

Marker assisted breeding of organic heterogeneous wheat in Denmark



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Anders Borgen

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Background

- Breeding started in 2006 (plus conservation varieties)
- Commercial production of conservation varieties since 2008 (including Øland wheat)
- Genetic markers for bunt resistance since 2010
- CCPs in commercial production within Landsorten since 2021 (Mariagertoba and Popkorn)
- Total production in 2025: 1600ha in DK, N, UK, B (and NL)

Priority traits

- Weed competition
- Baking quality under low input conditions
- Durability in resistance
- Yield stability
- Special traits (human health, seed colours)

Breeding strategy

- As much diversity as possible
 - within crop diversity (populations/CCP for the sake of farmers)
 - between crop diversity (niche varieties for the sake of consumers)
- Meet end user's special needs (farmers, millers, distillers, and consumers)

Screening for resistance



My nursery yesterday



The role of Marker Assisted Breeding

- Supplement in the breeding toolbox where it makes sense to use it
 - Difficult phenotyping
 - Pyramiding genes

Examples of MAS

- Cereal Cyst Nematodes in spring wheat
 - difficult phenotyping
 - Solution: MAS for the Cre1 gene
- Common bunt
 - Pyramiding genes
 - Solution: 59 genes identified, incl. Bt-genes
- Baking quality
 - pyramiding genes
 - Solution: HMWG subunits and seed hardness
- Stripe rust resistance
 - Pyramiding genes and horizontal Adult Plant resistance

Example: Common bunt



Example: Common bunt

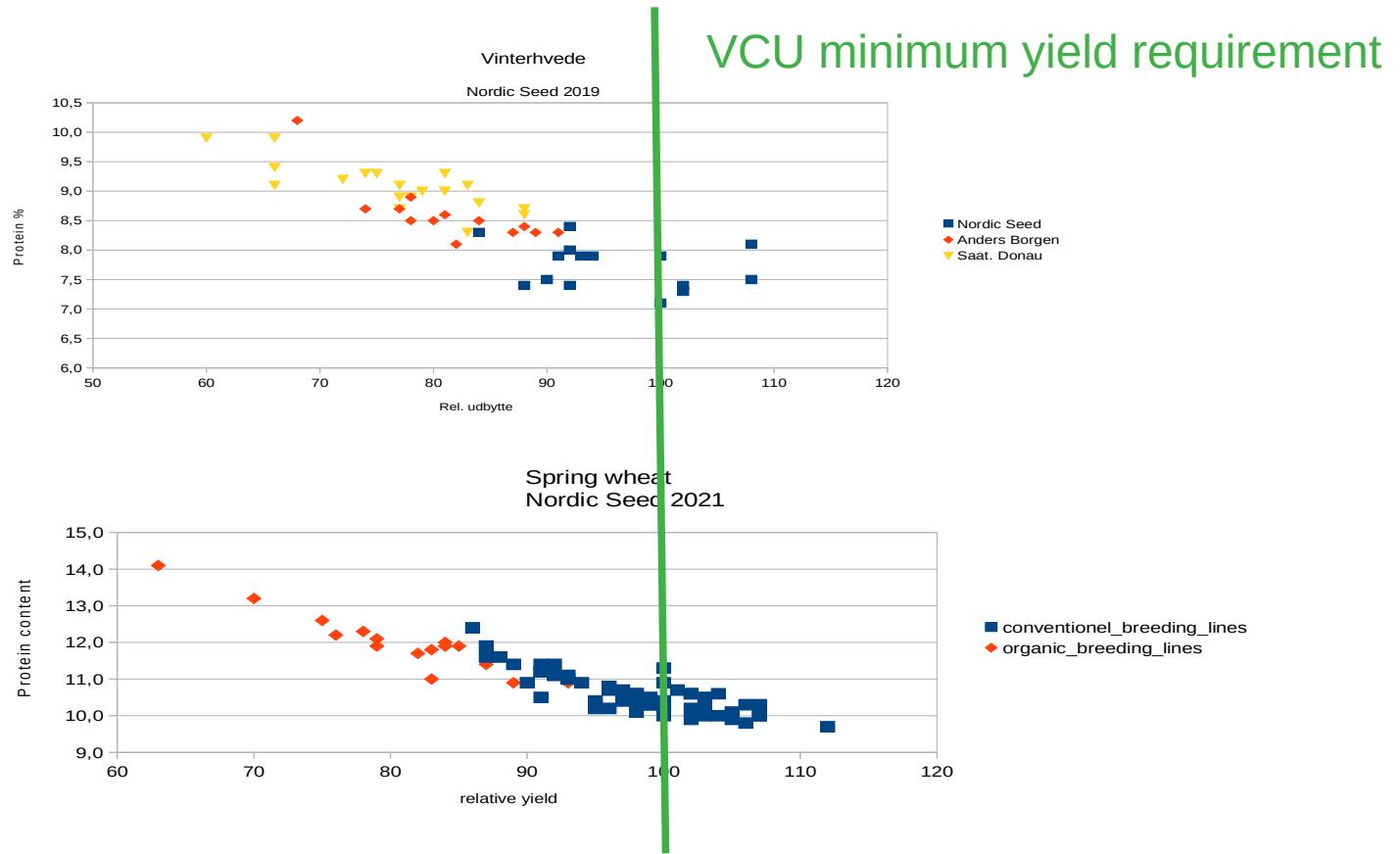
- 17 genes known when we started, but no reliable markers available
- Today, we have identified 59 genes
- useful marker haplo-types developed for 20 genes
- close to identify 3 actual genes (Bt3, Bt9, Bt10)

Example: baking quality

Markers are available from literature, but need to be validated before application

Glu-A1	Glu-B1	Glu-D1	effect on baking quality
	7OE	5+10	4
	17+18		4
	13+16		3
	7+8		3
	7+9		2
1	14+15		2
2*		2+12	1
		3+12	1
Null	6+8	4+12	0
	20		0
	7		0
	1RS:1BL		-5

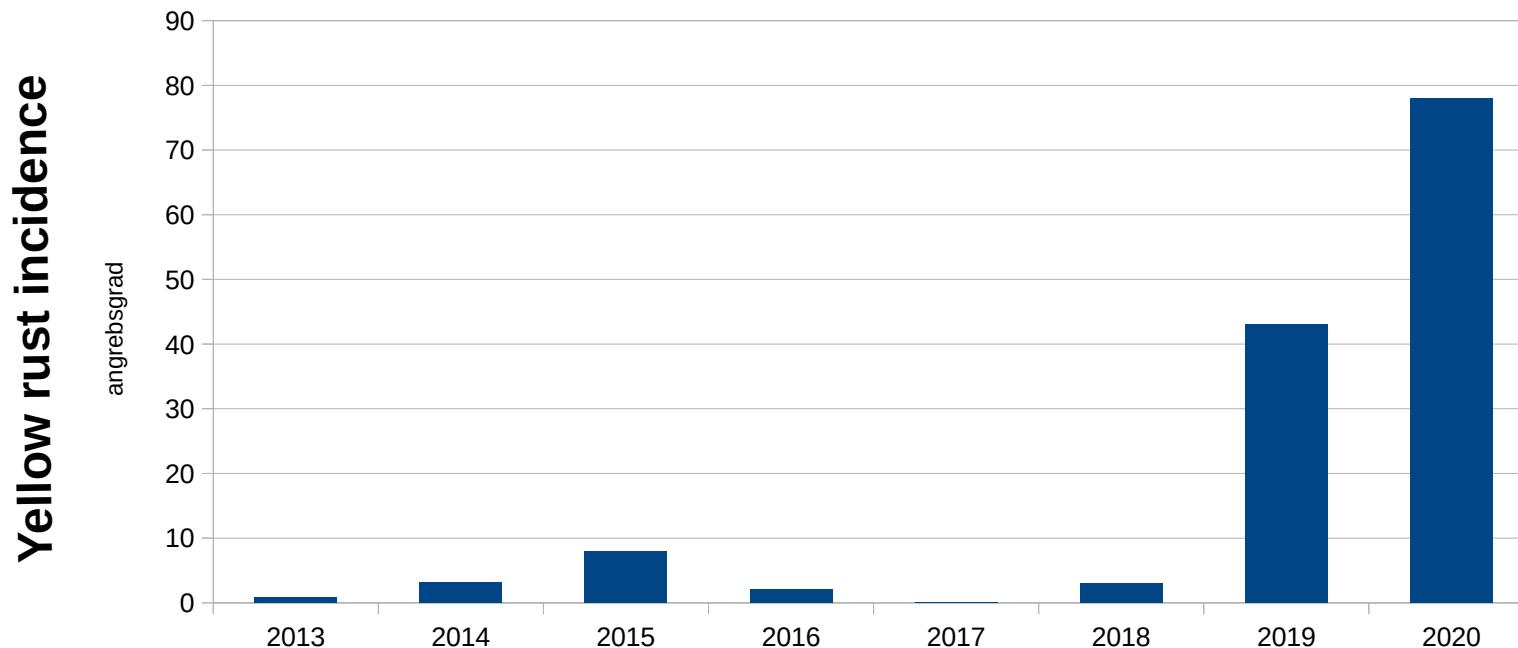
Protein content in organic wheat



Example: Stripe rust

Variety Benchmark

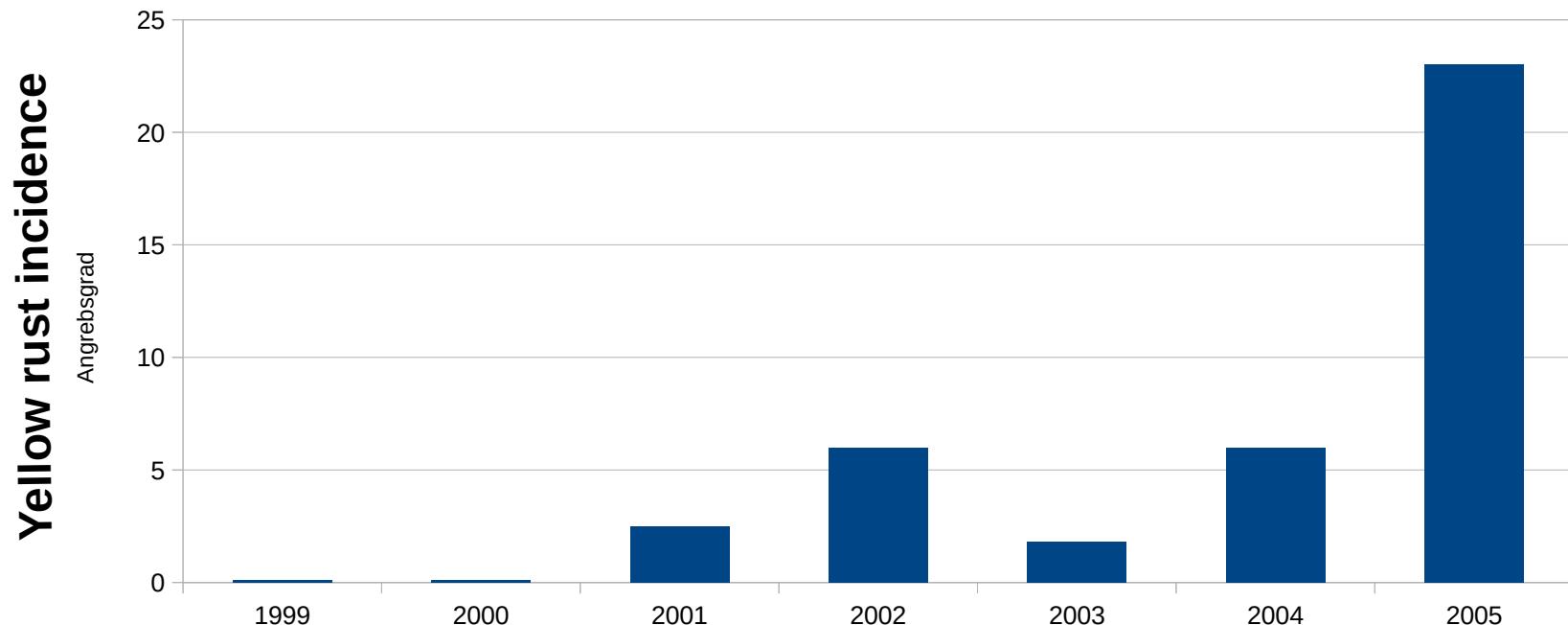
Landsforsøgene



Example: Stripe rust

Variety Cardos

Landsforsøgene



Example: Stripe rust

- a wealth of genes are already identified, and many have been cloned already
- Virulence of rust races in Europe are generally well known

High priority seedling resistance genes (SRG):

- Yr5
- Yr15
- Yr34
- Yr63

Horizontal (APR) genes:

- Lr37/Yr17/Sr38,
- Lr34/Yr18/Sr57,
- Yr10,
- Yr9,
- Yr36,
- Yr39,

Weed competition in organic grain





Let's join forces
to hack the genes