Implementation of Group Selection in Forest Tree Breeding

Mathieu Tiret, Leopoldo Sánchez, Martin Lascoux

Individual Performances vs Group Performance

$$\sum BV_{Individual} \neq \text{Population value}$$

- Heritability and Response to selection.
- Intraspecific Interactions.
- Parasitism and Selective Pressure.

Group Selection: Sustaining Long Term Genetic Gain

Optimal Contribution Selection (OCS)

min. **α Population Coancestry − (1-α) Genetic Gain**

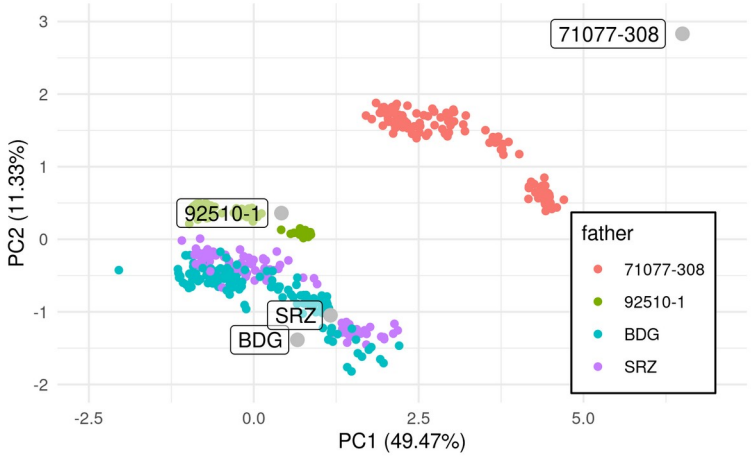
Group Selection: Sustaining Long Term Genetic Gain

Optimal Contribution Selection (OCS)

min. **α Population Coancestry – (1-α) Genetic Gain**

Dataset: *Populus nigra*

- 1000 individuals, replicated 8 times.
- Phenotypes
  - height, circumference, resistance to Rust.
- Genotypes
  - 7000 SNPs.



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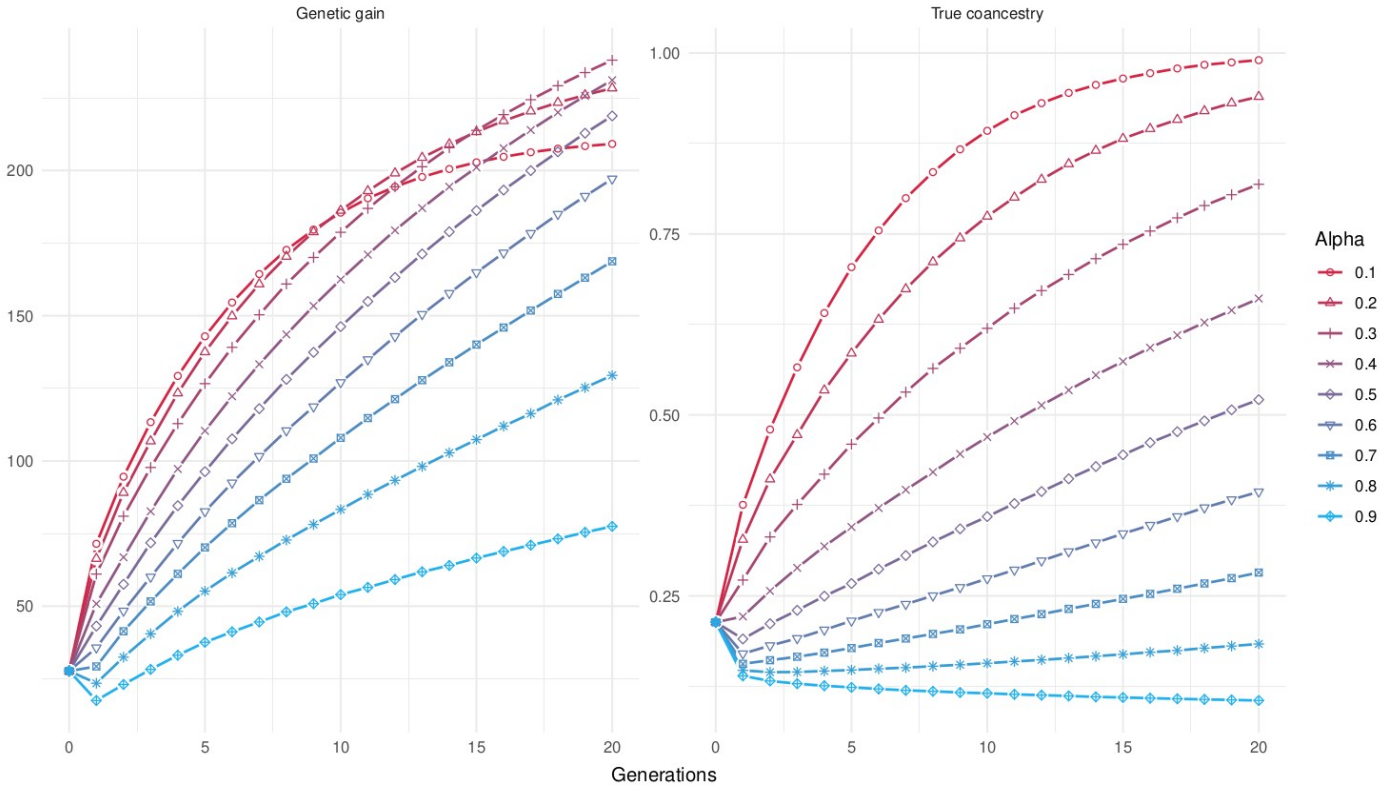

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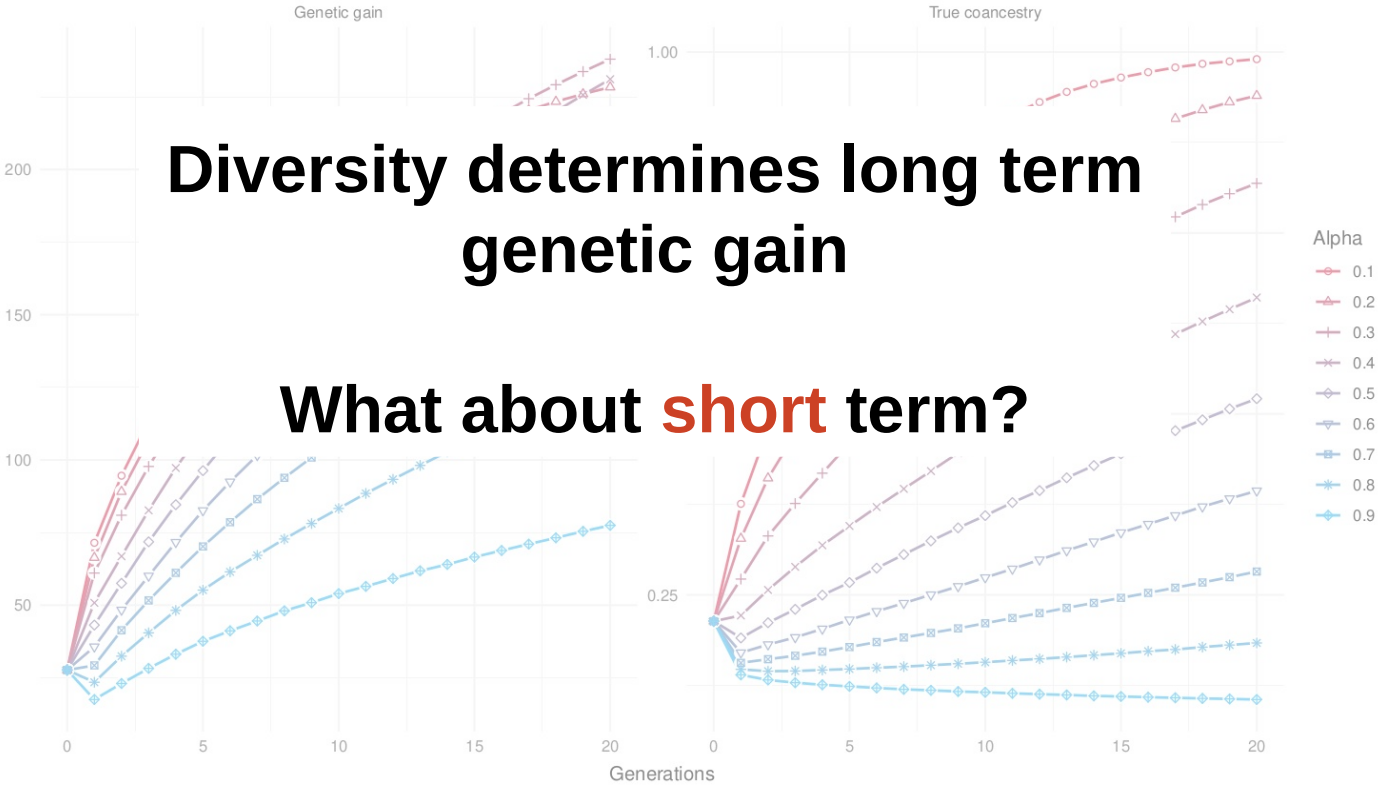
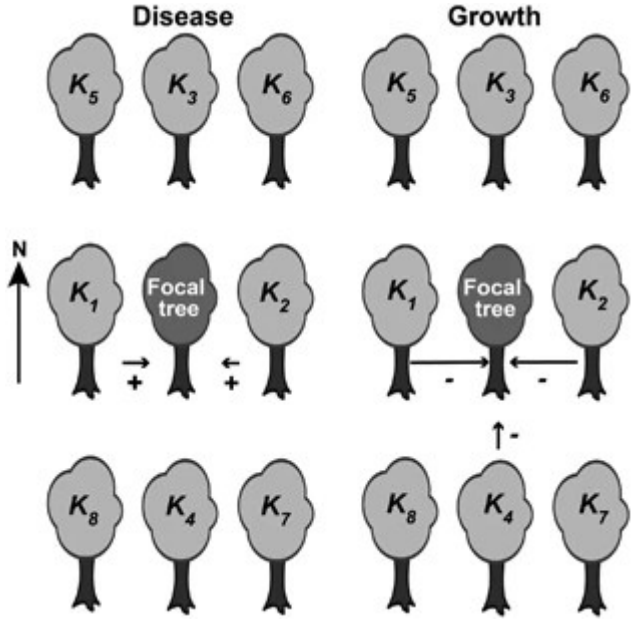


Diversity determines long term genetic gain

What about short term?

Group Selection: Short term Interactions

Interaction between individuals in **Genomic Selection** is **Intraspecific Competition**



Silva et al., Heredity 2017

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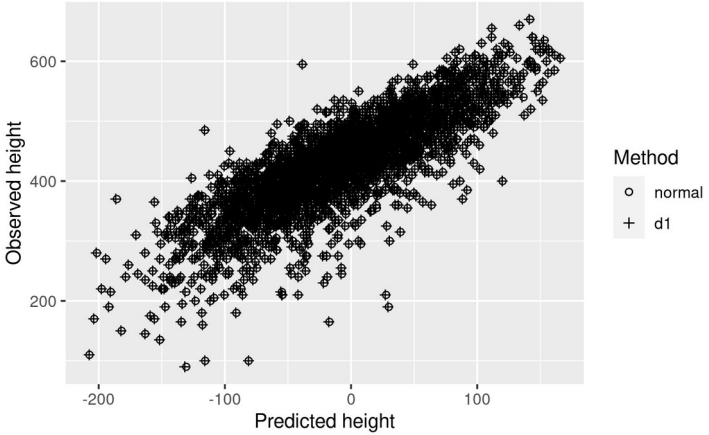

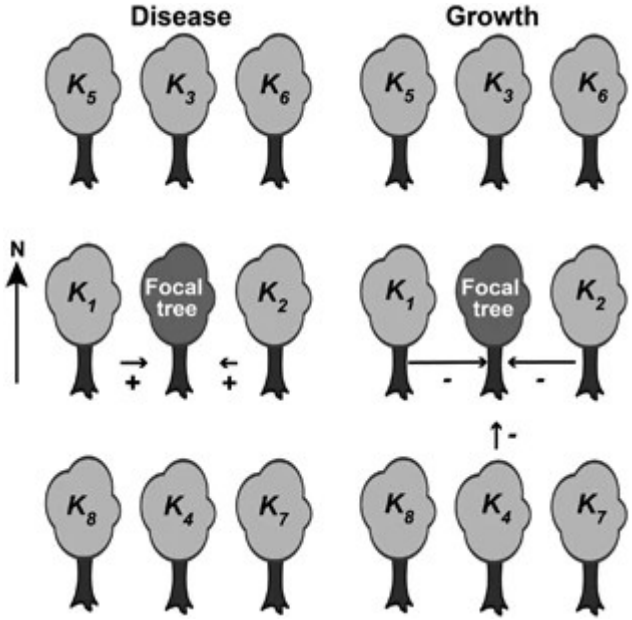

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Group Selection: Short term Interactions

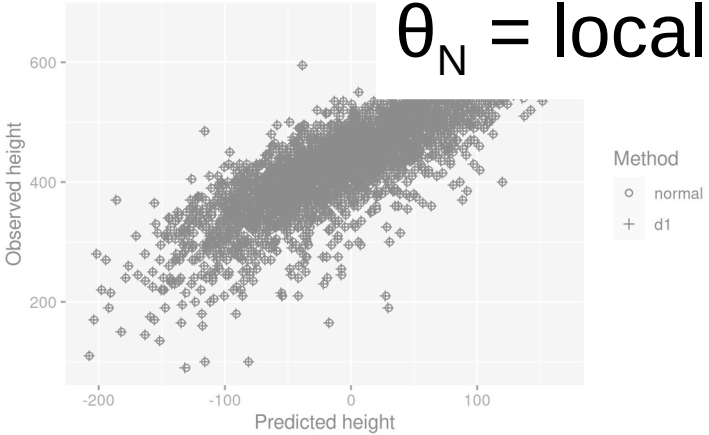
Interaction between individuals in **G**

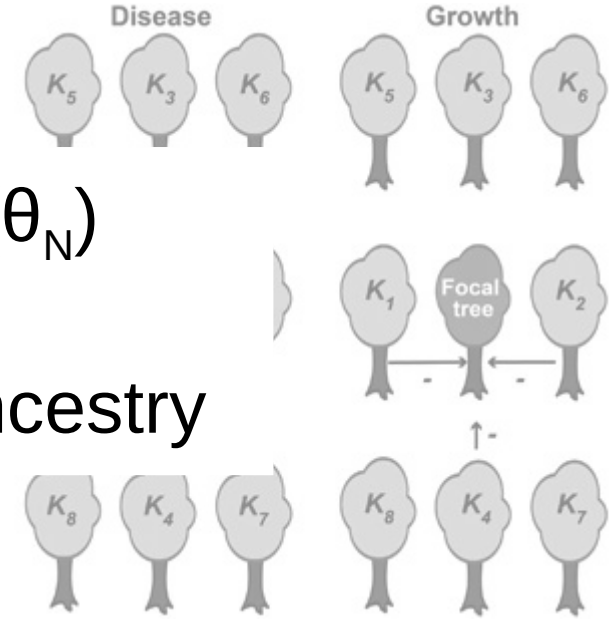
Selection is **In**

Competition

Phenotype ~ $f(\theta_N)$

θ_N = local coancestry





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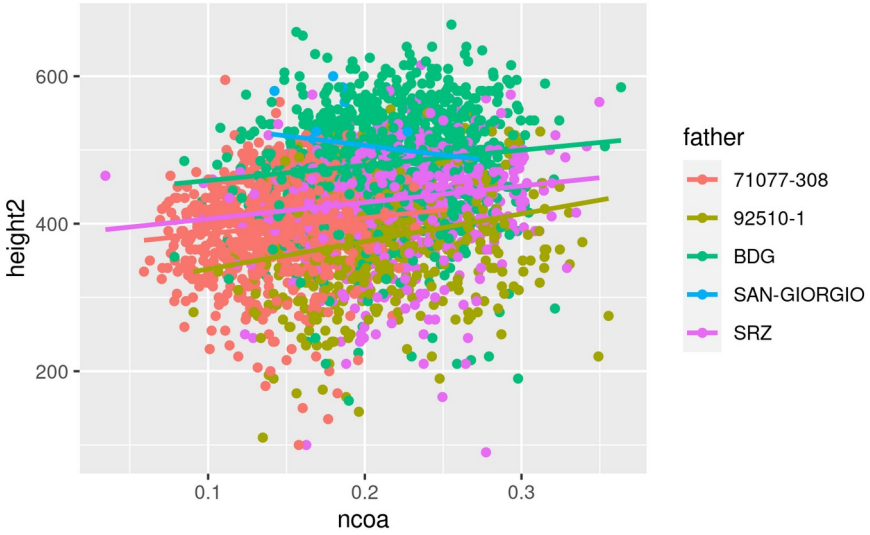

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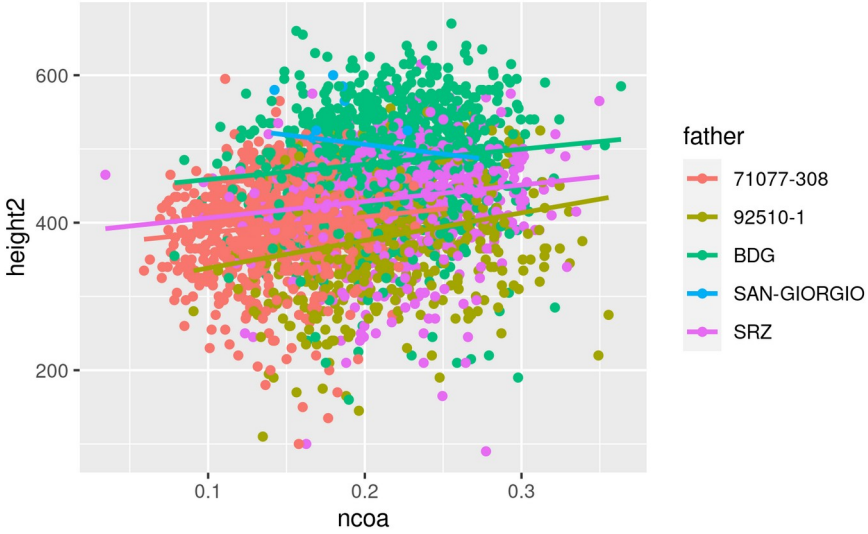

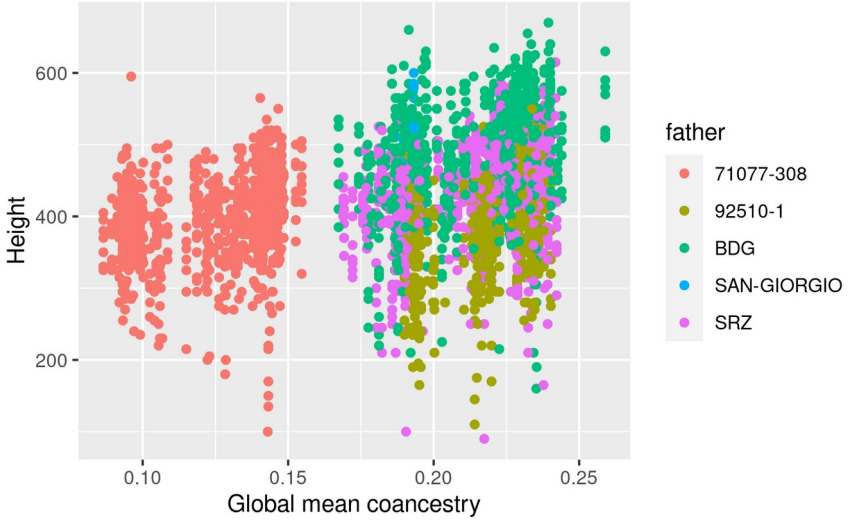

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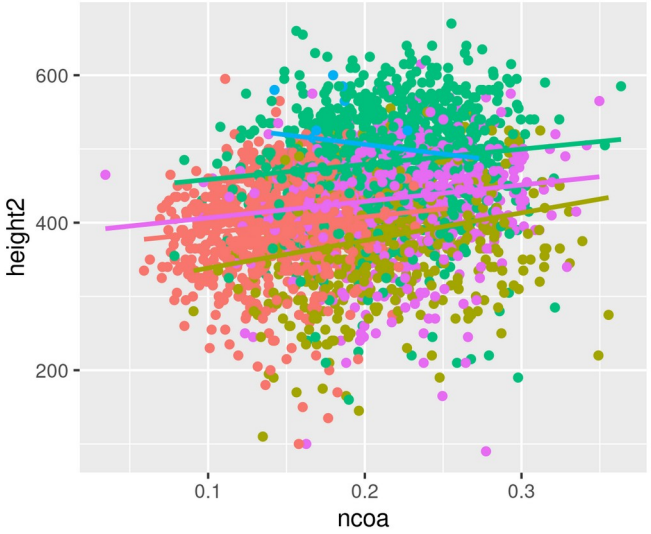

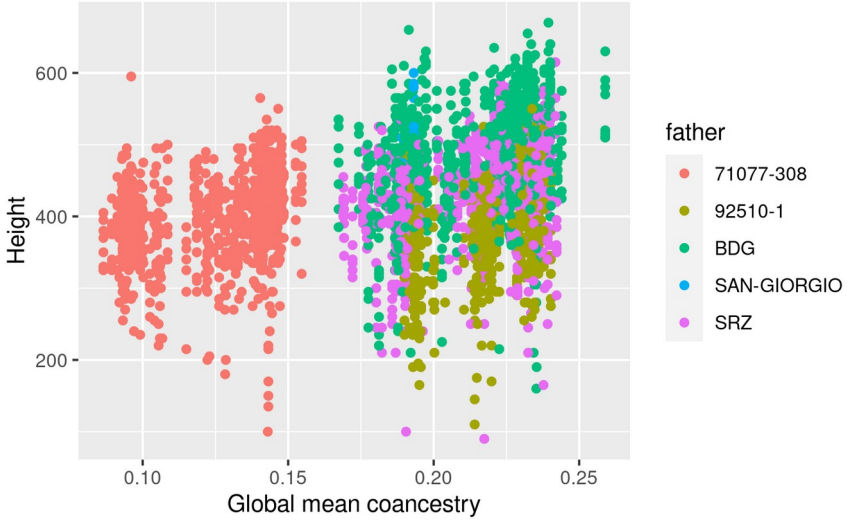

Selection of relatedness vs Co-selection of related

Group Selection: Short term Interactions

Dataset: *Populus nigra*

- random block design.

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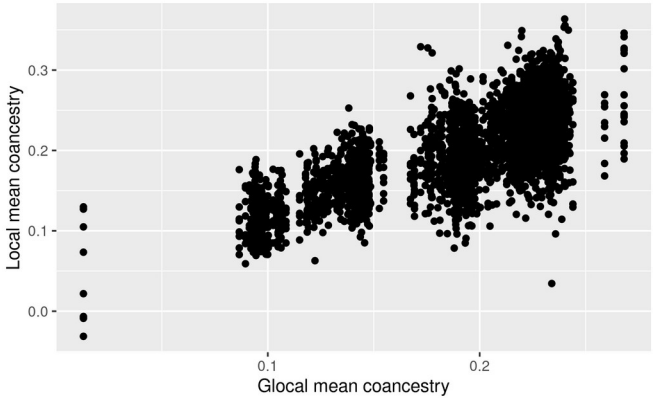
$$Y \sim Spatial + Animal + \mathbf{e}\ ,\ \mathbf{e} \sim \theta_N + \varepsilon$$



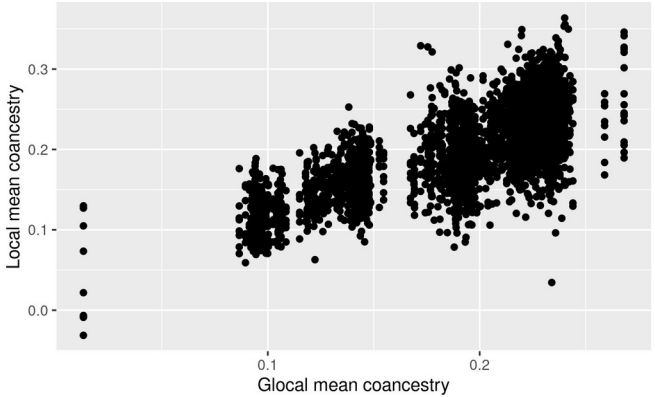
Group Selection: Short term Interactions

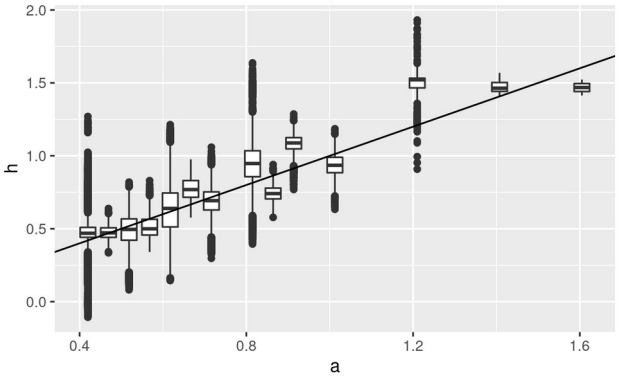
Dataset: *Populus nigra*

- random block design.

$Y \sim Spatial + Animal + \mathbf{e}$, $\mathbf{e} \sim \theta_N + \varepsilon$

$\theta_N \sim A$ (pedigree) or H (genomic)





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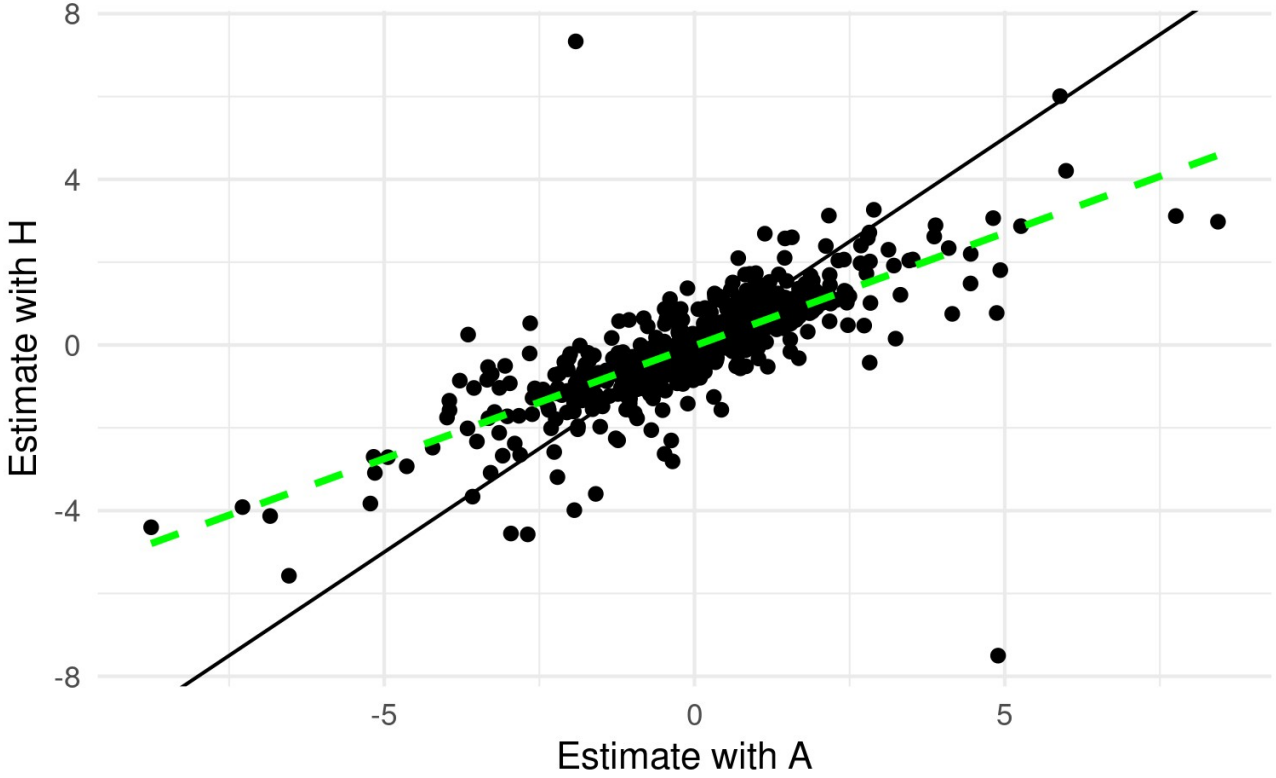

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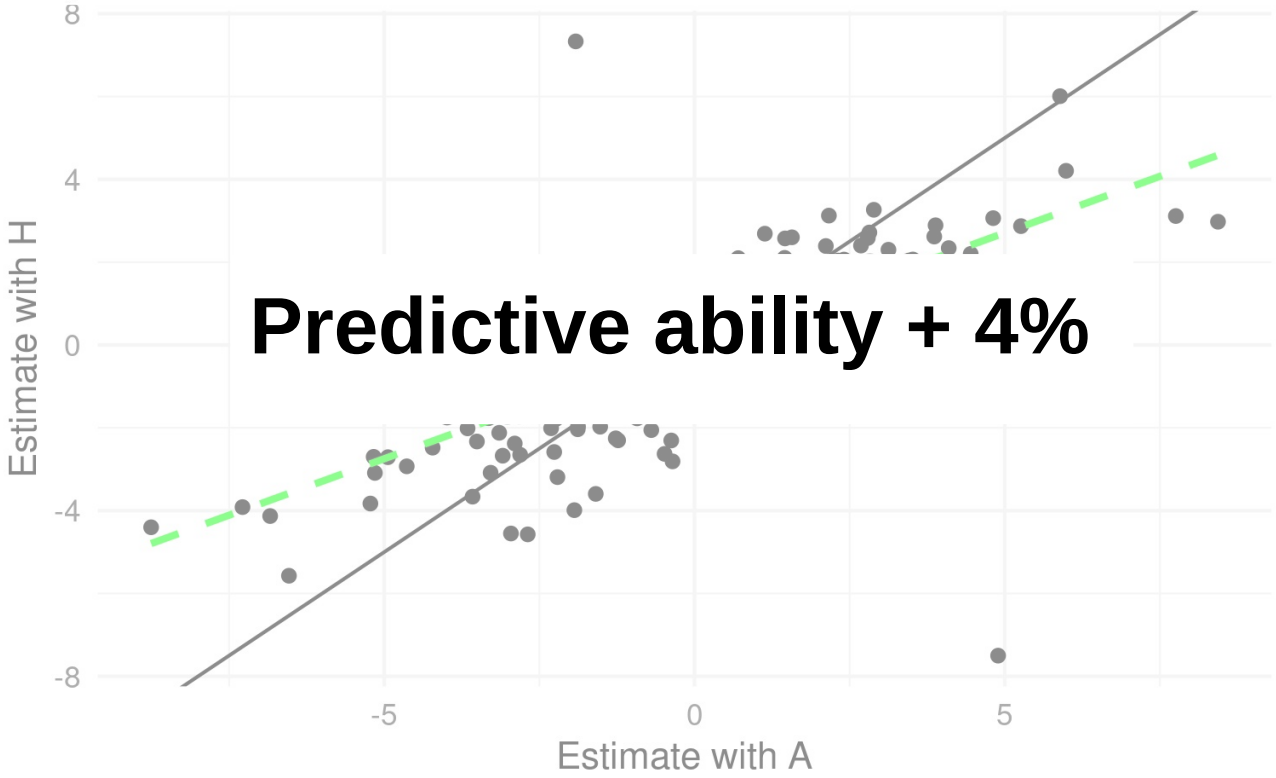

Perspective and Future Challenges

Genetic Diversity - Long term vs Short term

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