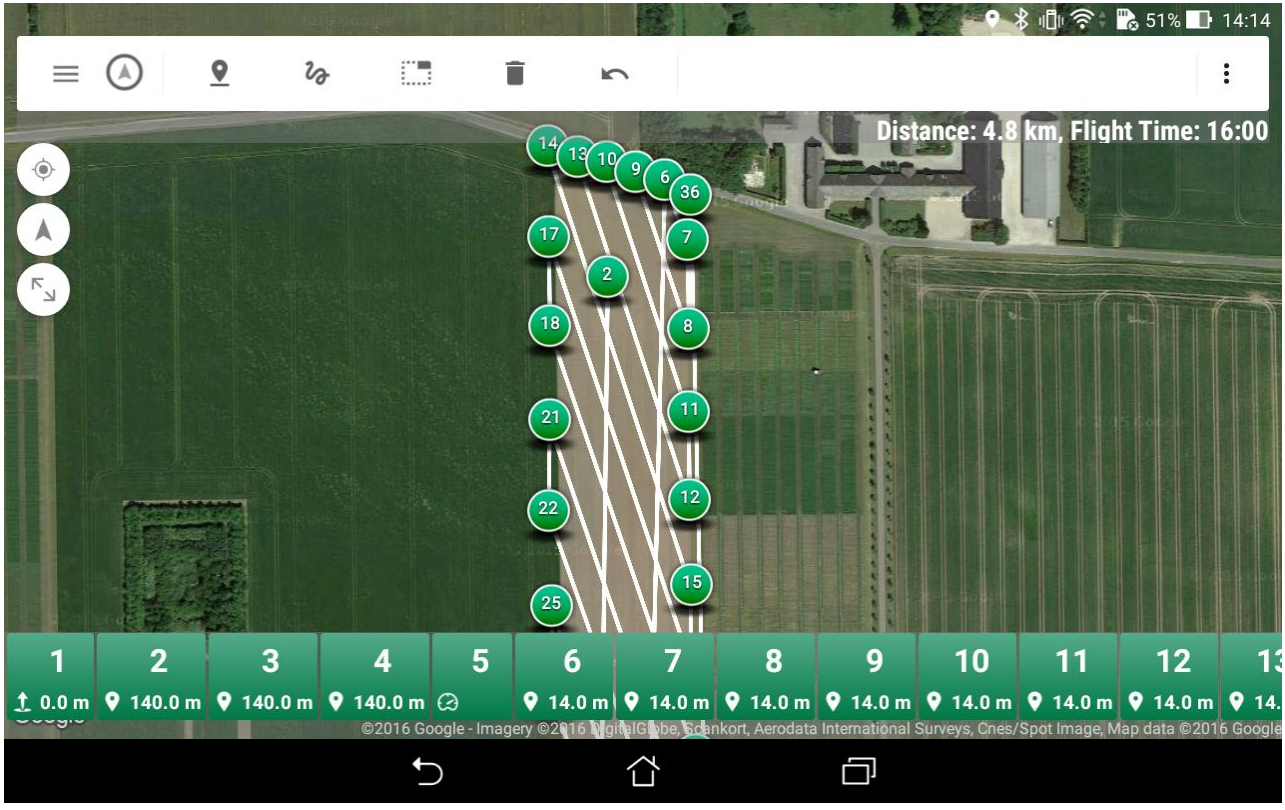
1. Increases accuracy significantly

2. Decreases phenotyping unit time (PUT)

3. Provides new information not otherwise acheivable

Nordic Plant Phenotyping Network (NPPN)

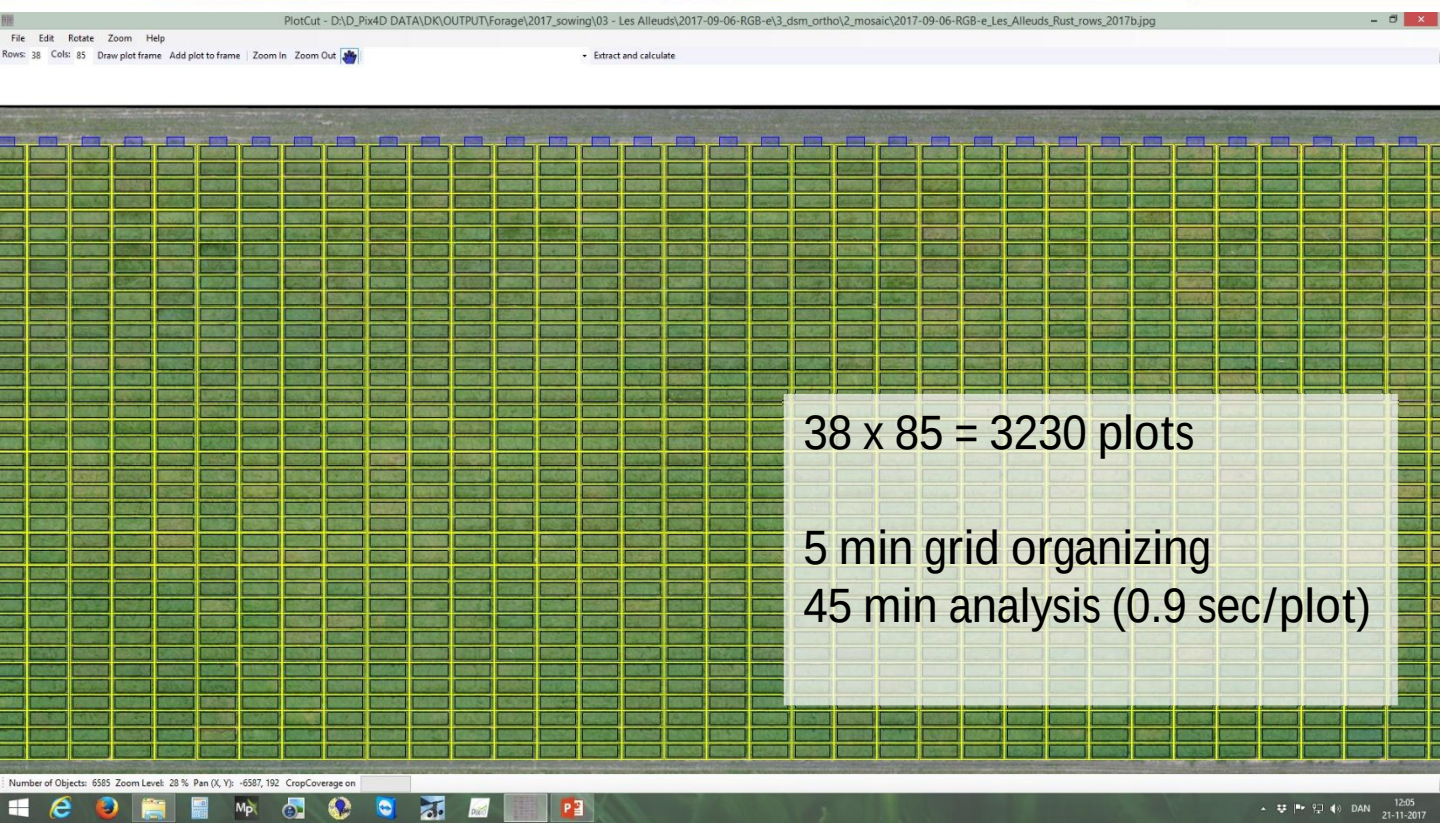
1st SOLO Mission



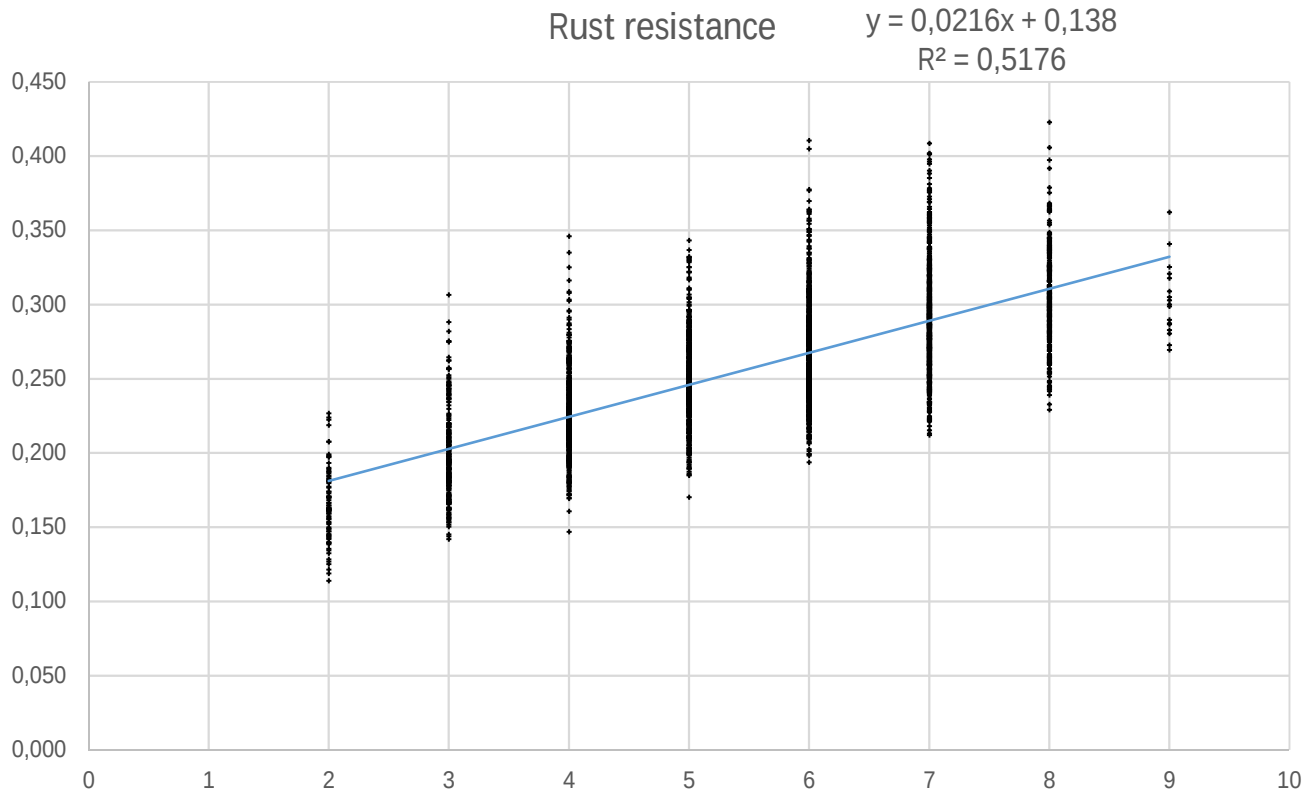
Since then…

- 108 flights
- Covered ~ 130 ha field trials
- 24,000 RGB images
- 60,000 multispec images
- ?? Field scorings
- 540 hrs image stiching
- ?? Project meetings

PlotCutter at work



Usefull?


Rust resistance
y = 0,0216x + 0,138
R² = 0,5176
0,450
0,400
0,350
0,300
0,250
0,200
0,150
0,100
0,050
0,000
0
1
2
3
4
5
6
7
8
9
10