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ETH zürich

Phenotyping a dynamic trait: leaf growth response to environmental restrictions

Kristina Jaškūnė



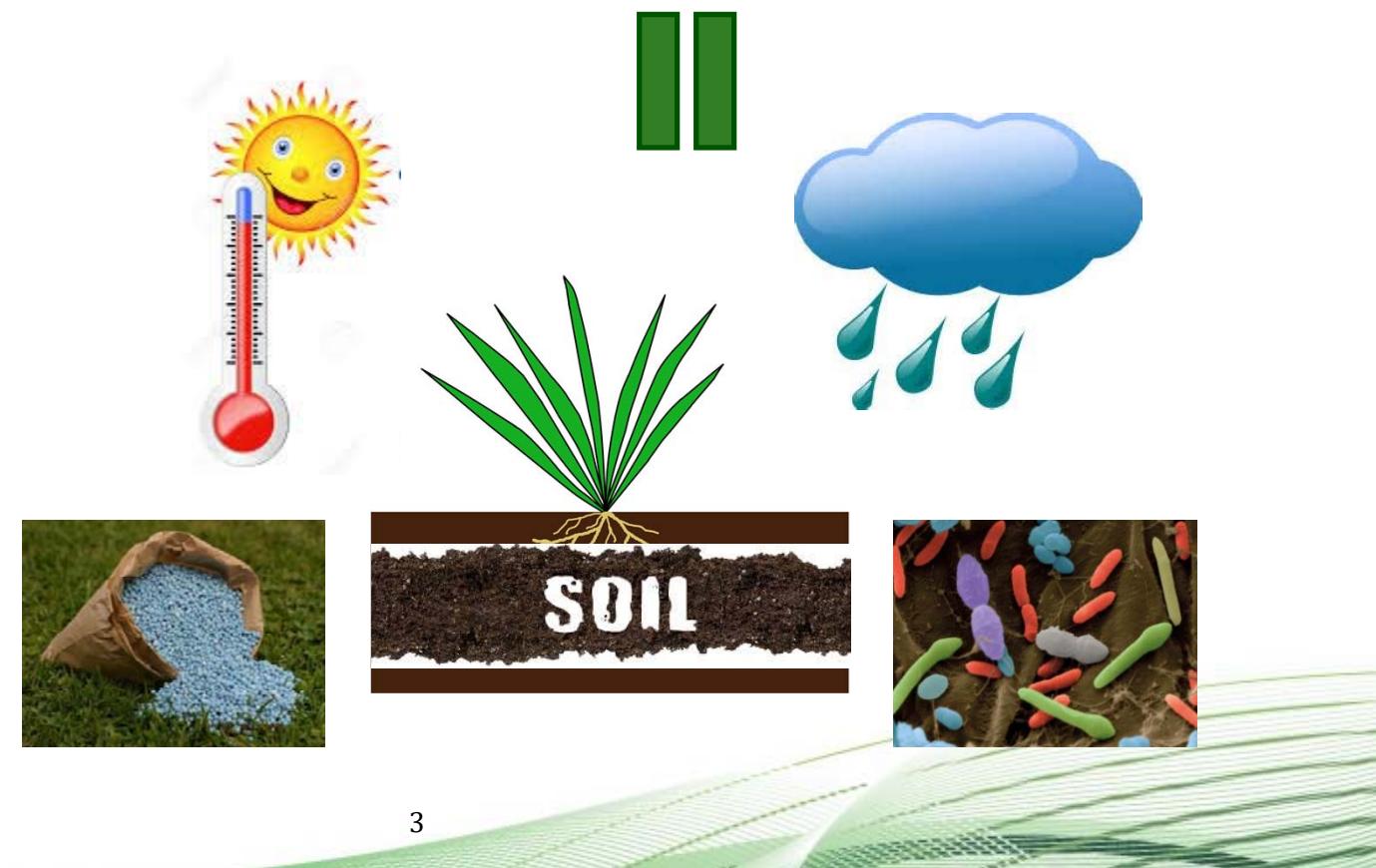
Drought in temperate regions?

- Drought is a major limitation in crop productivity
- The frequency, severity and duration are predicted to increase
- Drought cost CHF 500 Million, Switzerland, 2003
- Maize yield reduction by 27.5%, USA, 2012
- ~20% of forage crop yield loss, Lithuania, 2015, 2018, 2019



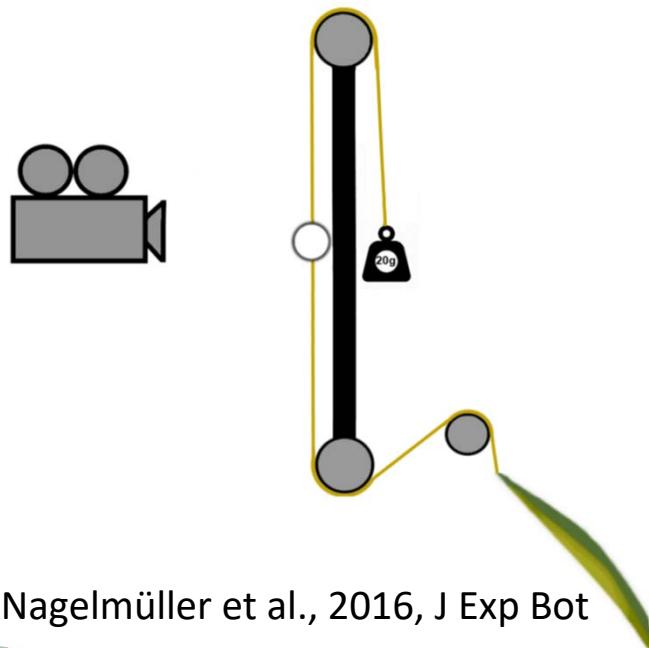
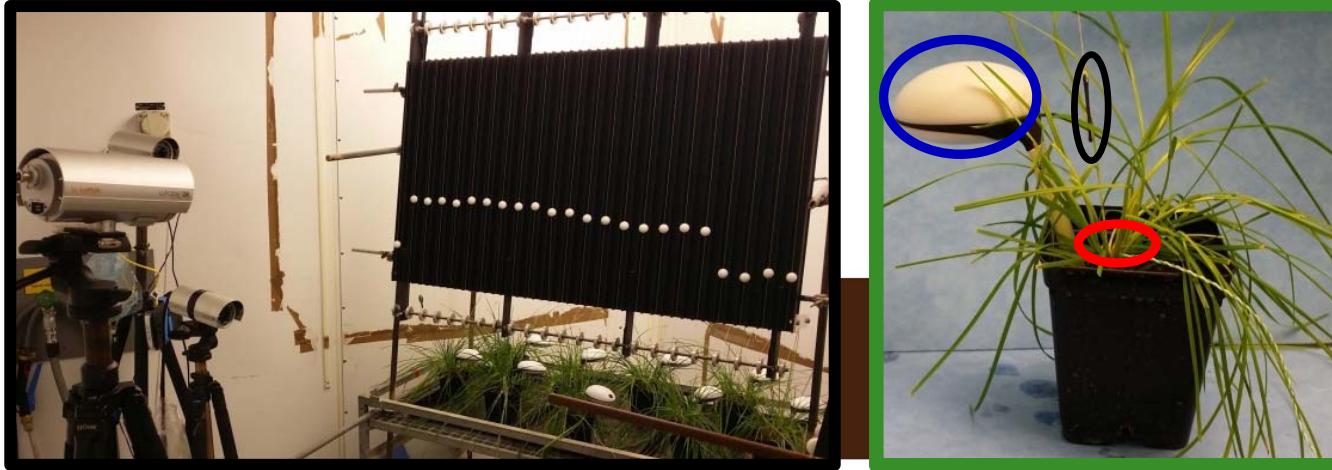
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Improving drought tolerance

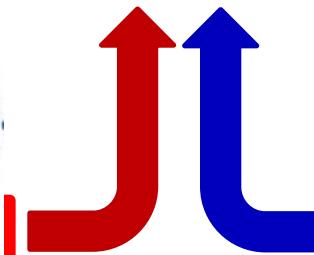
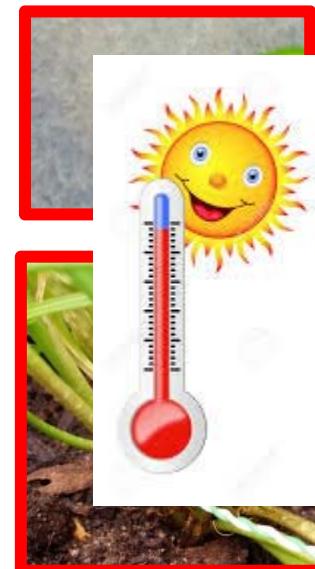


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Phenotyping platform

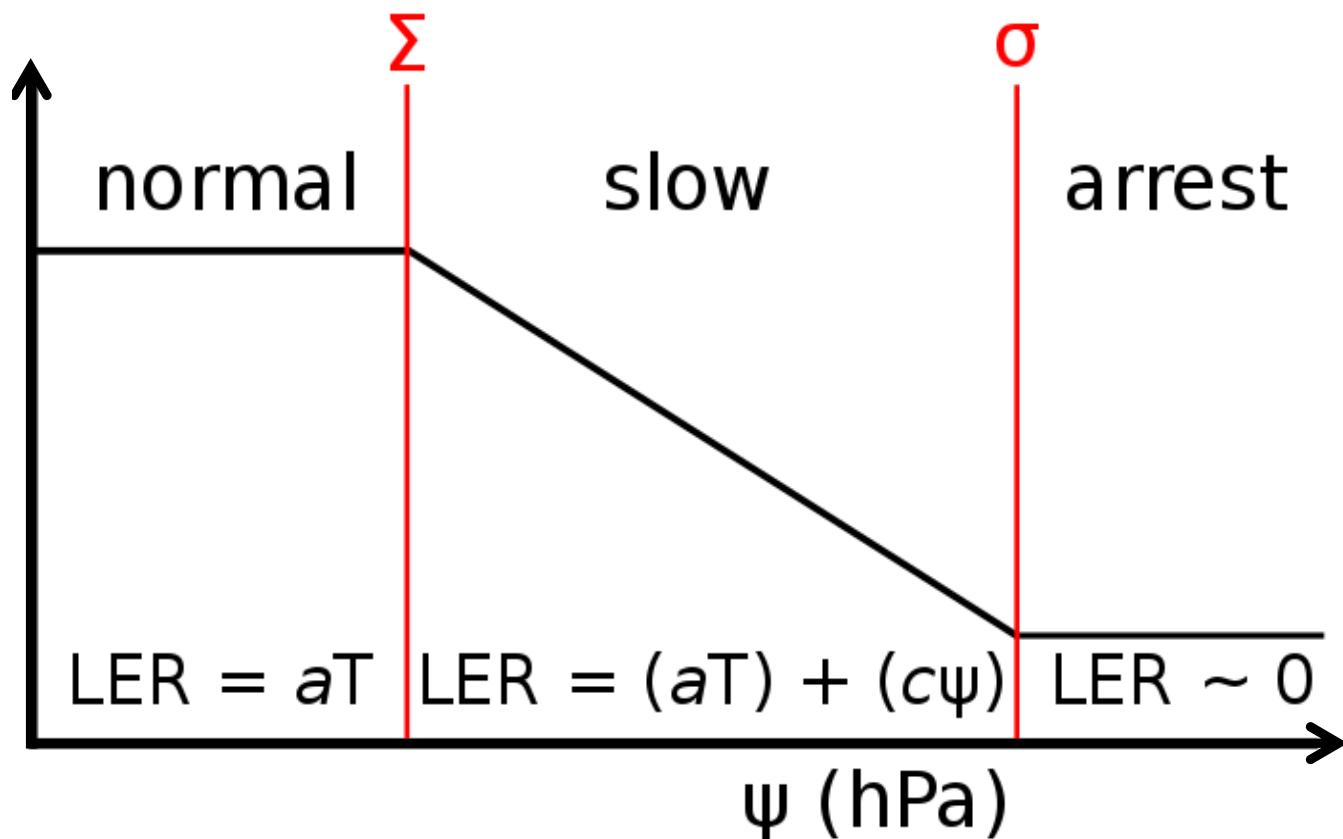


Nagelmüller et al., 2016, J Exp Bot



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Leaf growth under water deficit

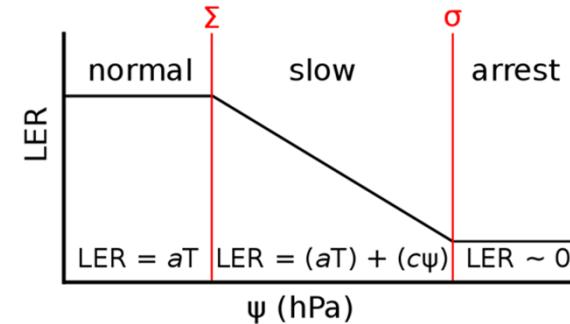


T = temperature

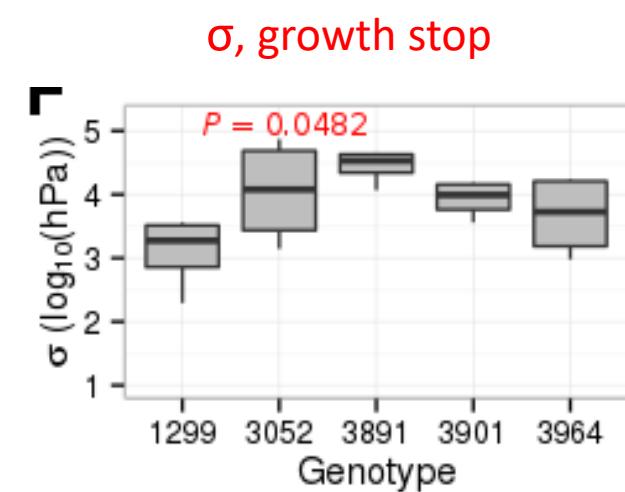
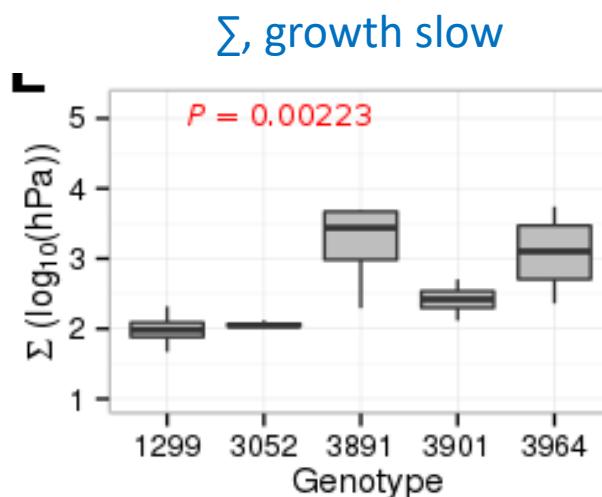
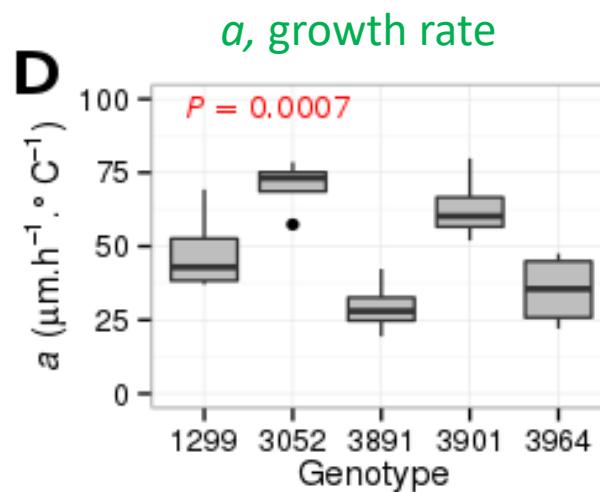
a, c = genotypic response

Leaf growth under water deficit

The phenotyping approach enables to determine when water potential (Ψ) slows (Σ) and arrests (σ) leaf elongation rate (LER)



Genotypic differences



Applicability of the approach

- Determines genotypic response to water stress
- Time independent phenotypic response
- Non-invasive, labour and cost effective

-  **frontiers**
in Plant Science
- ORIGINAL RESEARCH
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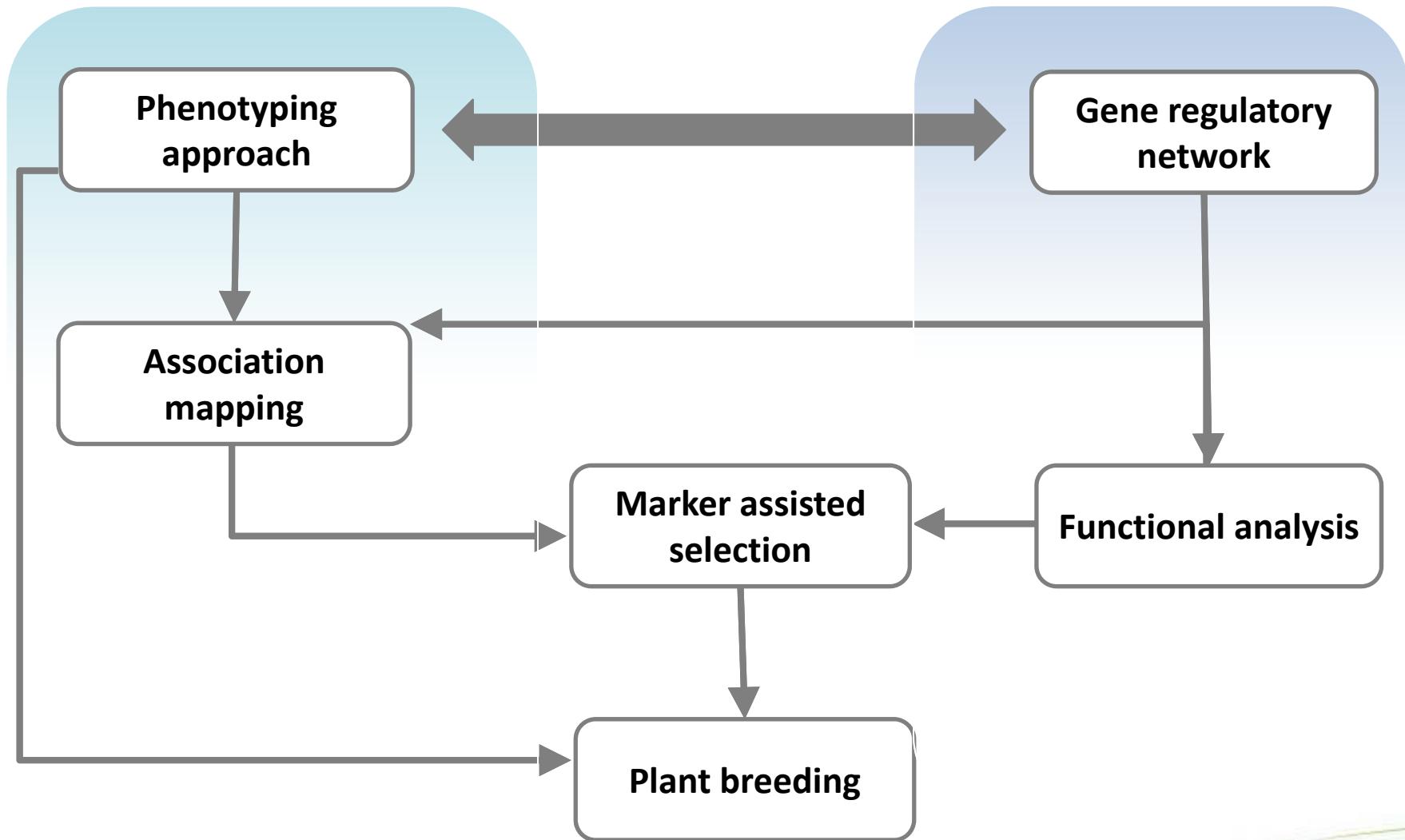
Phenotyping a Dynamic Trait: Leaf Growth of Perennial Ryegrass Under Water Limiting Conditions

Steven Yates^{1†}, Kristina Jaškūnė^{2†}, Frank Liebisch³, Sebastian Nagelmüller³, Norbert Kirchgessner³, Roland Kölliker¹, Achim Walter³, Gintaras Brazauskas² and Bruno Studer^{1*}

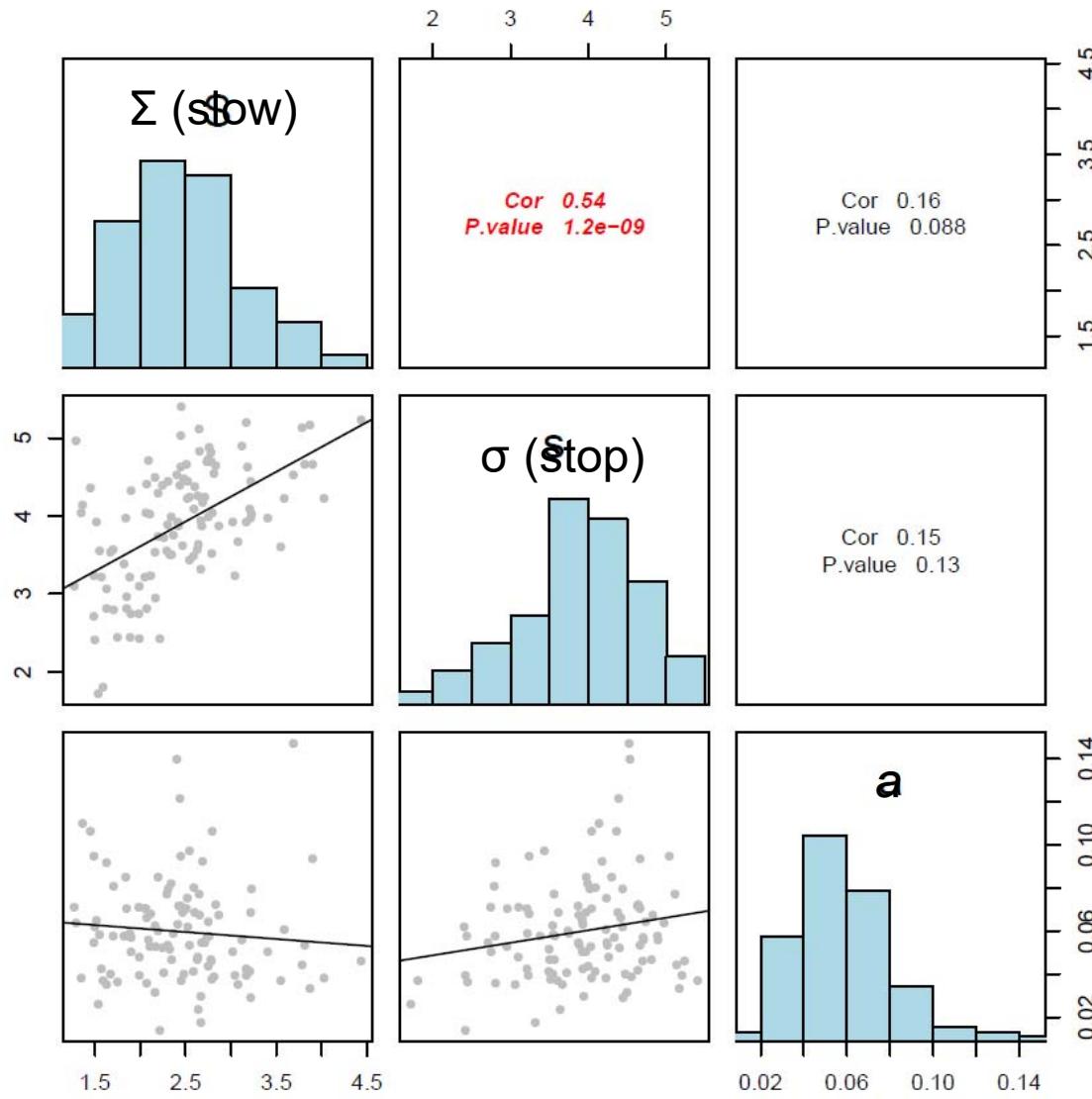


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Outlook



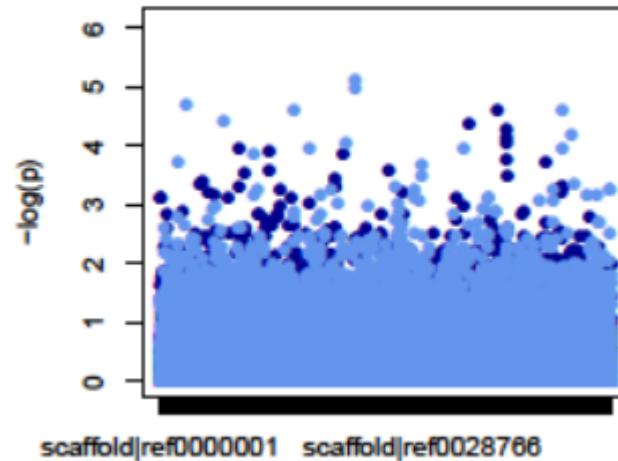
Growth response of different genotypes



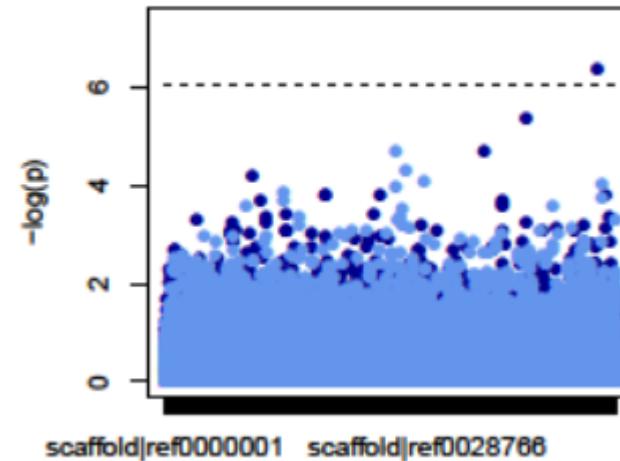
- Data from 216 genotypes (association mapping panel)
- H^2
 - $\Sigma = 67.98\%$
 - $\sigma = 67.03\%$
 - $A = 63.67\%$
- Correlation between drought response (slow and stop)
- No correlation between drought response and growth rate
- Indicates that an active process limits growth

GWAS

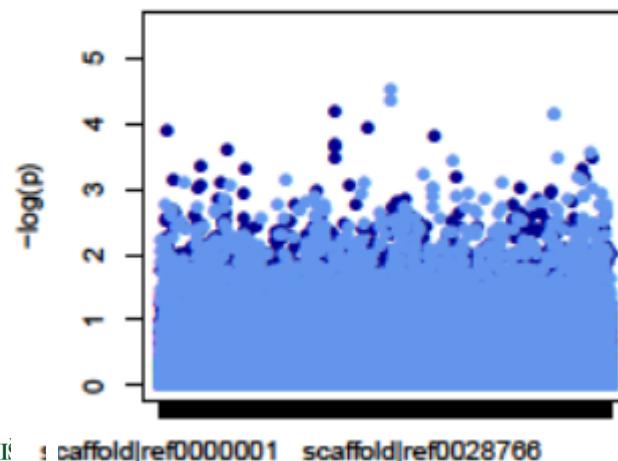
growthMean



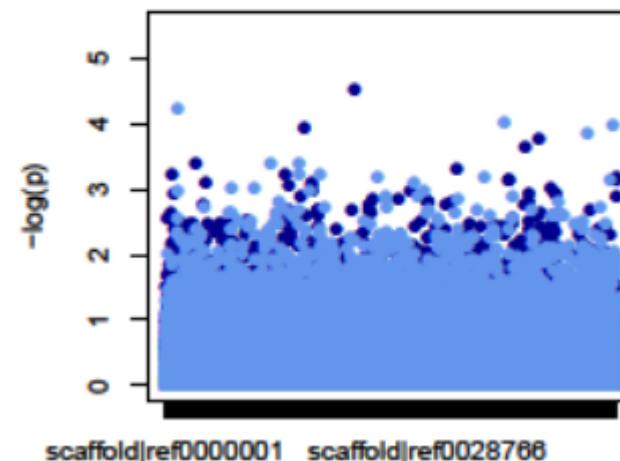
slowMean



stopMean



tolMean



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Leaf growth of winter wheat during cold acclimation as an indicator for winter survival



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