



On-farm conservation in
the forage species timothy,
meadow fescue and red clover
- the way of creating new landraces in Norway

Kristin Daugstad
Norwegian Institute for Agricultural and
Environmental Research



Norwegian agriculture

- Almost 50 000 farms (30 000 less than 20 ha) - becomes fewer and larger.
- 65 % of the agricultural area are grassland to feed ruminants.
- 240 000 milking cows that in average produce 7100 kg of milk per year. (865 000 cattle at all).
- Over 1 million sheep, on forest and mountain pasture in the summer.
- Big variations in growing conditions from south to north, and from coast to inland.
- Long winter - necessary to conserve the forage

Collection of forage outfields
- both grazing and harvesting



Production of barley and oat on cultivated area on the farm



Cultivated meadows

- A change from collection to cultivation started about 1850 in the southern parts of Norway.
- Imported seed of timothy and red clover were used, with the consequence of severe winterdamage on the meadows.
- Own seedproduction improved the winter-survival, and the farmers "set aside" the best part of the meadow for seed production.
- As late as 1920 it was still not common to cultivate grassland in the northern parts of Norway, due to lack of winterhardy varieties.

..new varieties and the use of mineral-fertilizer demanded new methods in forage conservation...



Landraces

- In cross pollinated species a population consists of a large number of different genotypes, each with a little different characteristics and growing value.
- Under a given climate and growing condition some genotypes will be better adapted than other genotypes.
- These adapted genotypes will produce more seed than the less adapted genotypes, resulting in an improvement in the next generation

Landraces

- During generations landraces were adapted to the local climatic conditions and to the harvest management.
- Up until the early 1950's there existed many landraces of timothy and red clover in Norway
- It became easier to buy seed, and the use of mineral fertilizer reduced the need for nitrogen-fixation from clover
- Almost all of the landraces were lost before we saw the value in preserving them. Except....

Molstad red clover



Molstad red clover

- About 1850, from the farm Molstad in south-eastern part of Norway (Brandbu).
- The origin is most probably from imported seed and not from wild Norwegian clover.
- Molstad was the most important red clover variety until 1980-1990.
- Used in the breeding programs for new varieties.
- Stored in Nordic Genebank together with a few other landraces.

Grindstad timothy



- Grindstad timothy originated on the farm Grindstad in the south-eastern part of Norway.
- In the 1860's seed from Scotland was imported to a neighbouring farm that was used as an agricultural school.
- The timothy was grown as normal practice at that time. It was used for hay and the best part of the meadow was used to produce seed for the next generation.
- In 1916 the first registered seed was sold.

Grindstad timothy

- In the early 1960's, new scientifically developed varieties were approved that showed better results than Grindstad. And silage started taking over for the drying of hay.
- The seed production of Grindstad was changed from 1962.
 - The meadow was cut for two years as silage
 - Seed was harvested the third year
 - This seed was used to establish new meadows.
- After some years Grindstad made "comeback" as the most common variety.



Tollef Grindstad

New landraces by on-farm conservation

- Storing landraces *Ex-Situ* stops their continuing adaption to changing environments and growing conditions.
- The aim of the project is to make new landraces by restarting the processes that created them.
- The "Grindstad-story" tells us that it is possible.
- Cover the different growing conditions in Norway, now and in the future.
- Funded by Norwegian Genetic Resource Center from 2003.

Management has changed ...



....today



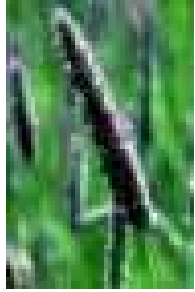
Round bale
silage most
usual

Change in grazing methods



New landraces by on-farm conservation

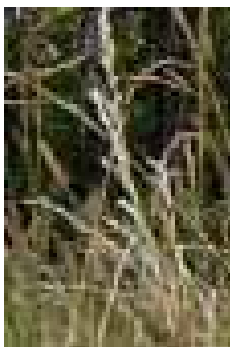
- Change in management
- Change in climate
- On-farm conservation is an extensive way to develop new varieties adapted to the agriculture of the future.
- To succeed we must start with material that contains a broad range of qualities.



Genepool timothy

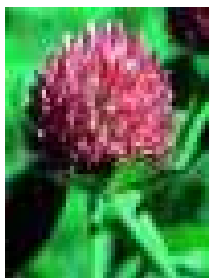


- 20 plants from 20 cultivars - about 400 genotypes
 - Norway (2), Sweden (2), Finland (1), Belgium (3), Canada (2), USA (2), Czech Republic (1), Russia (1), Lithuania (2), Estonia (2) and NOR1 and NOR2 from a nordic project
- A broad Nordic gene-pool containing 379 accessions (description of timothy 1994-1997).
 - About 1600 genotypes



Genepool meadow fescue

- 15 varieties
 - Norway (5), Denmark (1), Estonia (1), Netherlands (2), Germany (2), Polen (2), Belgium (1), ex. Soviet (1)
- 132 accessions from Nord Gen, each of 12 genotypes
 - The accessions available at the time the project started in 2003



Genepool red clover

- 9 varieties, each 20 genotypes
 - Nordi, Lea, Liv - Norway
 - Rajah - Denmark
 - Pallas, Ares, Bjørn, Bjursele, Jesper - Sweden
- 1800 genotypes from a crossing between accessions in the genebank and some russian material (established at Løken and in Denmark(?) in 1995).
 - 283 accessions - 46 ex. Soviet, 12 outside nordic countries, and the rest from nordic countries
 - 55 % D2 Norway, 22,5 % of each of D2 DPI, and D2 DP II



Project outline

1. Create broad gene-pools in each of the three species based on the forage collection of Nordgen (NGB)
2. Intercross the accessions for two generations
3. (Produce seed for distribution)
4. Make a seed mixture of the three species
5. Distribute seed mixture to local farmers in different climatic areas

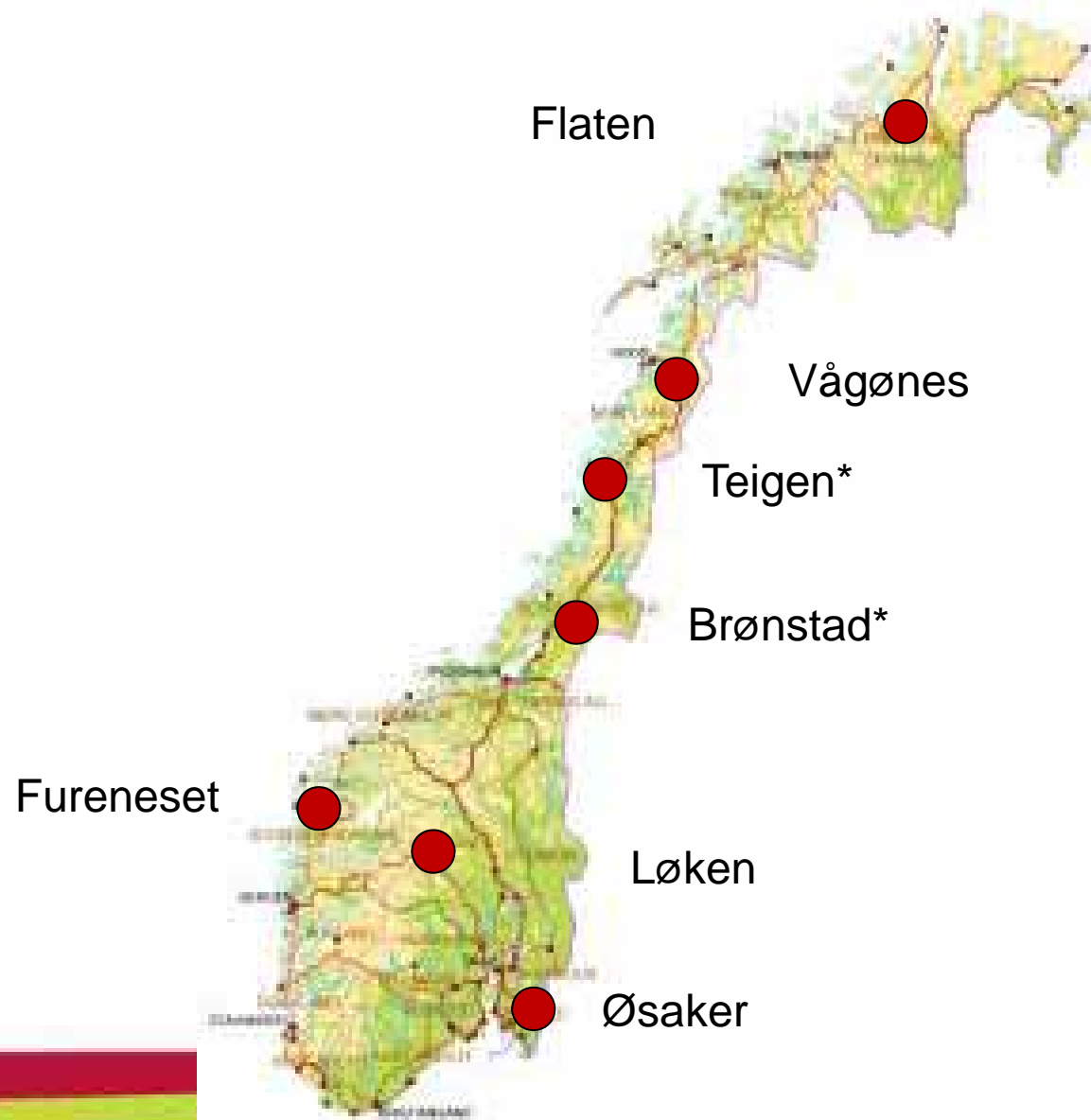
Project outline



6. The local farmer
 - a. Seed mixture year 0
 - b. Harvest as forage year 1 and year 2
 - c. Harvest seed year 3
7. The research station
 - a. (Thresh and) Clean the seed
 - b. Store a sample of each seed lot
 - c. Send seed mixture back to local farmer
8. Repeat step 6 and 7.

Results and experience so far

- After the two generations of intercrossing we were impatient and had enough seed, so we chose to continue with a combination of seed propagation and on-farm method.
- The seed mixture was made of 65% timothy, 25% meadow fescue and 10% red clover.
- The mixture was used to establish test plots in 2007 and 2008 on 7 locations each of about 600 m².
- Five test plots on research stations, and two at farms.



Locations

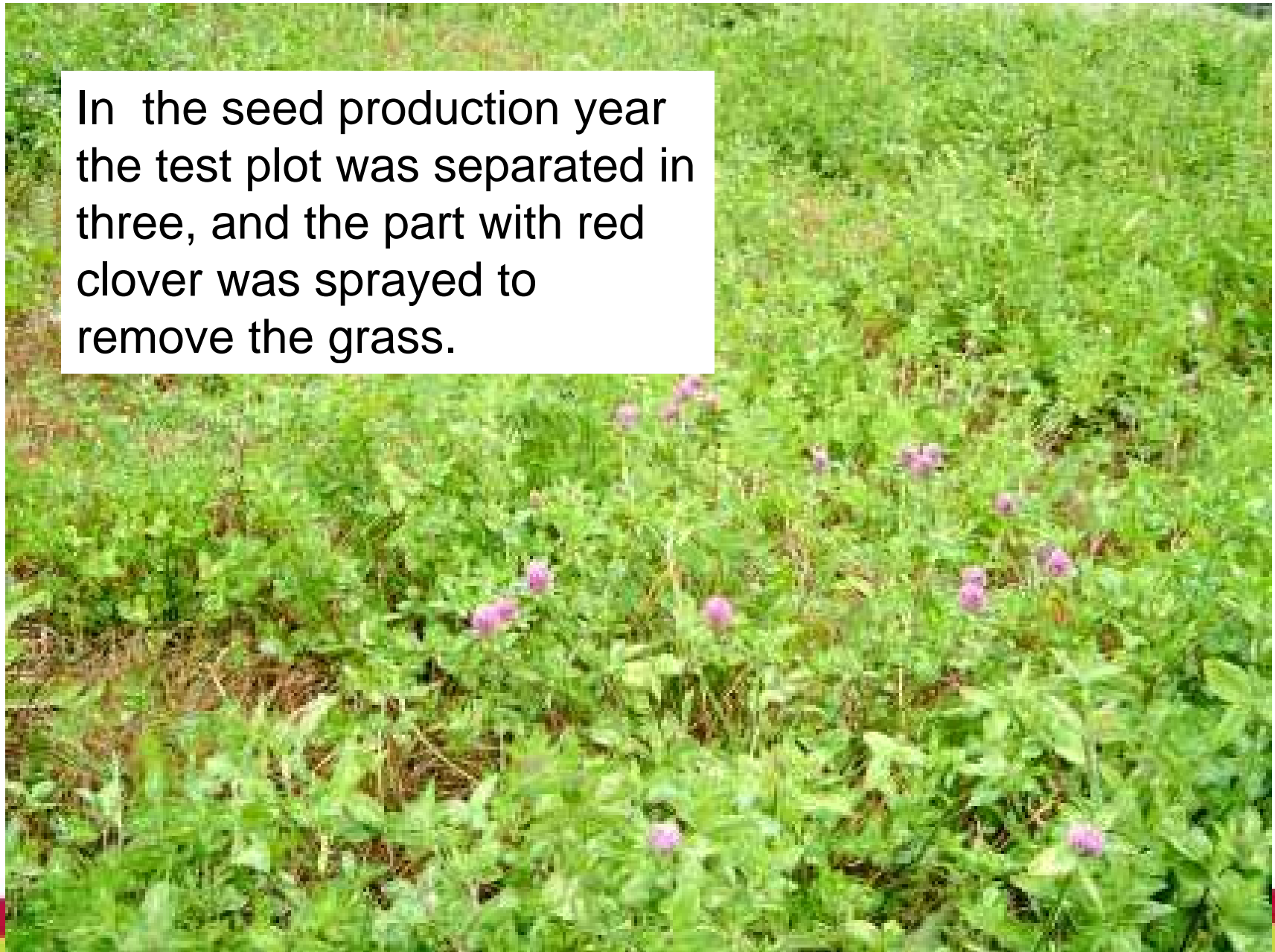
Location	Hight a. sea	°N	°E	Annual Precipitation	Annual Temperature
Øsaker	40	59,32	11,04	853	6,1
Fureneset	20	61,29	5,04	2010	7,0
Løken	530	61,12	9,06	590	1,6
Brønstad*	100	64,23	12,29	1000	4,3
Teigen*	40	65,91	12,42	1020	5,3
Vågønes	40	67,28	14,45	1055	4,3
Flaten*	20	69,93	23,25	400	1,3

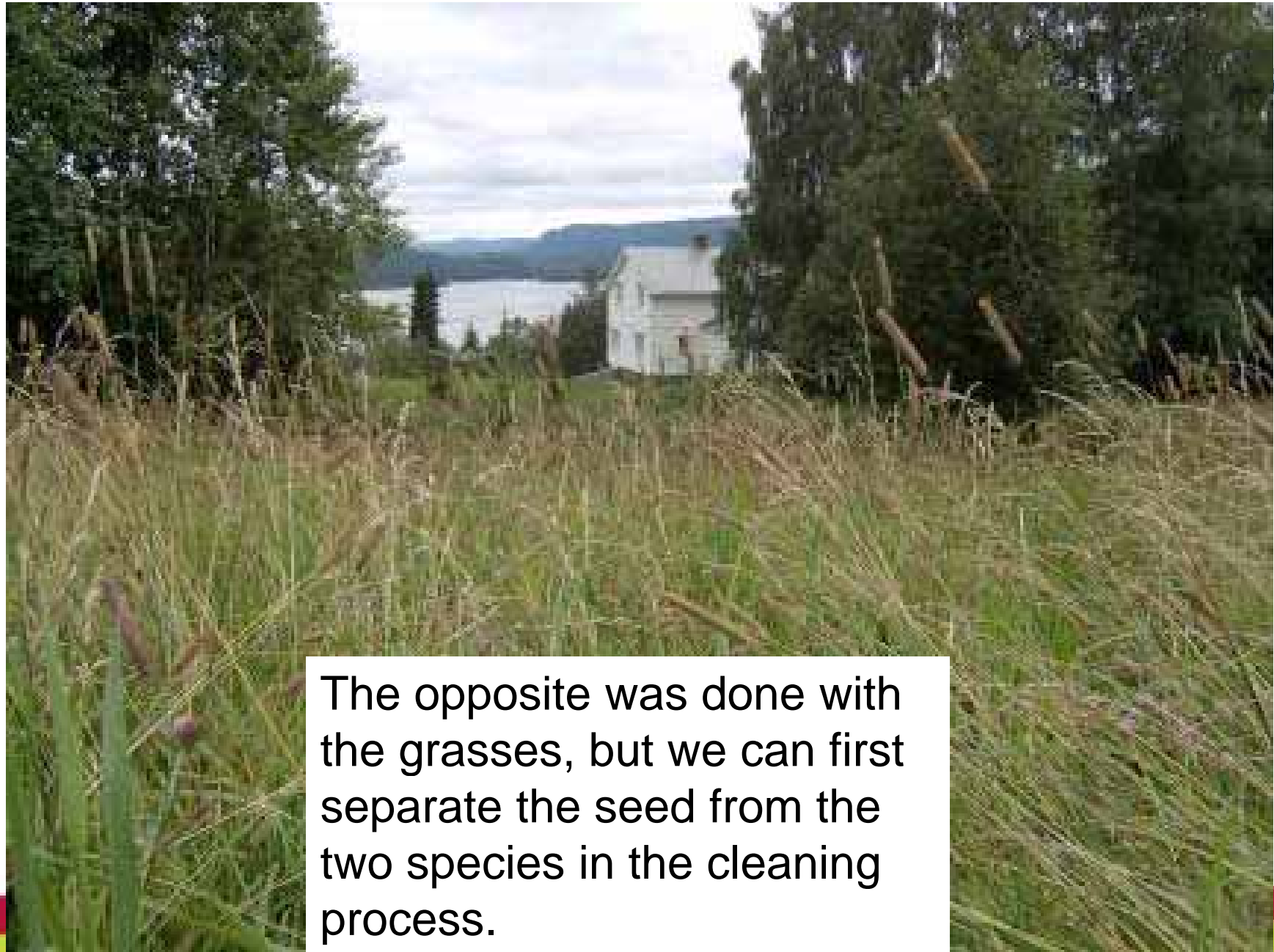
* Local farm



The red clover will have problems in the coldest parts of Norway.

In the seed production year the test plot was separated in three, and the part with red clover was sprayed to remove the grass.





The opposite was done with the grasses, but we can first separate the seed from the two species in the cleaning process.

Seed-production 2010

- Timothy and meadow fescue give mature seed all over Norway, at least in most years.
- Red clover seed has probably never been harvested in the northern parts in large amounts.
- Today the seed production is located in the south-eastern parts of Norway. With some timothy production in Trøndelag.
- We expect problems in the western parts with a lot of rainfall, and in the northern parts with short growing season.
- Equipment for seed harvesting is not common.

Løken 23.august 2010
-the old Wintersteiger
is still going



Vågønes 2009
-seed harvested by hand



Seed of red clover
harvested Vågønes 2009



orsk

Seed-production 2010

- On the three southern locations, most of the seed are harvested.
- The two locations in the middle of Norway are ready for seed production first in 2011.
- The two northern locations have had a bad summer, but if the autumn becomes warm the seed hopefully will be harvested soon....

The second generation of on-farm 2011 - 2014

- More locations on local farms.
- Smaller test plots (100-200 m²?) and only manuell harvesting of the seed will make it easier.
- How shall we find the interested farmers that can do a good job.
- The number of farmers are declining dramatically. And the ones left often runs several farms to get a living and do not have time to look after small test plots.
- We will figure it out during the winter.

