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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



Improving drought tolerance

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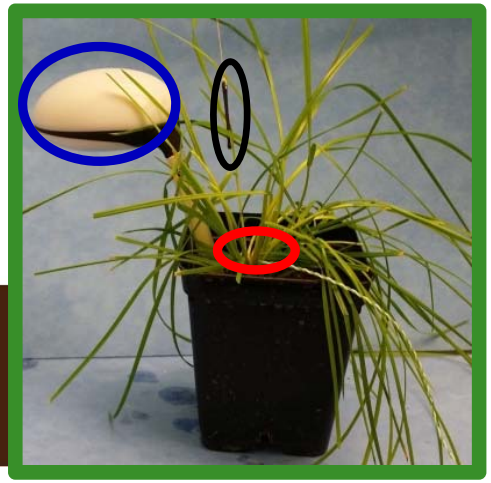
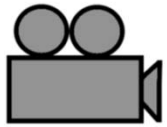
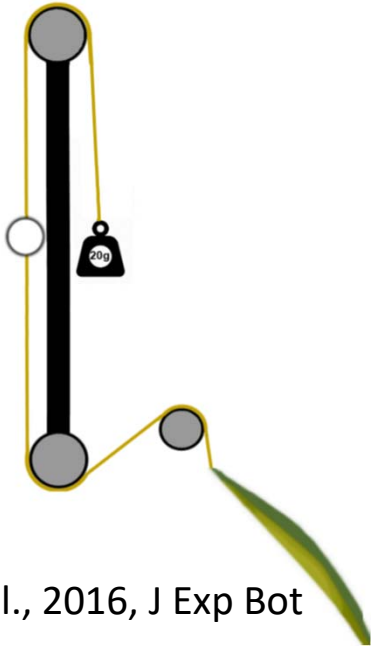
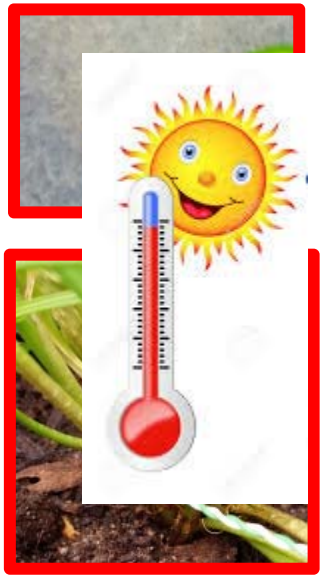
Phenotyping platform



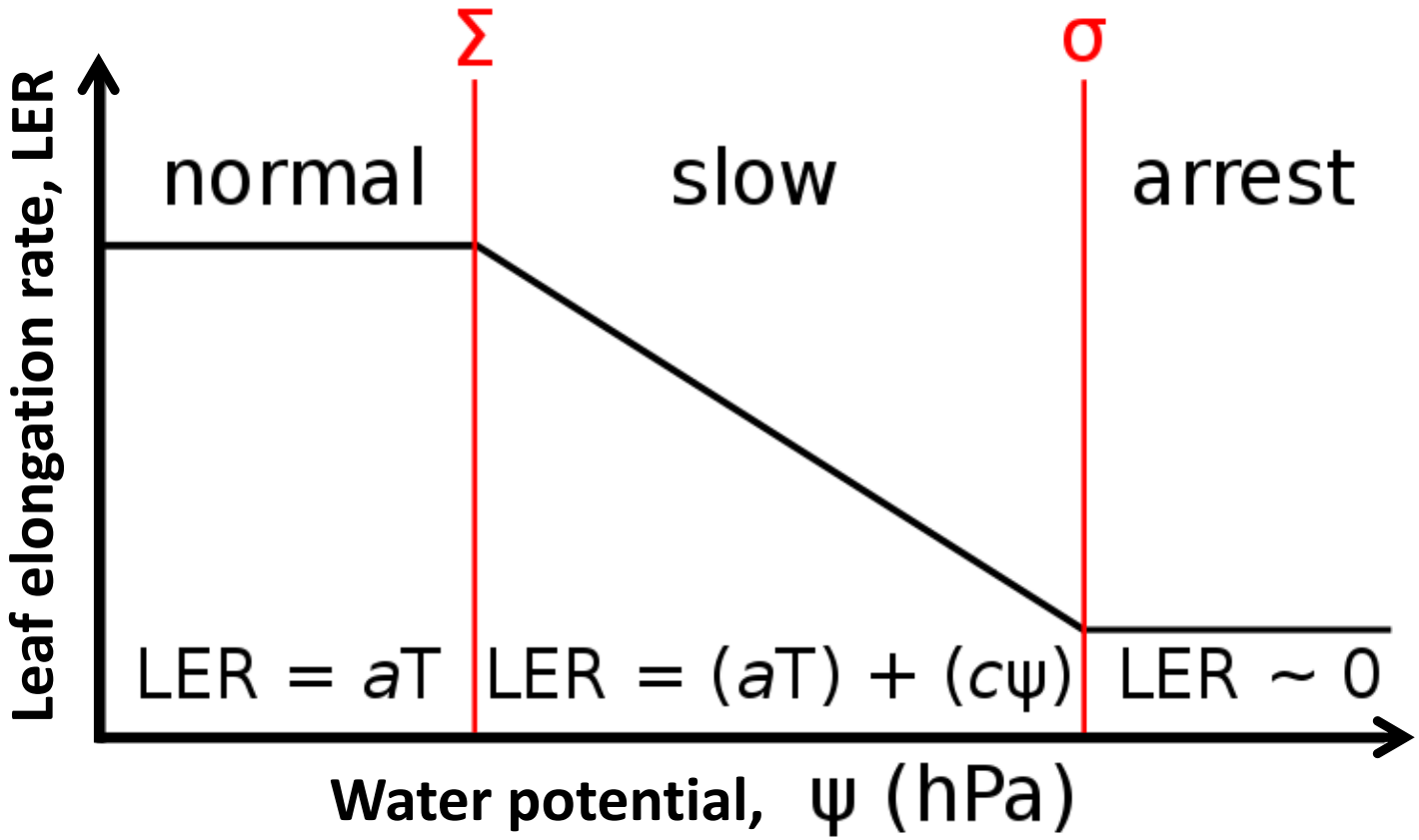






Nagelmüller et al., 2016, J Exp Bot

Leaf growth under water deficit

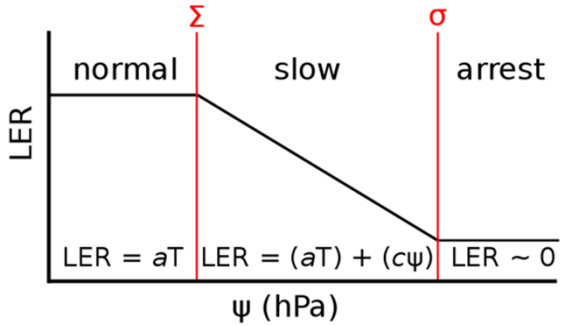


T = temperature

a, *c* = genotypic response

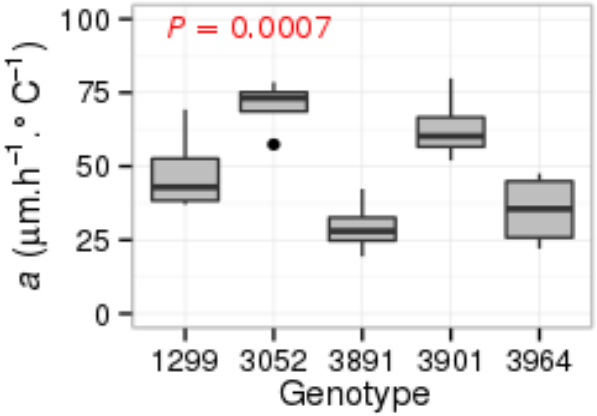
Leaf growth under water deficit

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

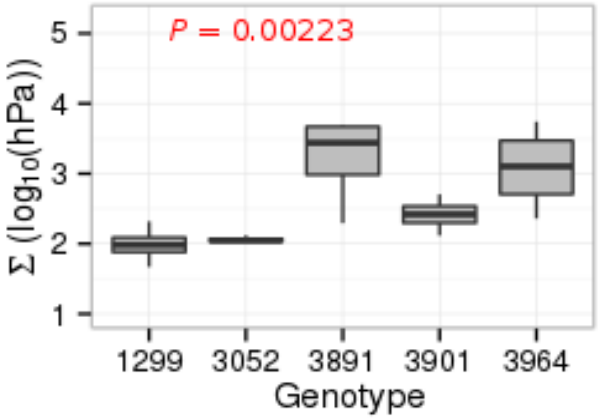


Genotypic differencies

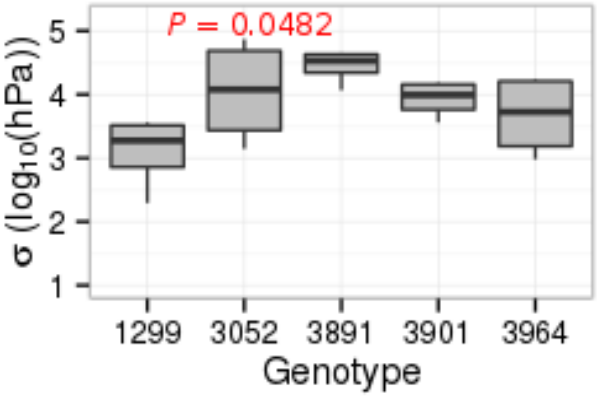
α, growth rate



∑, growth slow

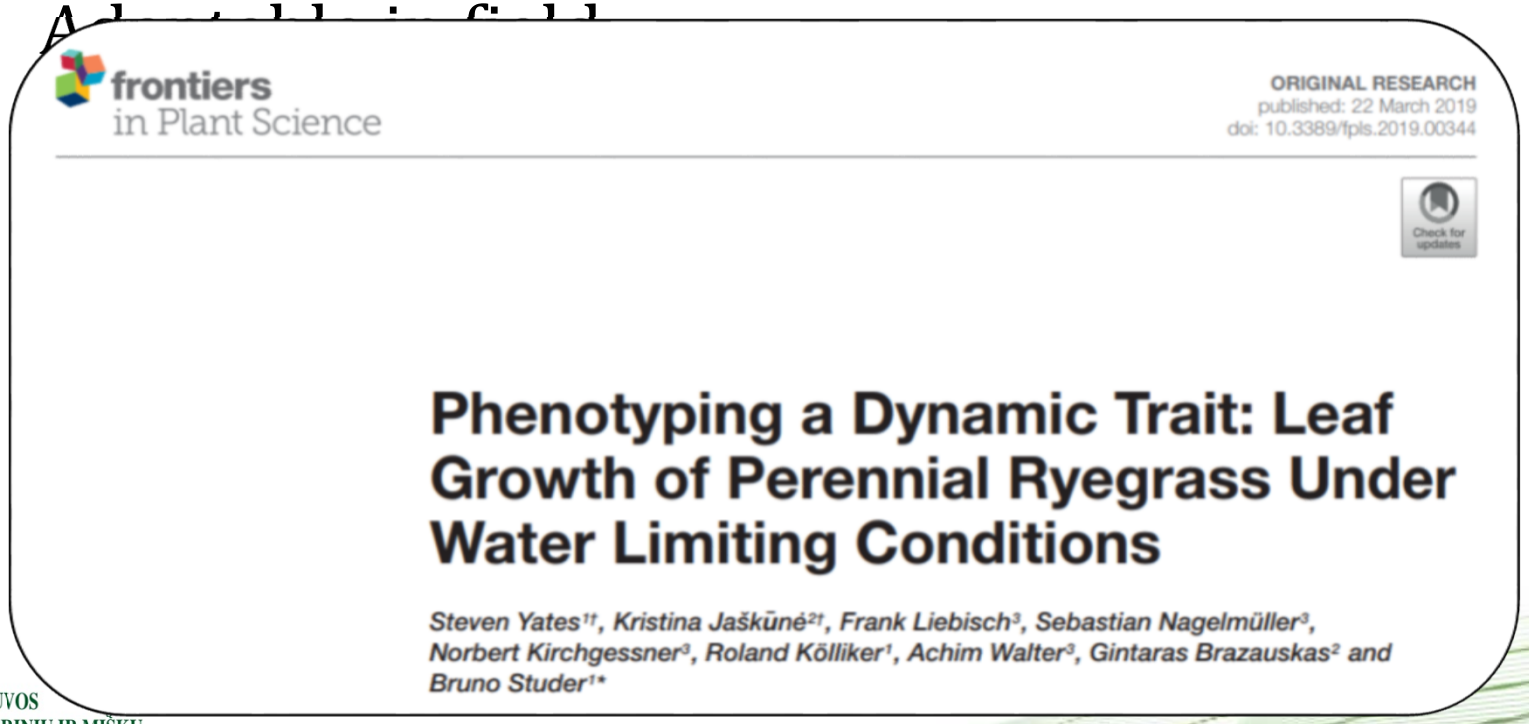


σ, growth stop



Applicability of the approach

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



frontiers in Plant Science

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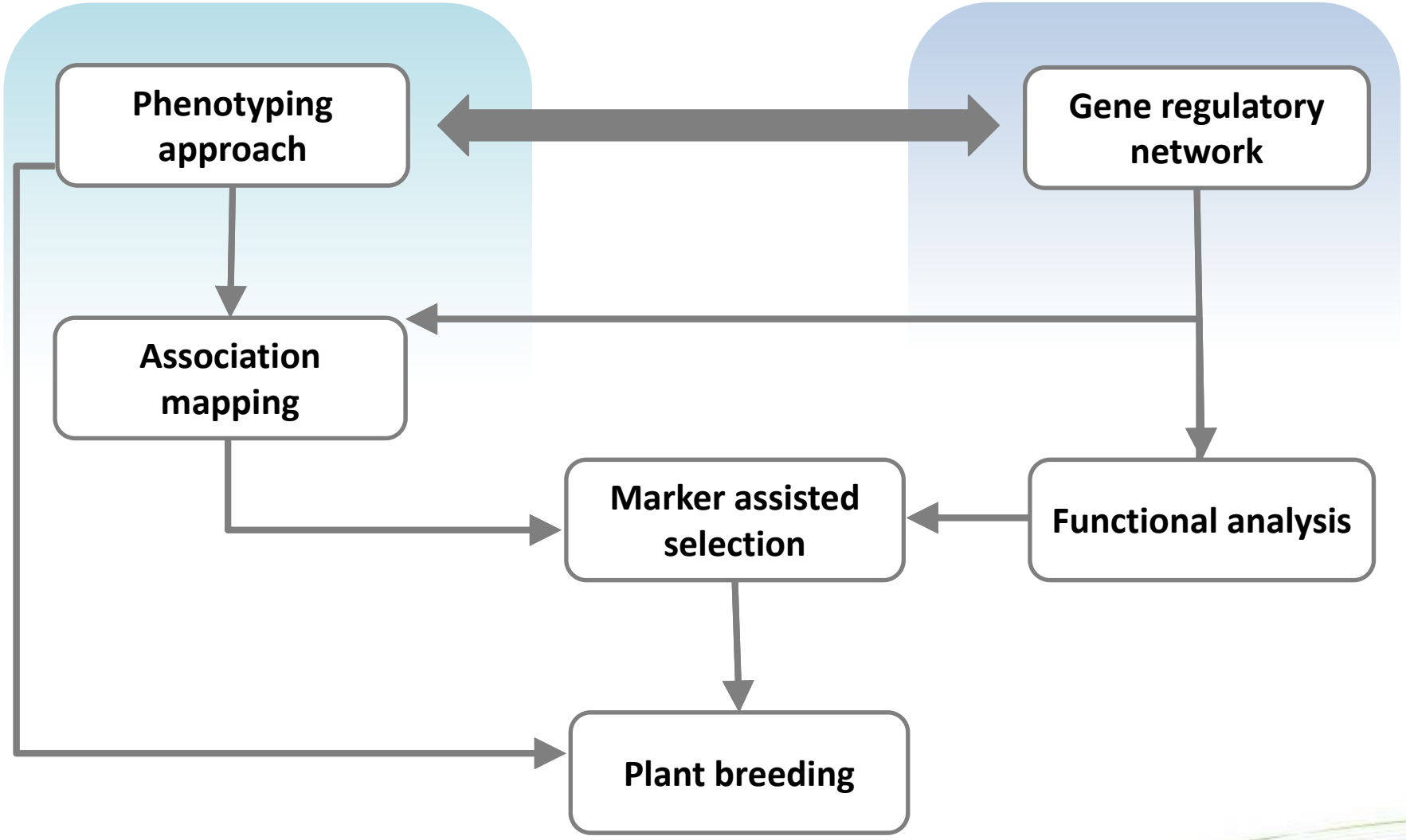
Check for updates

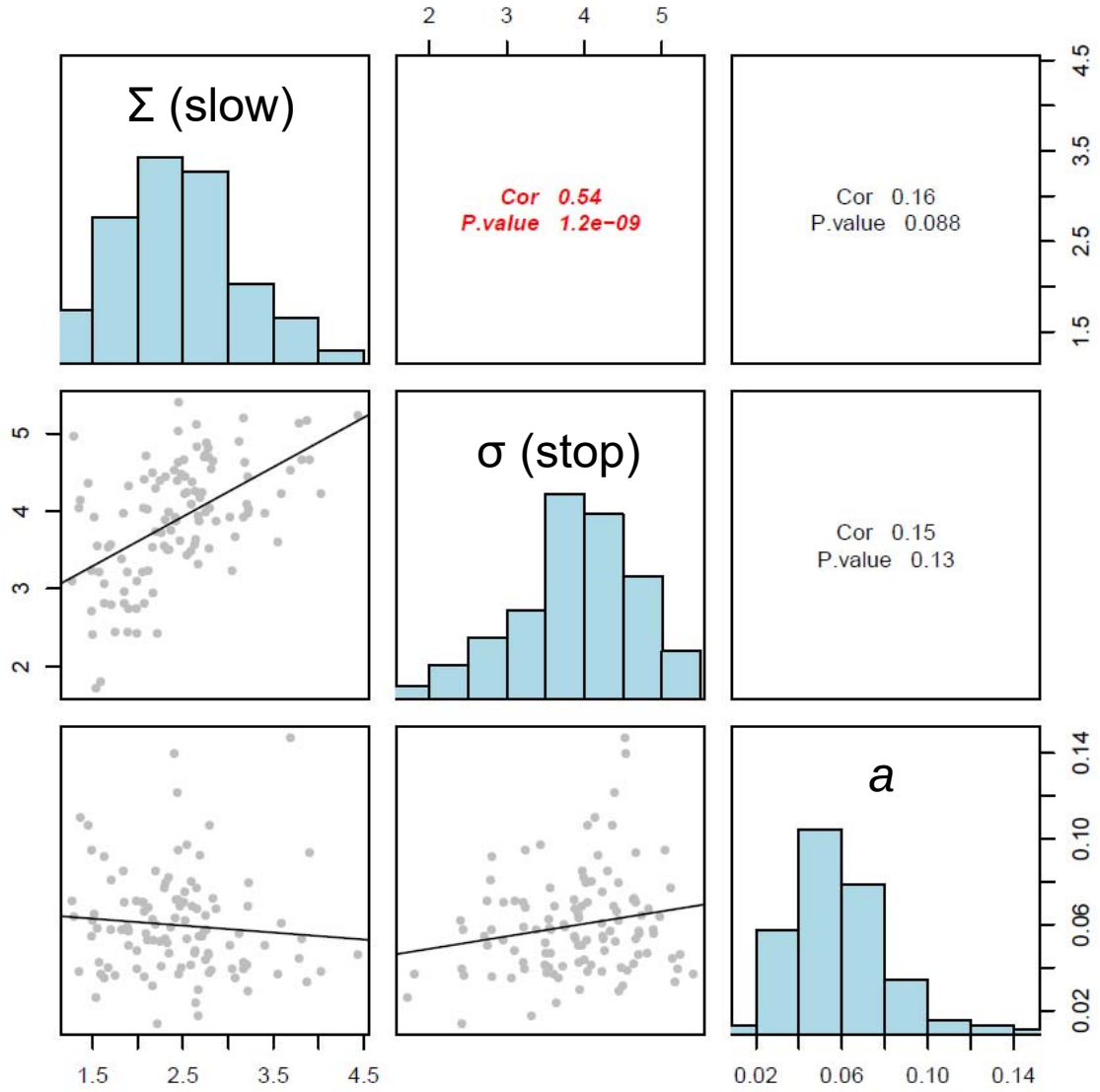
Phenotyping a Dynamic Trait: Leaf Growth of Perennial Ryegrass Under Water Limiting Conditions

Steven Yates[1†], Kristina Jaškūnė[2†], Frank Liebisch[3], Sebastian Nagelmüller[3], Norbert Kirchgessner[3], Roland Kölliker[1], Achim Walter[3], Gintaras Brazauskas[2] and Bruno Studer[1]*

Outlook

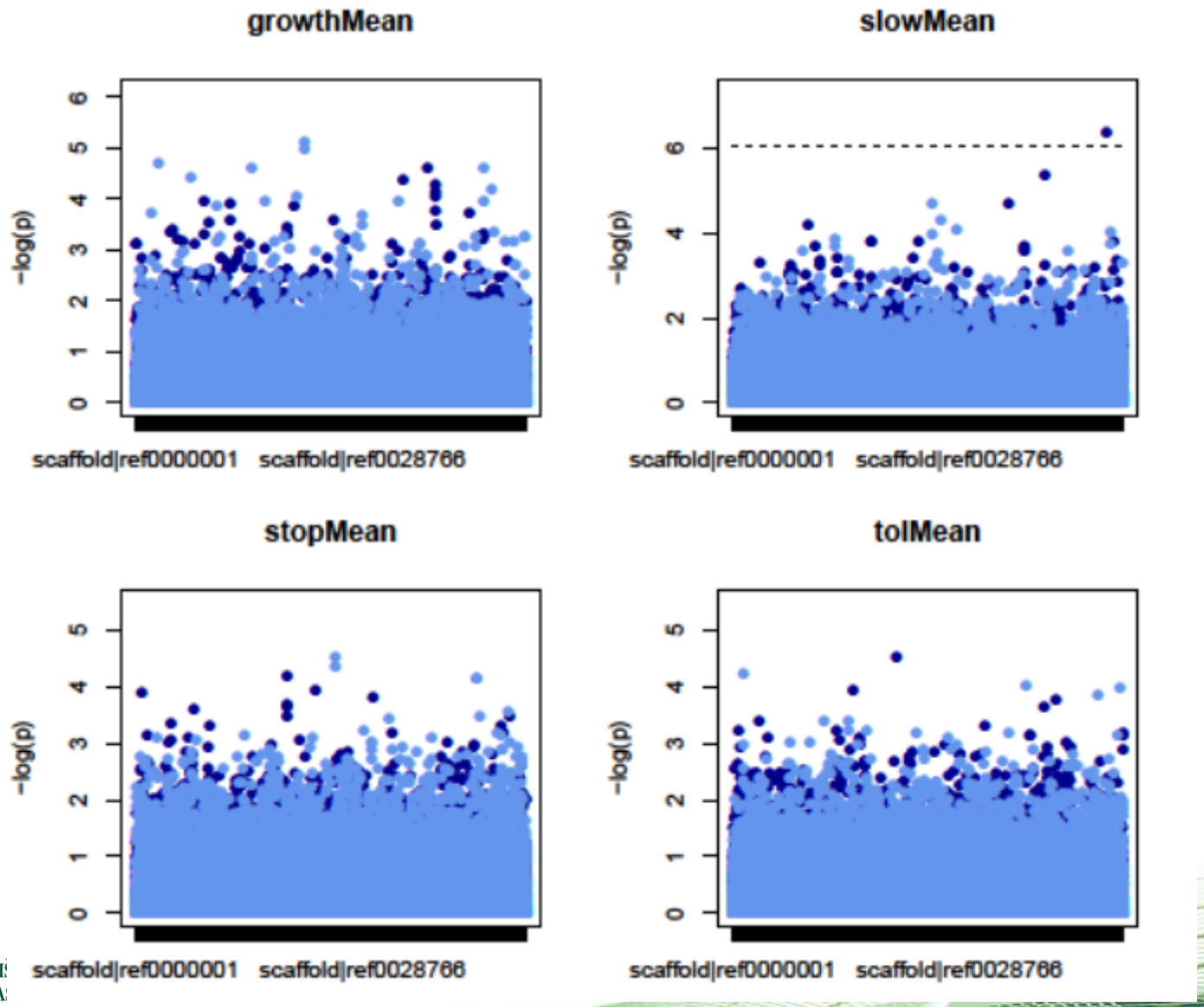

Phenotyping approach
Gene regulatory network
Association mapping
Marker assisted selection
Functional analysis
Plant breeding

Growth response of different genotypes



- Data from 216 genotypes (association mapping panel)
- H^2
  - Σ = 67.98%
  - σ = 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
−log(p)
scaffold|ref0000001
scaffold|ref0028766

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

Thanks

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