Application of Genomic Selection in Wheat Breeding

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GenSap2018
27-11-2018



Breeding goal

- Favourable alleles of traits of interest in one elite variety
  - Yield
  - Disease resistance
  - Lodging resistance
  - …
- Economic value of desired traits

Wheat breeding: developing inbred lines

P1xP2

F1 — Non-segregating generations

F2 — Segregating generations

F3

F4

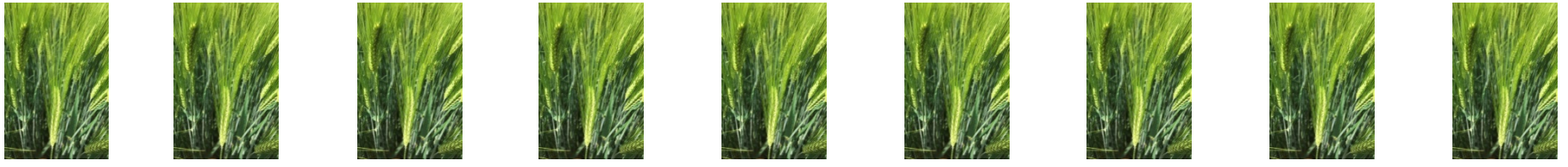
F5

F6

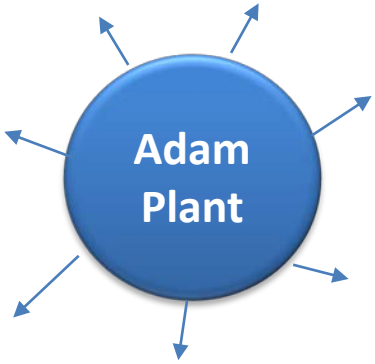
- Heterozygosity decreases by half every generation

AIM

- How much genetic gain can be increased by implementing genomic selection on conventional wheat breeding program
- Investigate how different level of correlation among traits can affect genetic gain



AdamPlant



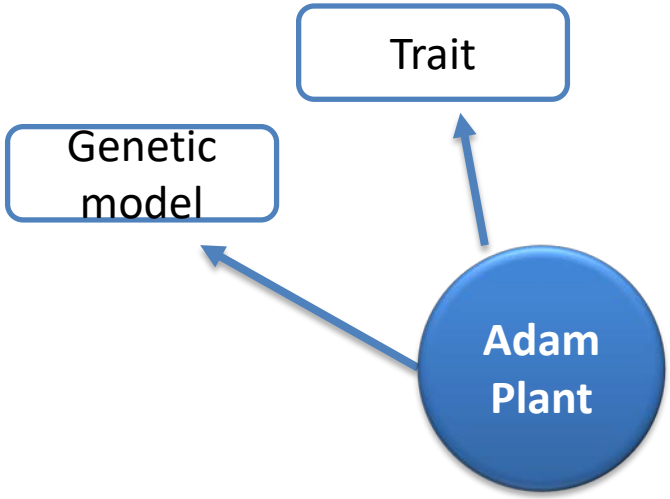
AdamPlant

- Finite-locus
- Infinite-locus
- Mixed-inheritance

Genetic model

AdamPlant

- Heritability
- Distribution of QTL effects
- Correlated traits



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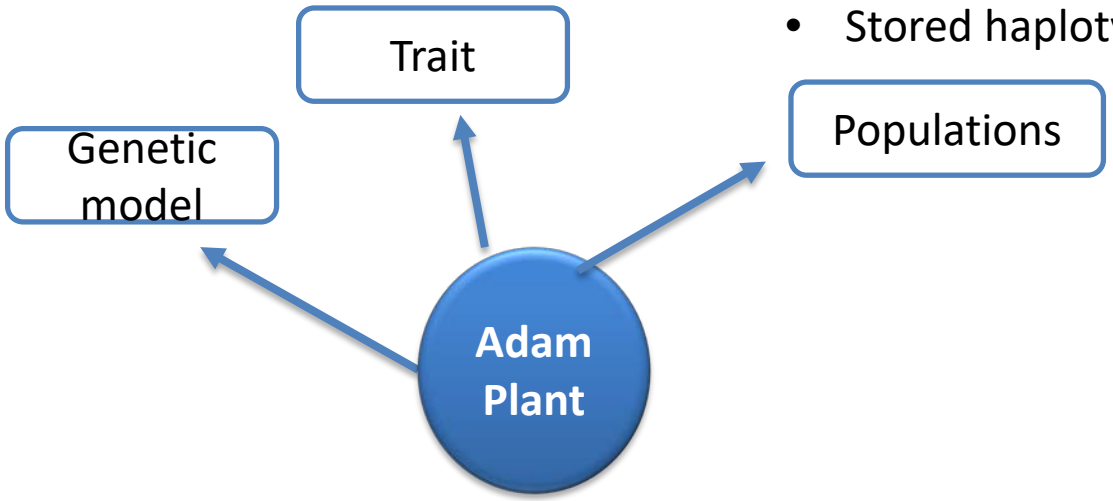
- Species
- User-defined founders
- Stored haplotypes



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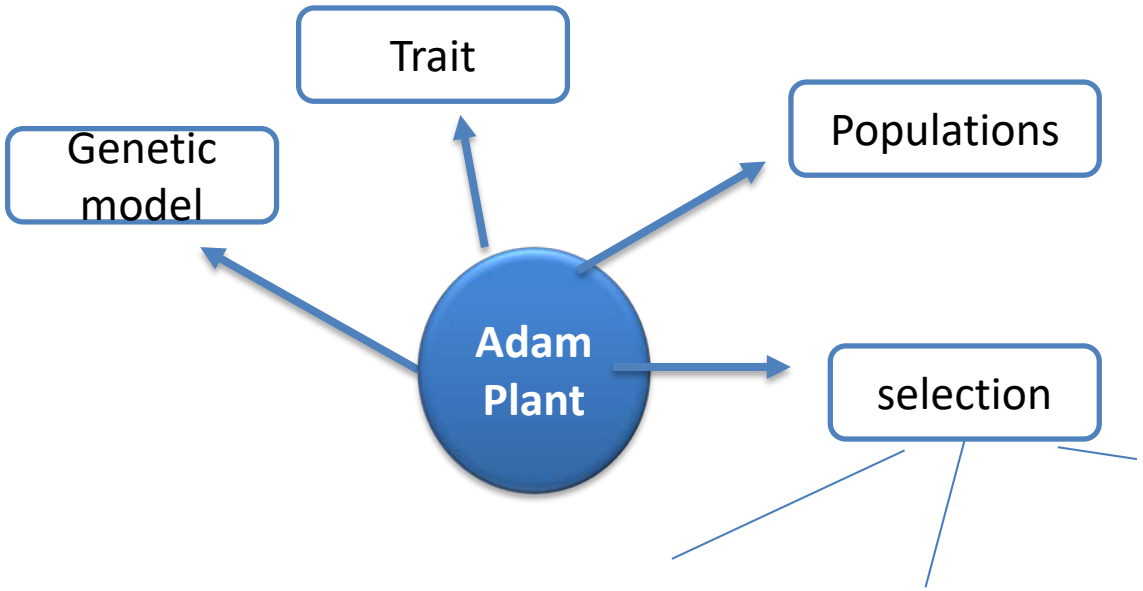

Seletion unit

- individuals
- Defined families (plot)
- Parallel breeding schemes

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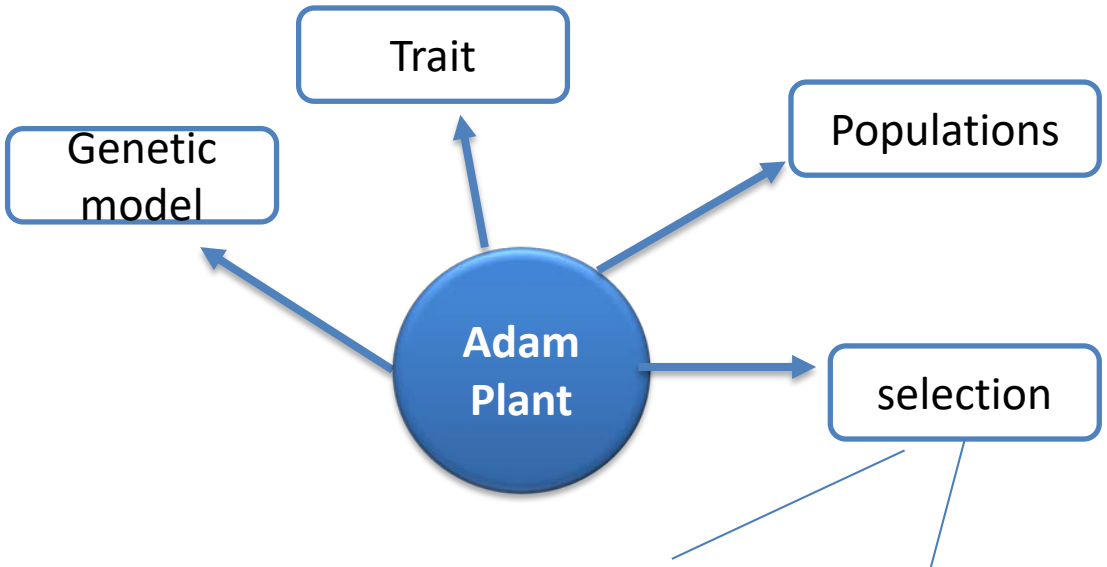

Seletion unit
- individuals
- Defined families
- Parallele breeding schemes

Seletion criterion
- Phenotypes
- True breeding values
- EBV (blup/gblup)

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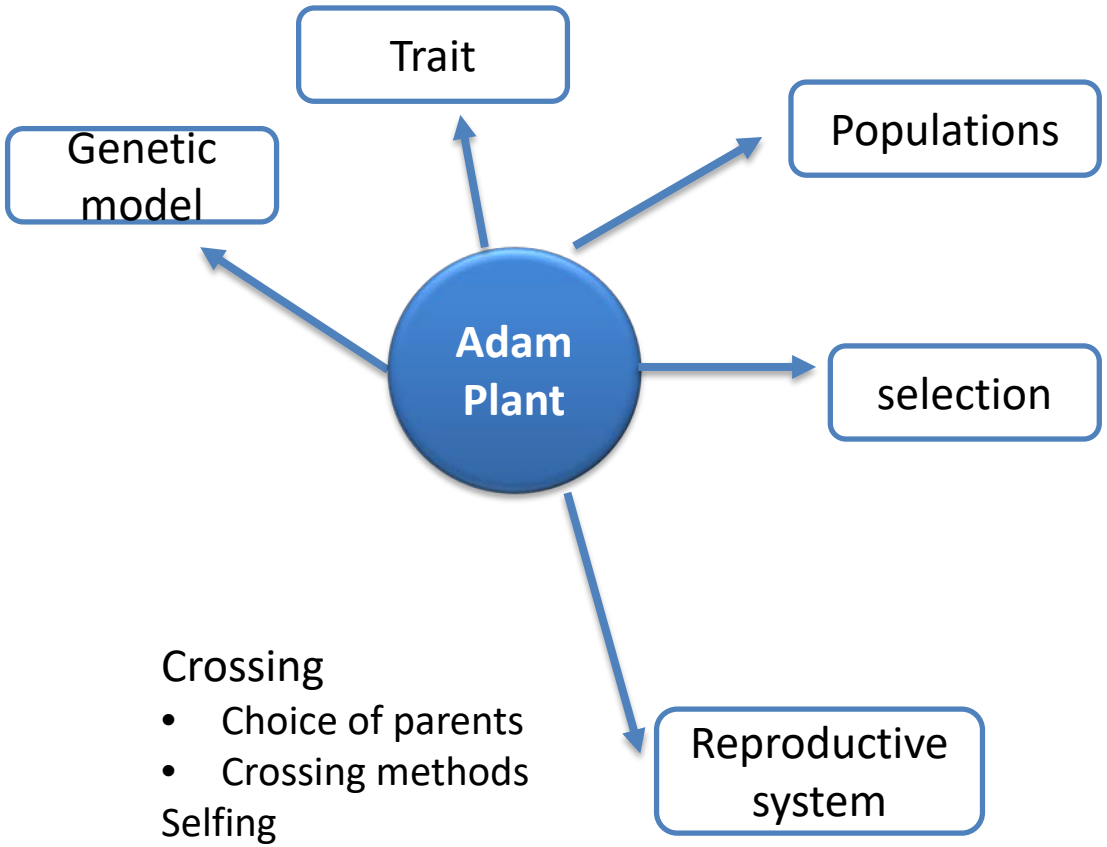

Crossing
- Choice of parents
- Crossing methods

Selfing

Double haploid

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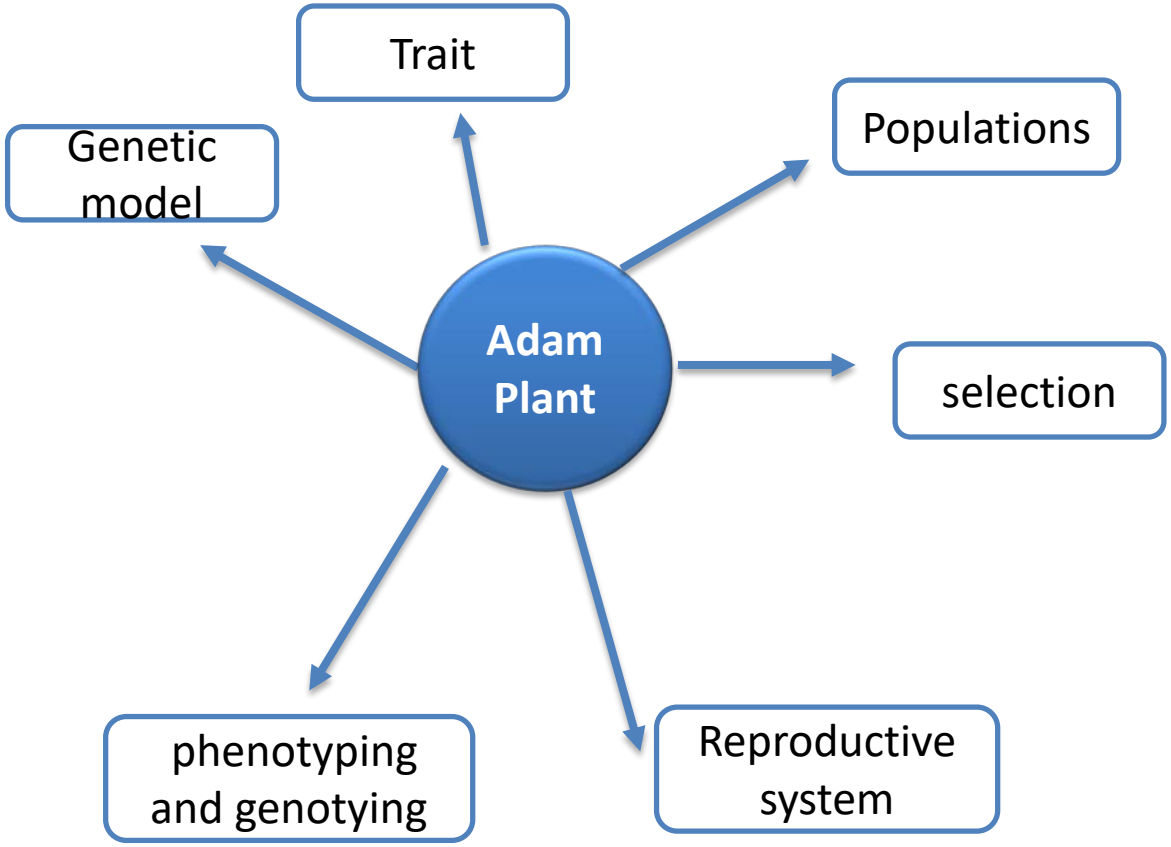
Trait
Genetic model
Populations
Adam Plant
selection
phenotyping and genotying
Reproductive system

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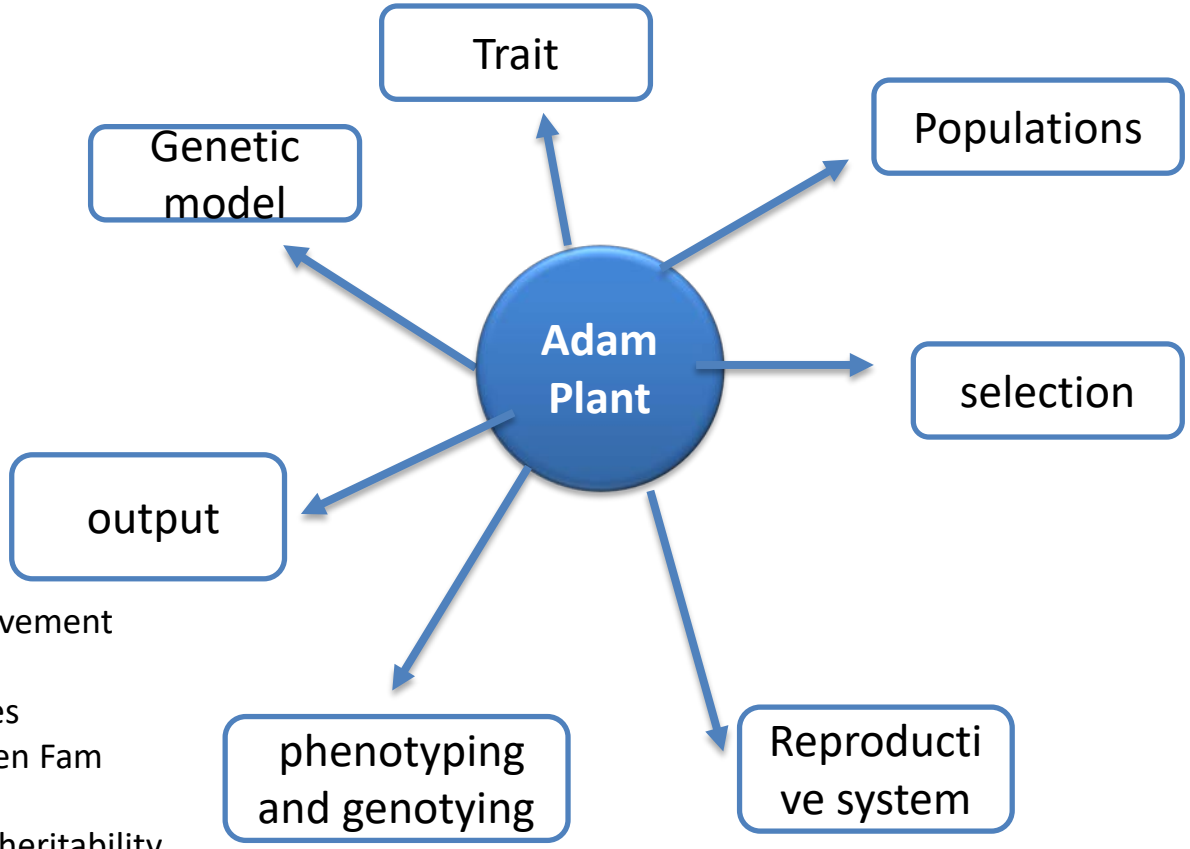
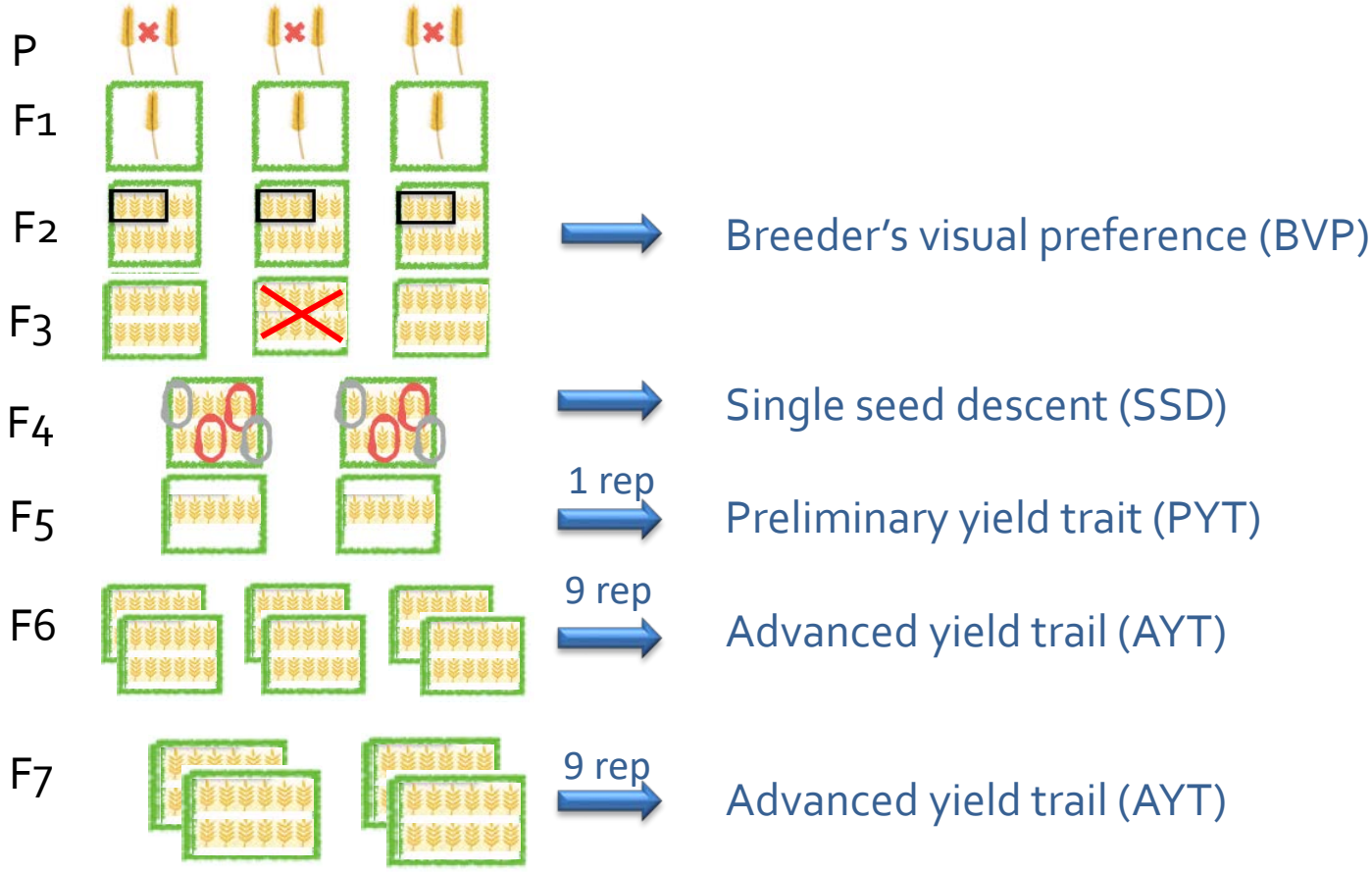
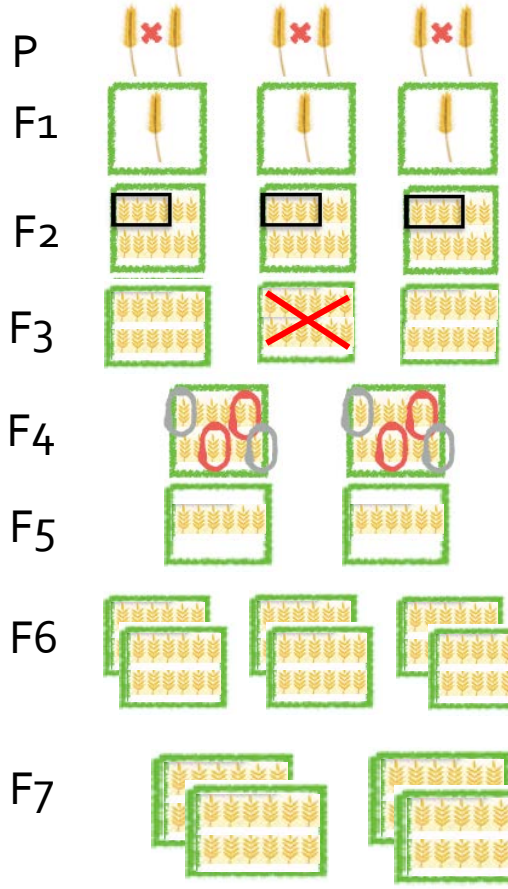


- Genetic improvement
- Inbreeding
- Homozygosities
- Within-between Fam variance
- plot & variety heritability
- Ancestral contritbutions
- …

Conventional phenotypic selection



Genomic selection



Breeder's visual preference (BVP)

Genotyping F4 single plants

1 rep

Phenotyping records for 150 F4 families

9 rep

Phenotyping records for 30 F4 families

9 rep

Phenotyping records for 5 F4 families

1. Estimating genetic values of F4 single plants for the second time

2. Select 5 out of 30 F4 familes (seeds of F4)

Simulation parameters

- True breeding value (TBV) of traits
  - Summation of allelic effects of QTLs
- Phenotypes= TBV+ Error

- Plot heritability (h^2)
  - BVP (F_2)= 0.1
  - yield at PYT (F_5) = 0.2
  - yield at AYT (F_6)= 0.3

Breeding scenarios

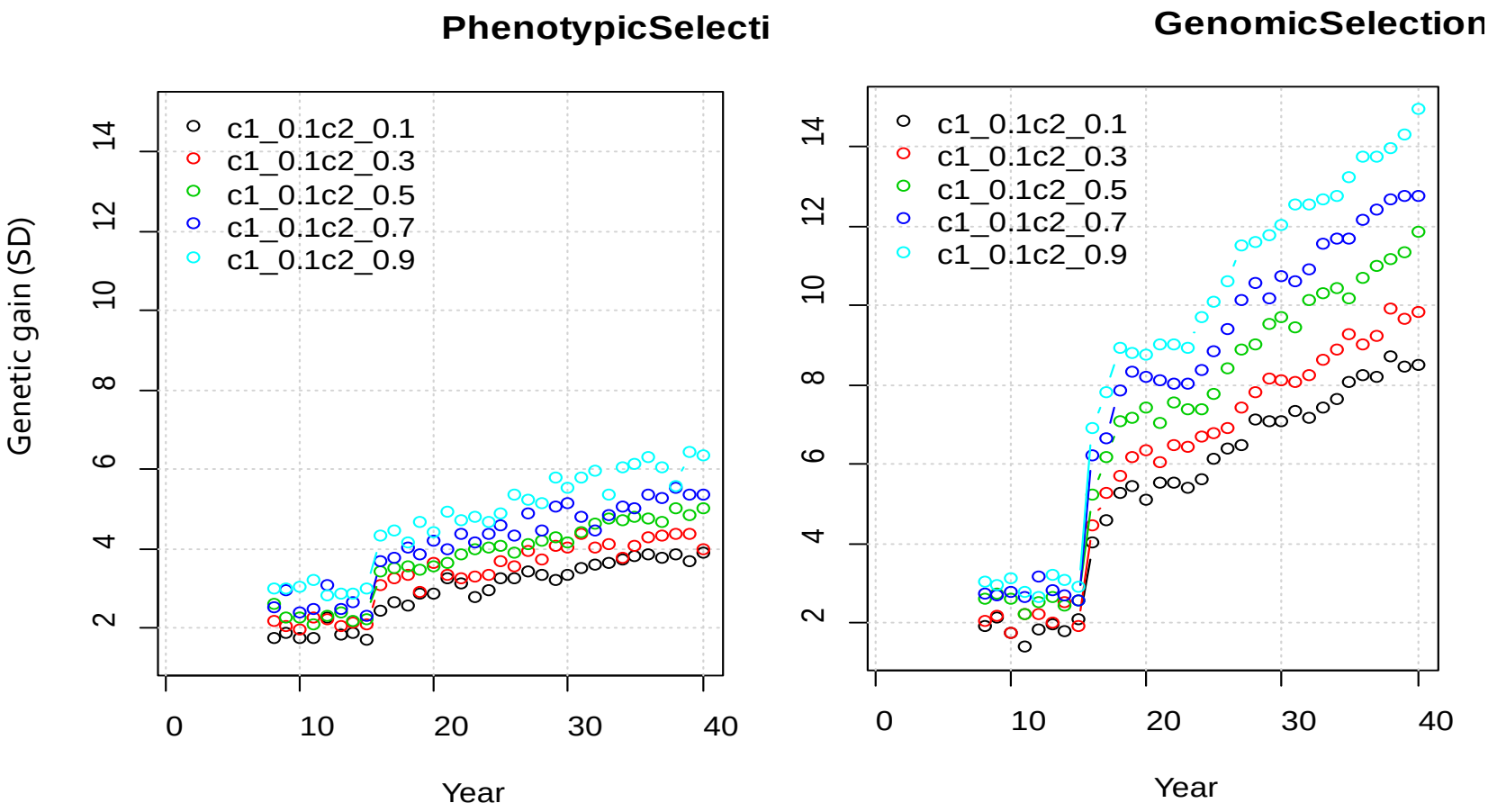
- Selection method
  - Phenotypic
  - Genomic
- Genetic correlations
  - BVP with PYT and AYT= 0, 0.1
  - PYT and AYT = 0.1, 0.3, 0.5,0.7, 0.9

- Breeding scenarios
  - Phenotypic selection
    - 10 scenarios
  - Genomic selection

    10 scenarios

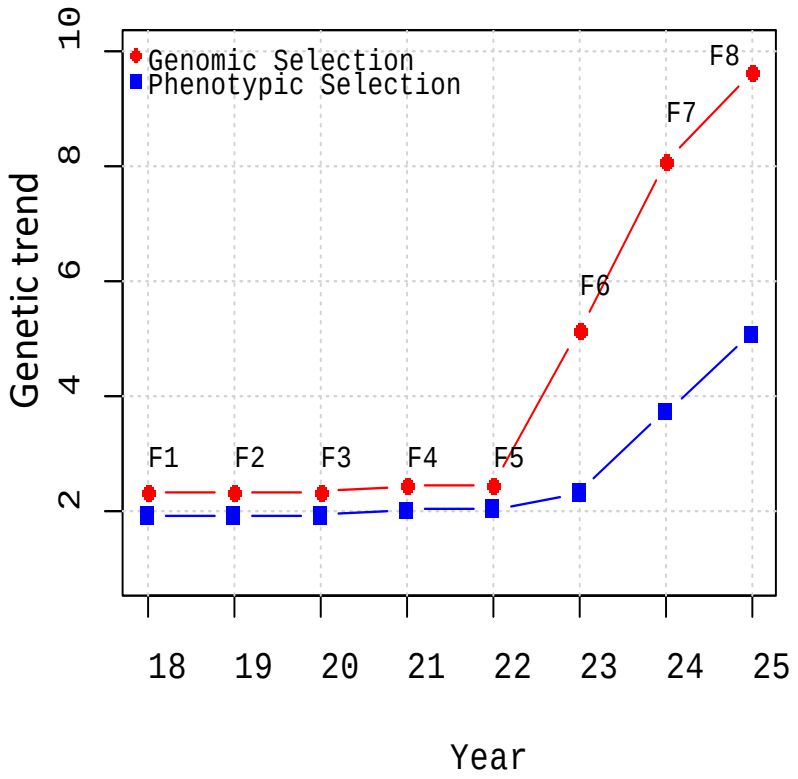
Genetic gain

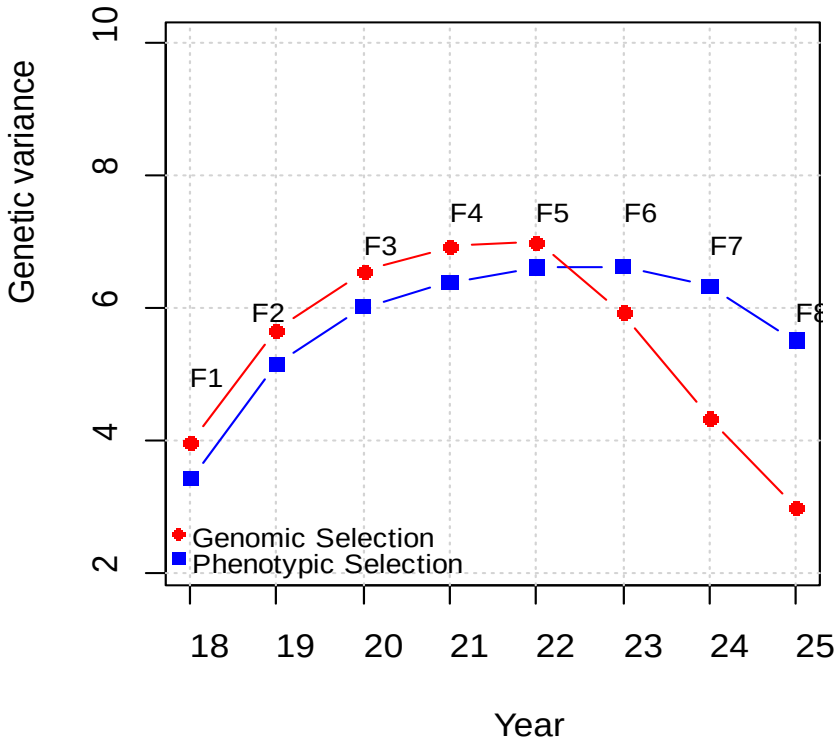
BVP with PYT&AYT= 0.1



Genetic gain and variance per cycle

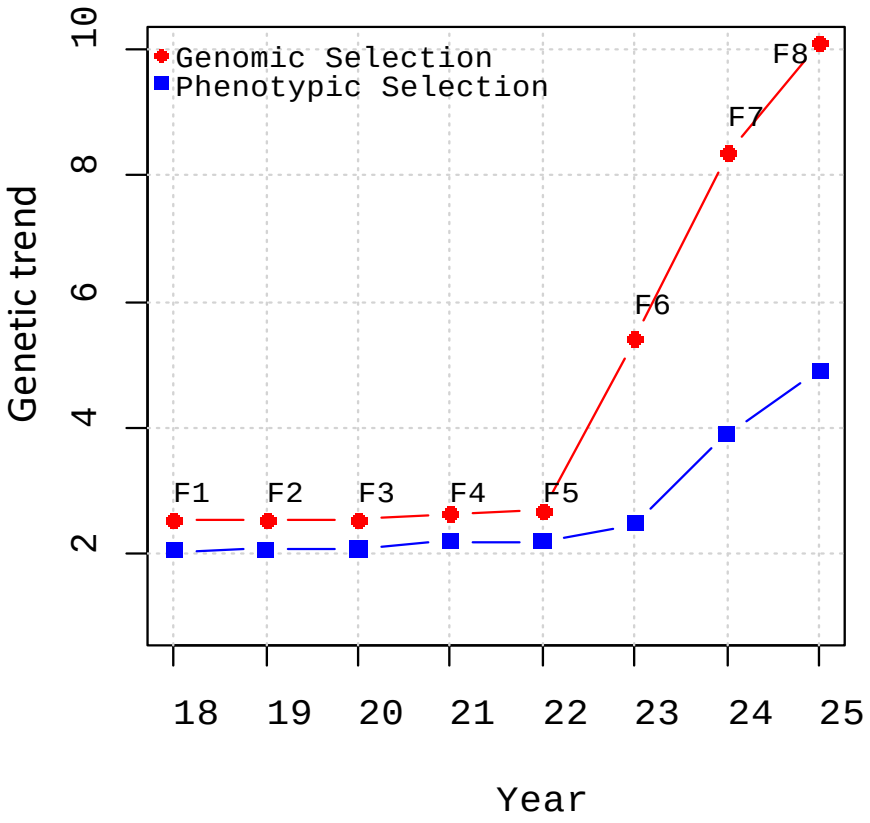
BVP with PYT&AYT= 0.1
PYT&AYT= 0.1

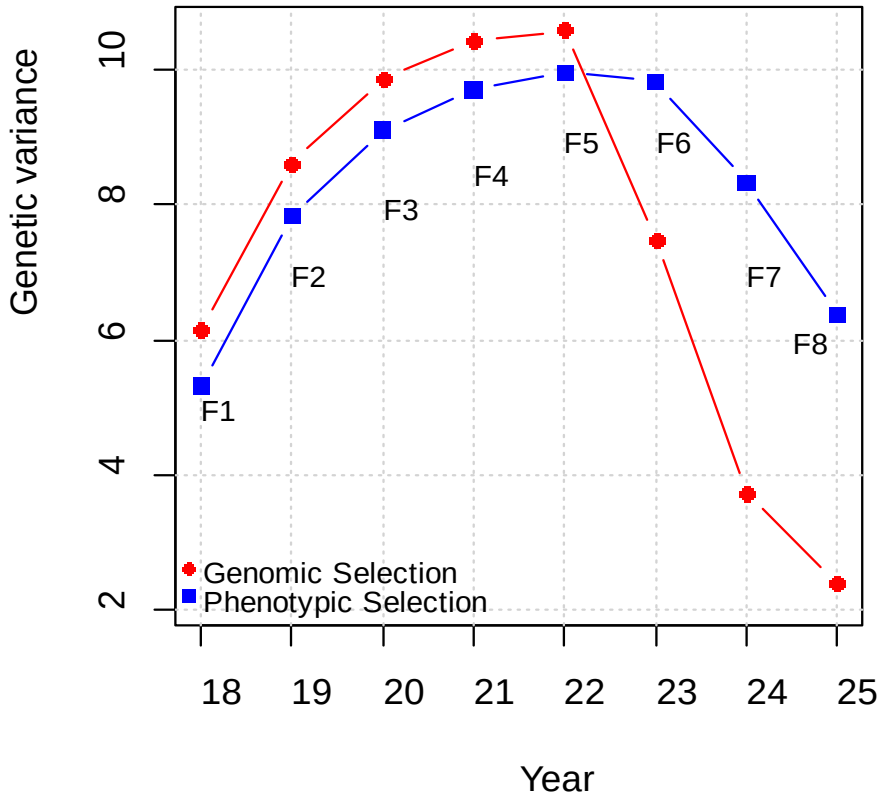




Genetic gain and variance per cycle

BVP with PYT&AYT= o.1
PYT&AYT= 0.9





Practical implications

- Genomic selection is a promising strategy to improve wheat breeding programs
- Genetic gain is doubled with genomic selection
- Higher increase in genetic gain is from F_5 to F6

Acknowledgement

Just Jensen
Huiming Liu
Christian Sørensen
Fabio Cericola

QGG

Jeppe Reitan Andersen
Jens Due Jensen
Vahid Edriss
Jihad Orabi
Ahmed Jahoor

Nordic Seed