



WINTER WHEAT - BREEDING AND GENOMIC SELECTION

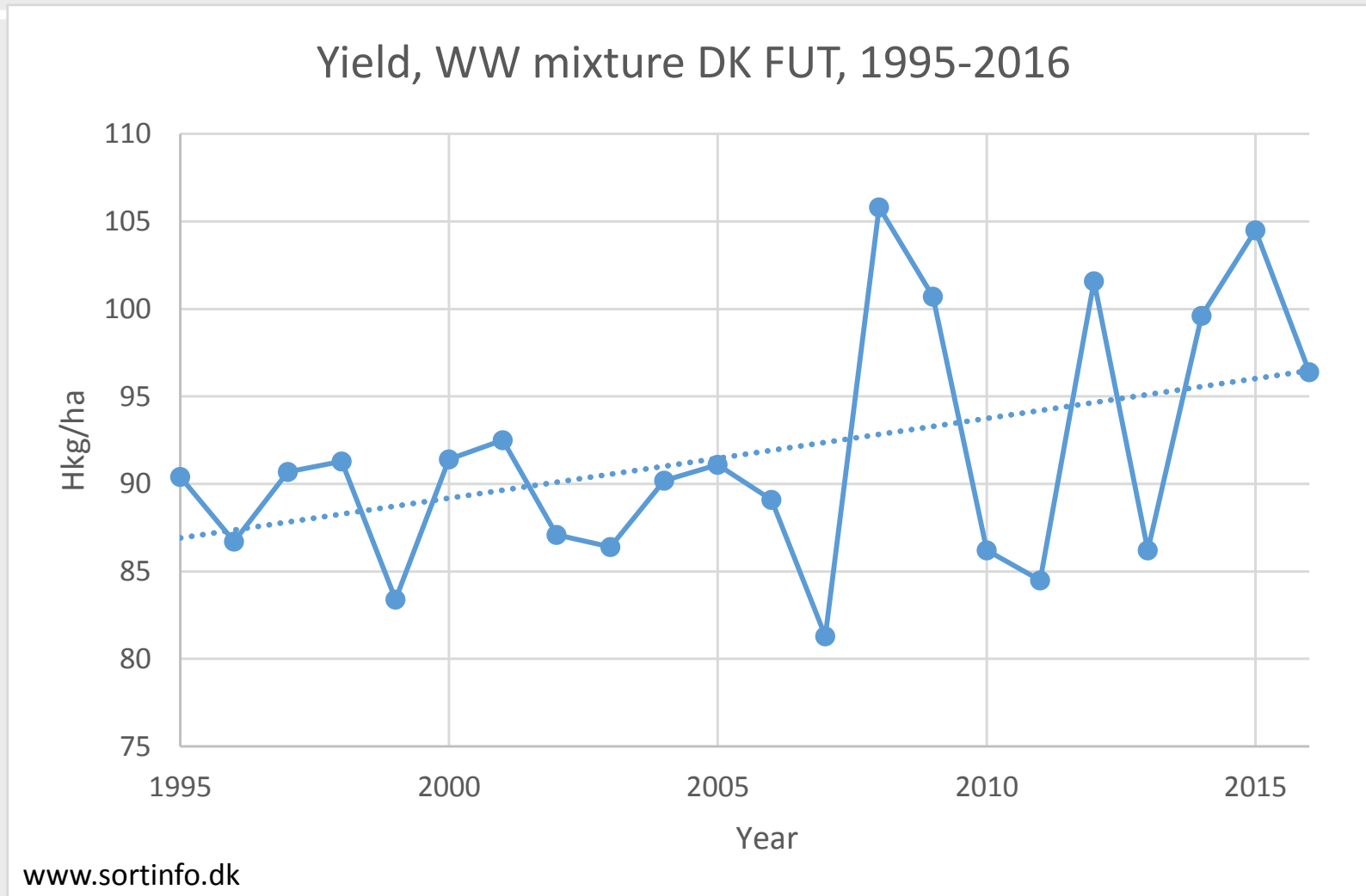
Jeppe Reitan Andersen

BREEDING ACTIVITIES AT NORDIC SEED

- Winter wheat
- Spring wheat
- Winter barley
- Spring barley
- Winter rye
- Peas
- Field beans

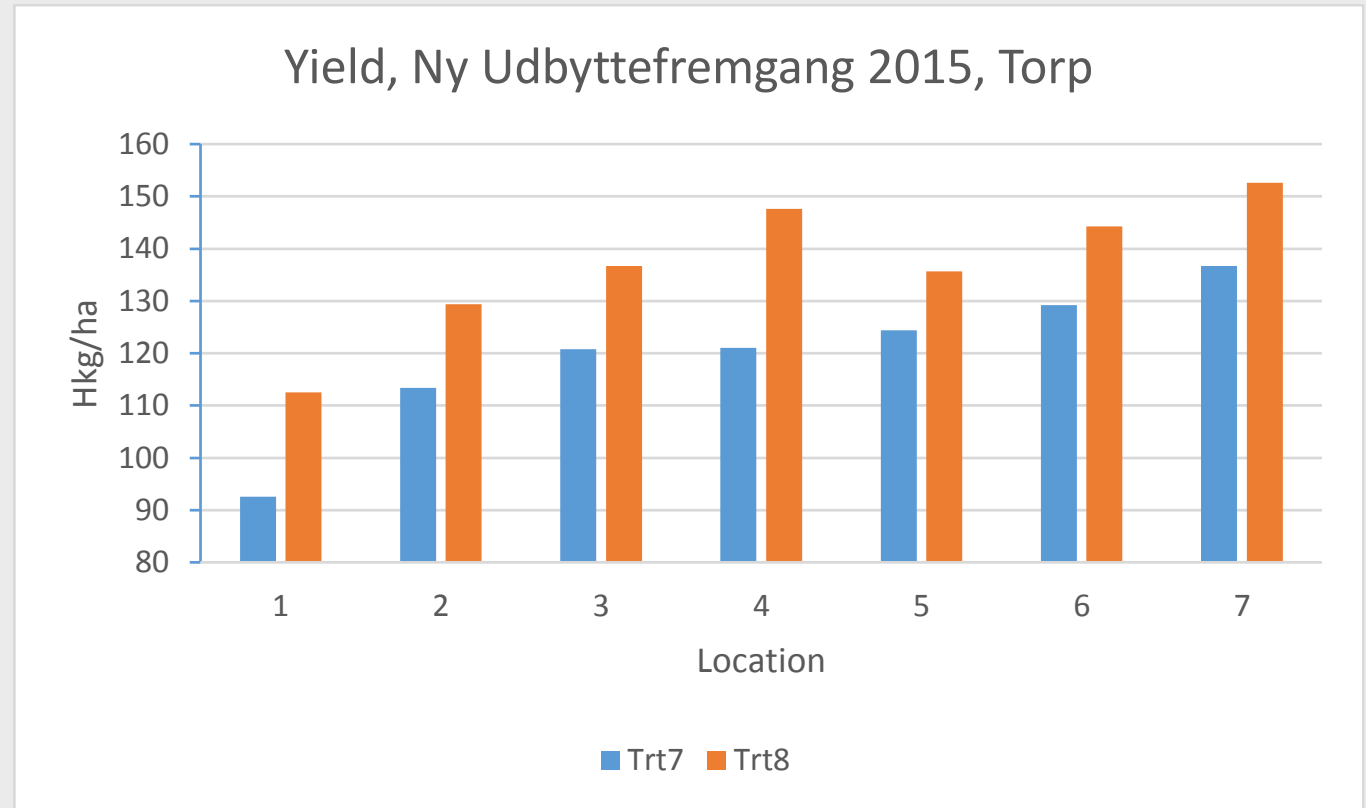


WINTER WHEAT YIELDS IN DK FARMER UNION TRIALS



'YIELD POTENTIAL' - IS NOT ABSOLUTE

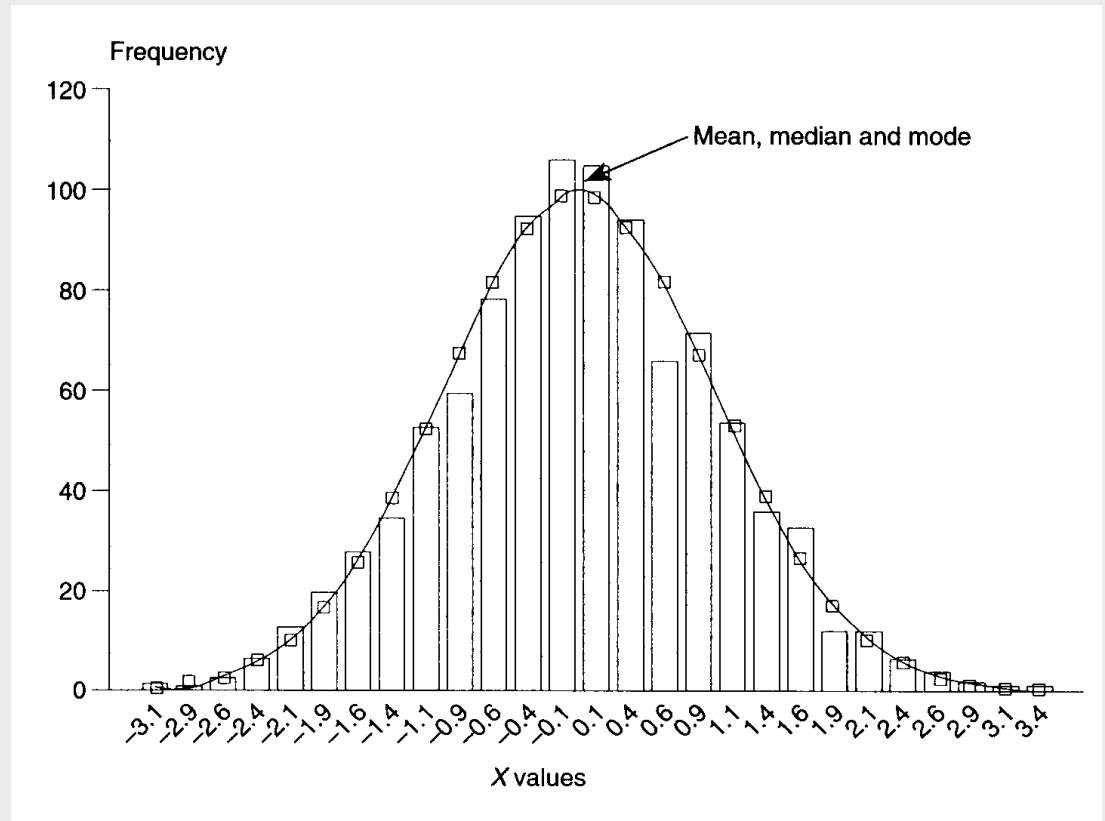
- Determined by
 - Genetics
 - Environment
 - Climate
 - Management
 - Interactions...



- Aim: develop varieties with a combination of desirable genes/characters to increase the chance of realizing yield potential in more environments.

INCREASING YIELD POTENTIAL – THE ART OF BREEDING

- Create diversity
 - crossing
- Selection
- Fixate traits
 - YIELD
 - Agronomy
 - Straw
 - Hardiness
 - Disease resistance
 - Quality
- **THROW THE GOOD, KEEP THE BEST**



BREEDING GAIN DEFINED BY:

$$\text{Genetic gain over time} = \frac{\text{intensity} * \text{accuracy} * \text{genetic variation}}{\text{Time per breeding cycle}}$$

- Selection intensity: strong selection in large numbers (crosses, populations)
- Selection accuracy: replicated trials,
 - Separate genetics from noise (environment)
 - Reliable DNA markers
- Genetic variation: introduce new (useful) genes in breeding pool
 - Not always desirable, 'wild' DNA is resistant to yield
- Time: decrease time per cycle (DH, shuttle breeding)

Year 1 – Crossing

Selection of crossing parents based on yield, agronomical characters, disease, DNA marker data



Year 2 to 4 – NURSERY SELECTION

Disease, agronomy, yield potential, quality.



Year 5 to 7 – YIELD TRIALS

Replicated yield trials, several locations, quality parameters, disease obs, DNA marker analyses



Year 8 to 9 – OFFICIAL TRIALS – VARIETY LIST

Replicated yield trials and multiplication



Year 10 – MARKETING AND SALES

Replicated yield trials and multiplication

SELECTION IN THE FIELD - DISEASES

- Septoria
- Rusts
- Mildew
- Fusarium
- Virus
- ...

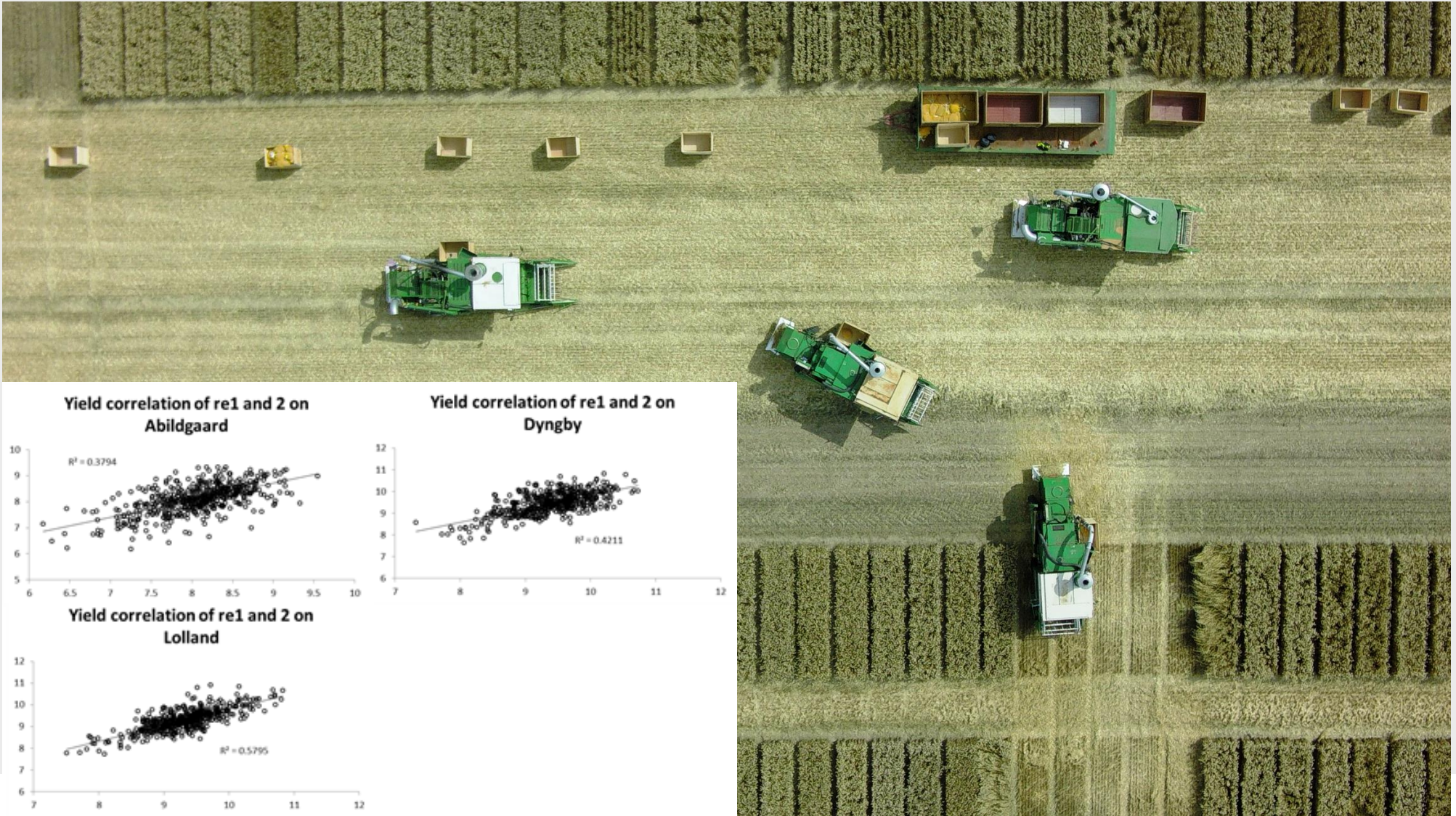


SELECTION IN THE FIELD - AGRONOMY



$$\text{Genetic gain over time} = \frac{\text{intensity} * \text{accuracy} * \text{genetic variation}}{\text{Time per breeding cycle}}$$

YIELD STABILITY: REPLICATIONS, LOCATIONS, YEARS...



Cultivating Value

Nordic Seed

POSTHARVEST: FALLING NO., ZELENY, OTHER



Cultivating Value

Nordic Seed 



Cultivating Value

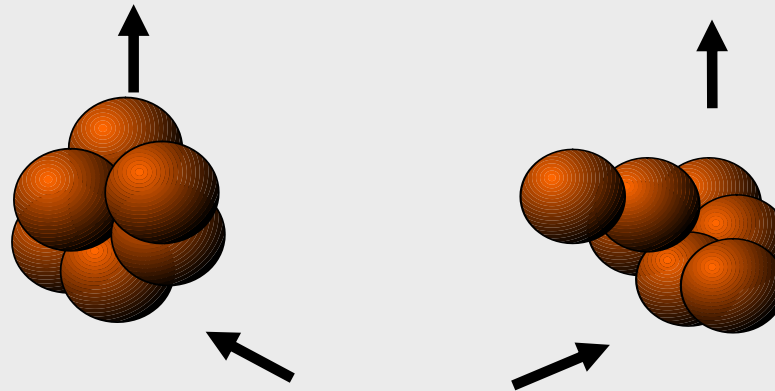
Nordic Seed 

GETTING TO THE DNA

Phenotype



Protein

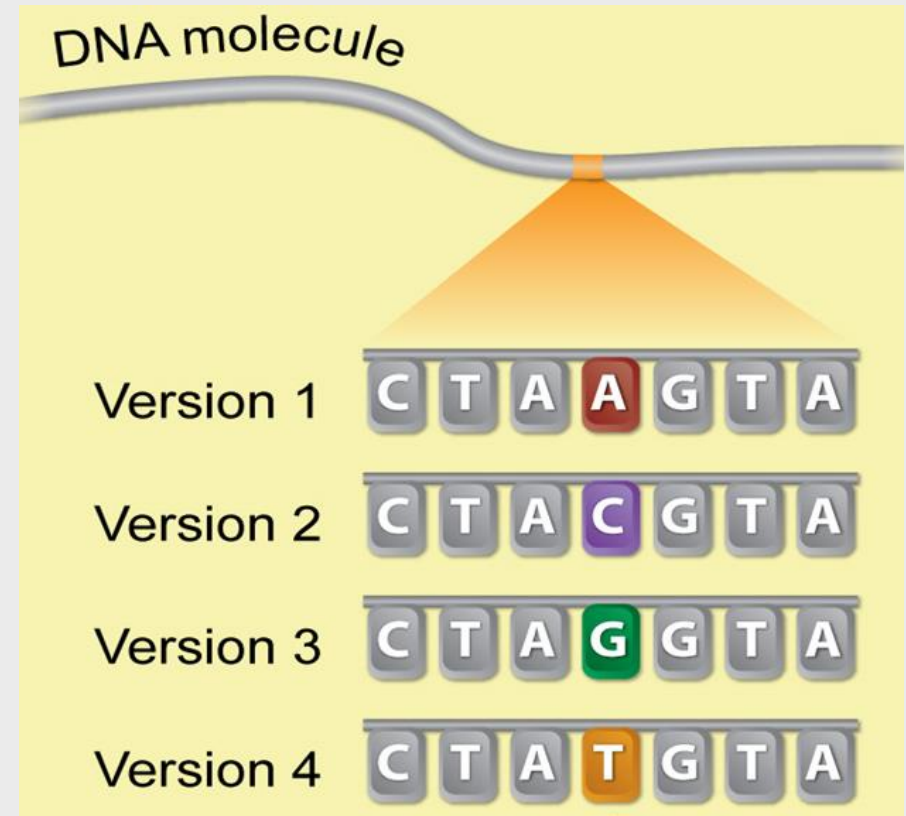
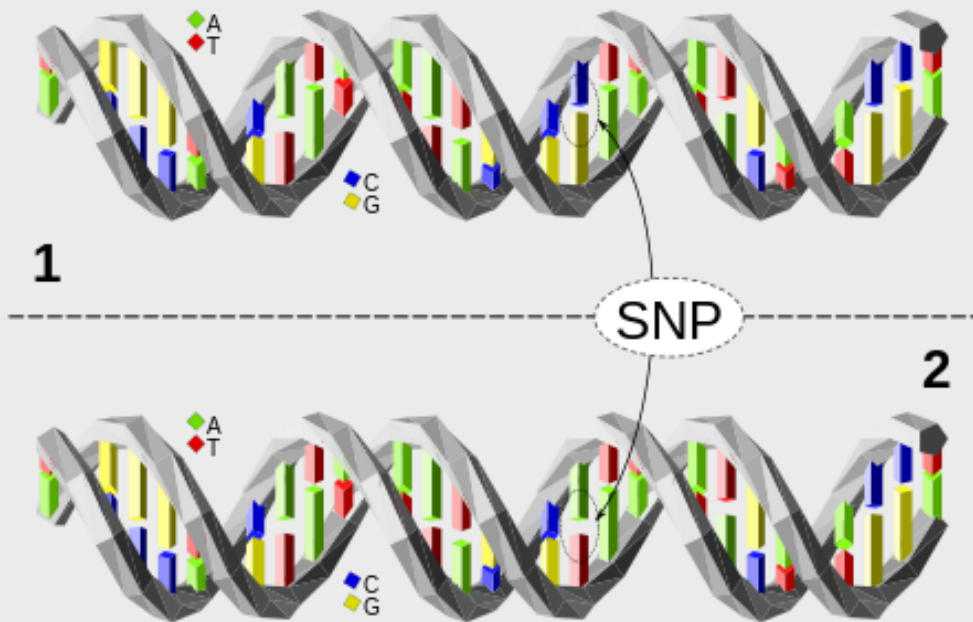


RNA

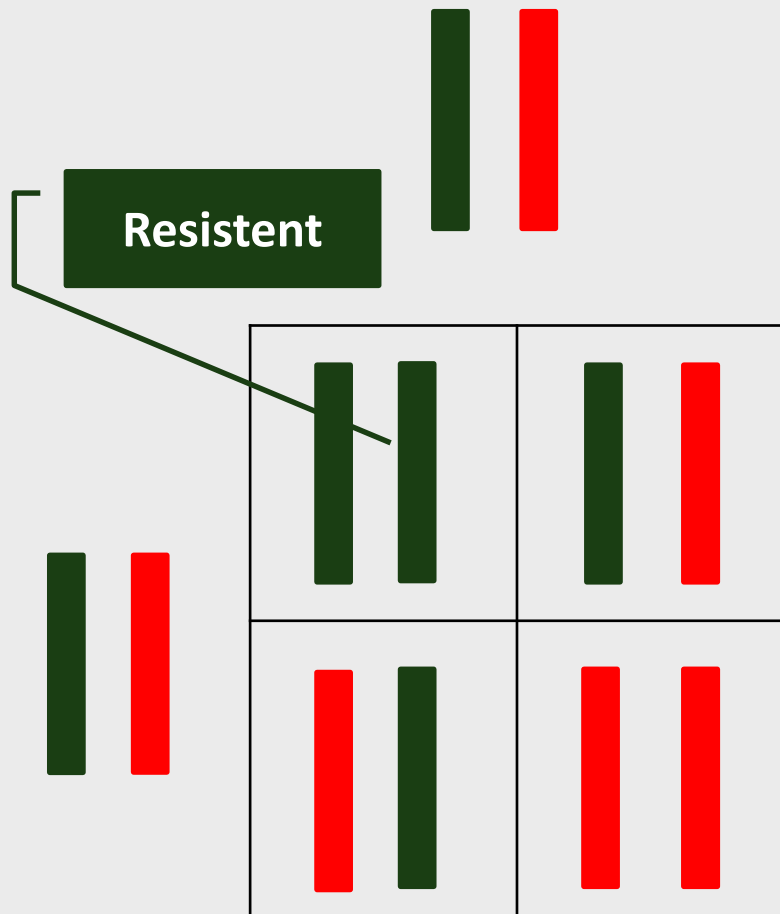
DNA



SINGLE NUCLEOTIDE POLYMORPHISM - SNP

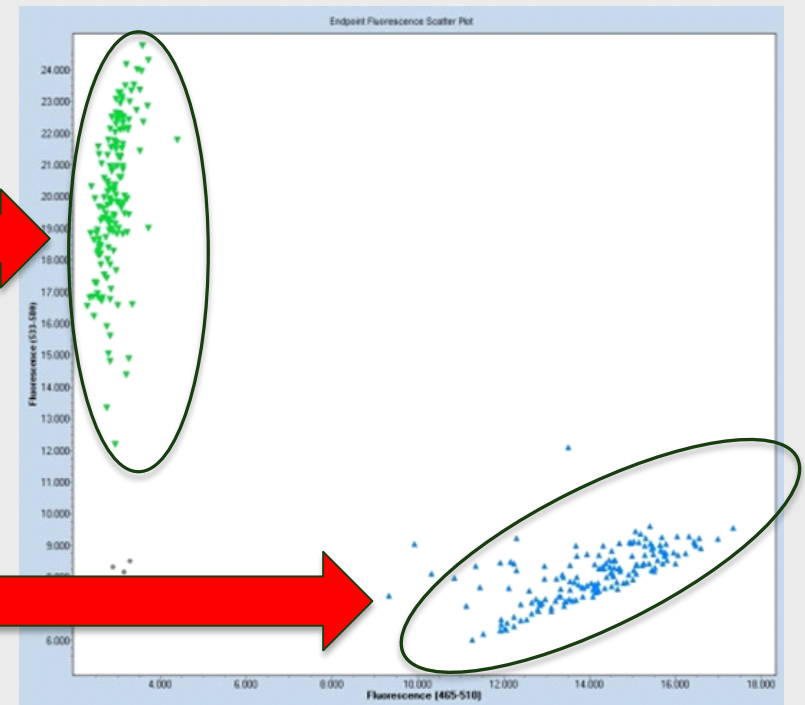


BREEDING – A NUMBERS GAME



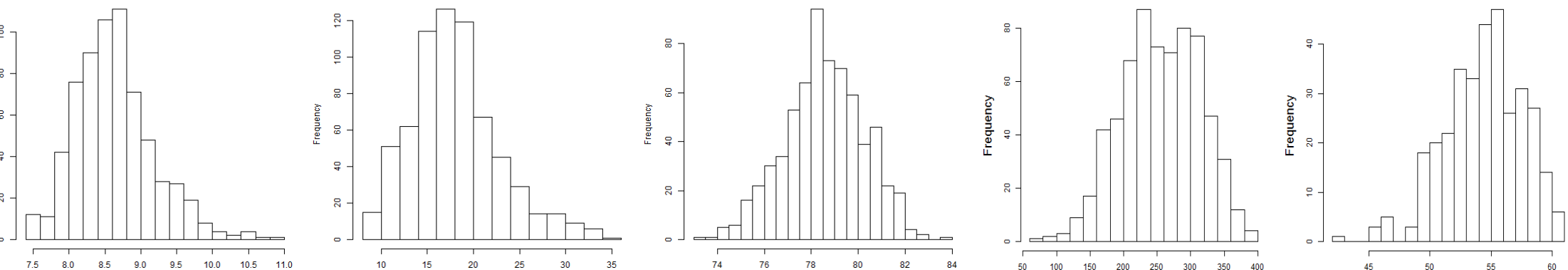
Encoding genes	Desired phenotype in
1 gene	1/4 of offspring
2 genes	1/16 of offspring
3 genes	1/64 of offspring
4 genes	1/256 of offspring
5 genes	1/1024 of offspring
6 genes	1/4096 of offspring

EASY: BARLEY YELLOW DWARF RESISTANCE



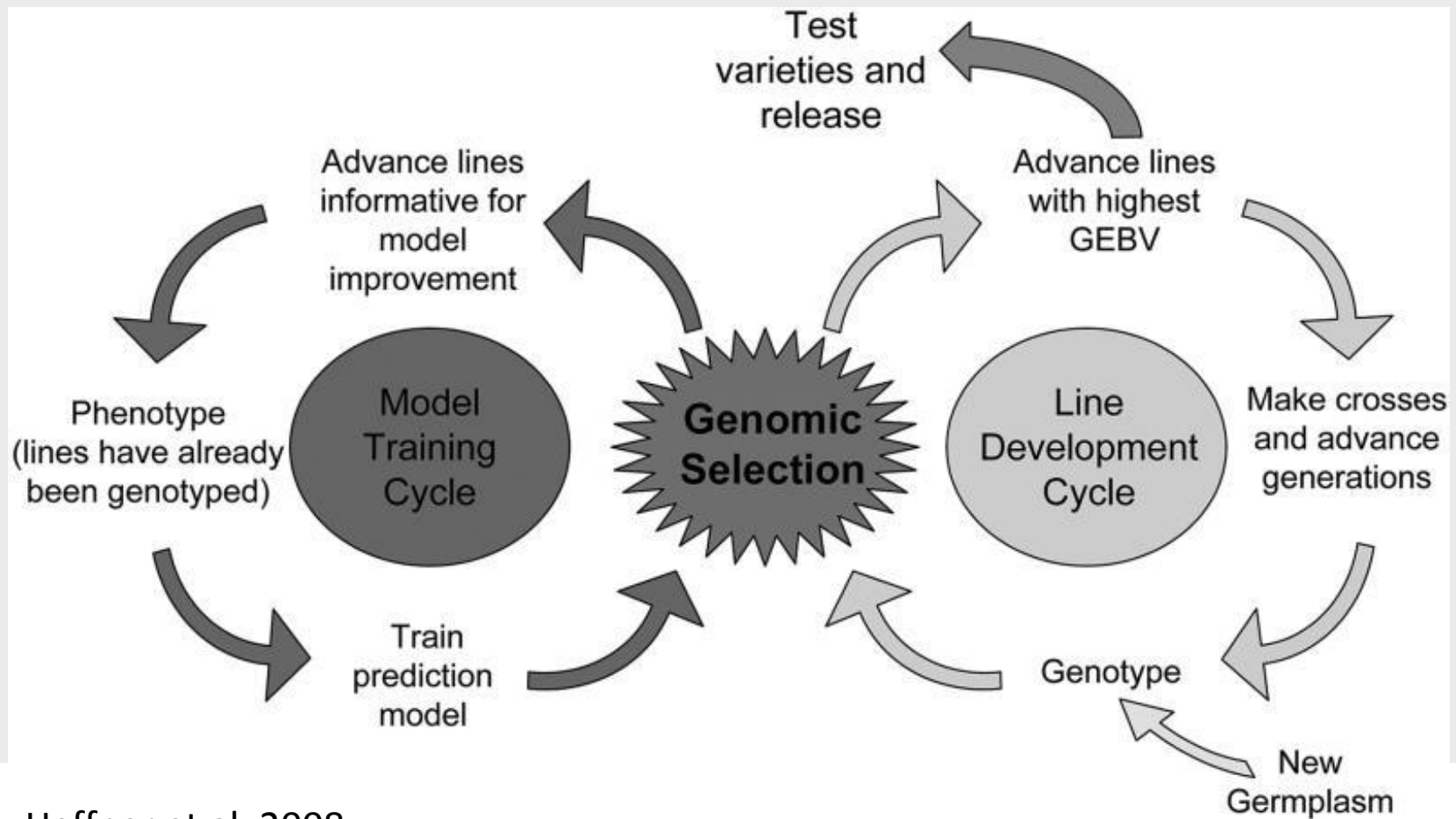
PROJECT: WHEAT QUALITY

- Industrial PhD project: Peter Skov Kristensen
- Århus University (Just Jensen, Fabio Cericola, et al.)
- ~700 breeding lines phenotyped
 - Protein
 - HLW, TGW
 - Hagbergs, zeleny



GENOMIC SELECTION – TEXT BOOK

- Other traits more difficult – more genes, smaller effects



Heffner et al. 2008



Cultivating Value

Nordic Seed 