Phenotyping complex traits: adaptability to drought and frost in perennial ryegrass

Gražina Statkevičiūtė

«Edit Grass 4 Food» meeting
Tallinn, 28th October, 2022

Coping with drought

Escape   Avoidance   Tolerance
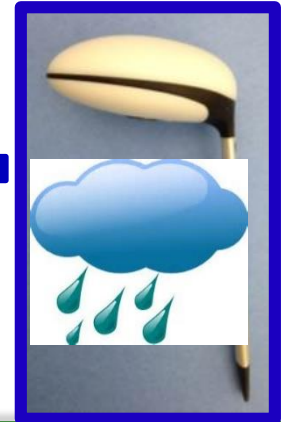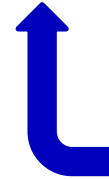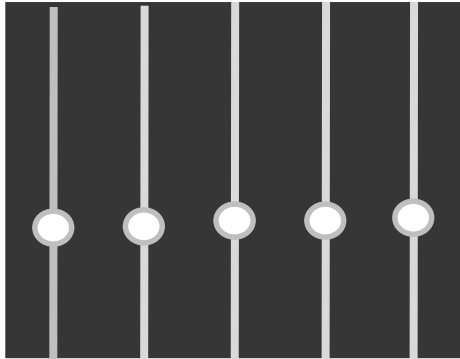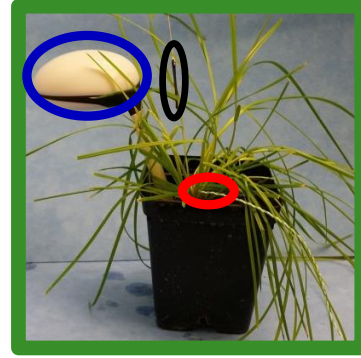

LAMMC
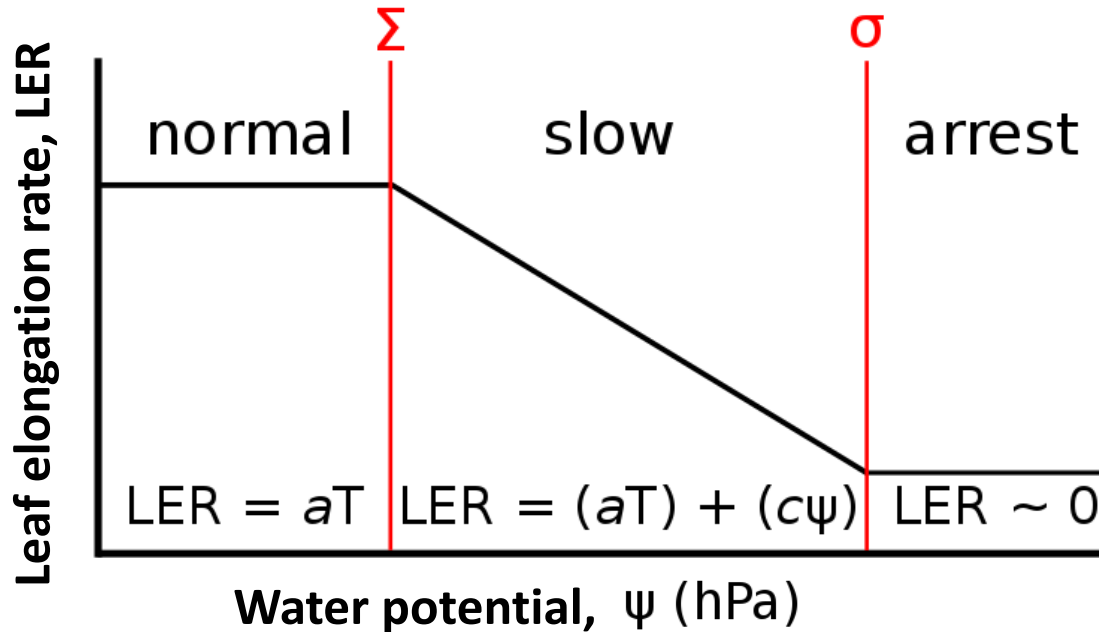
Improving drought tolerance

Yield = **Biomass**
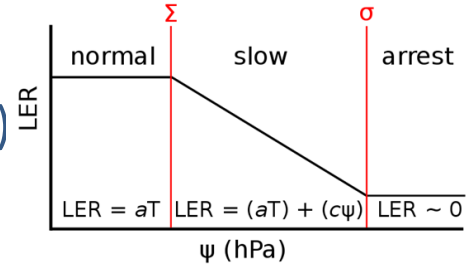
LAMMC

Phenotyping platform

Leaf growth under water deficit

T = temperature
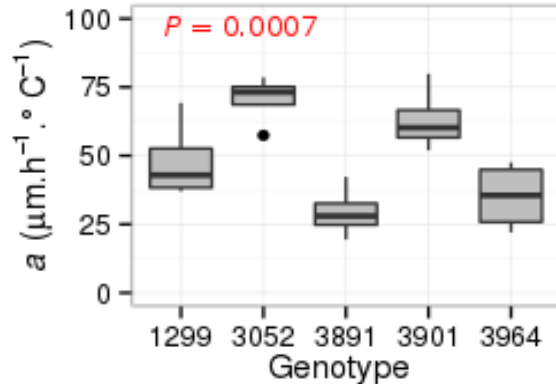*a*, *c* = genotypic response

LAMMC

Leaf growth under water deficit

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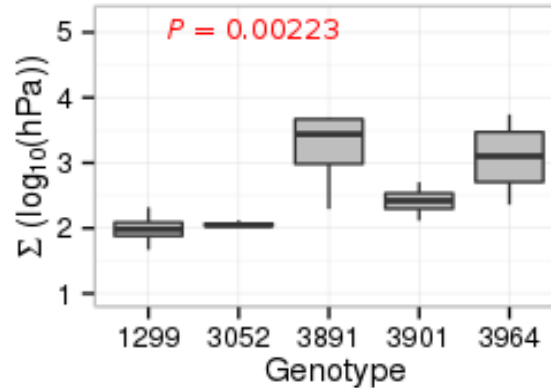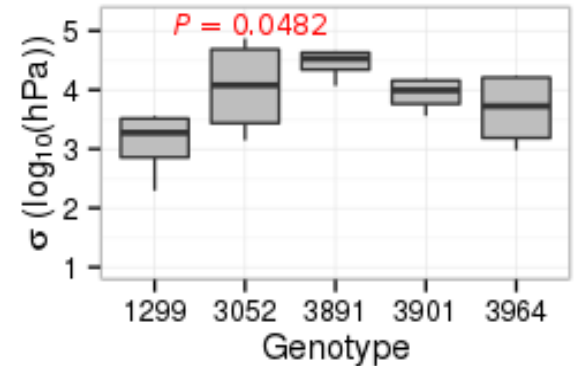

Genotypic differencies

a, growth rate

Σ, 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
- Adaptable in field
- Can be used in any monocot species
- Applicable to other abiotic stress

LAMMC

Check for updates

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

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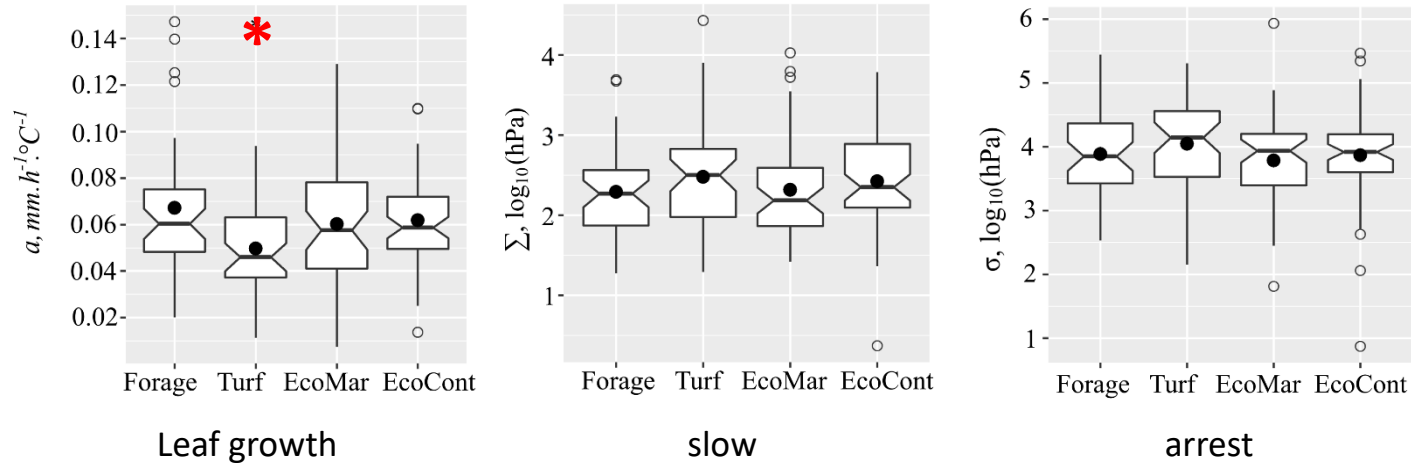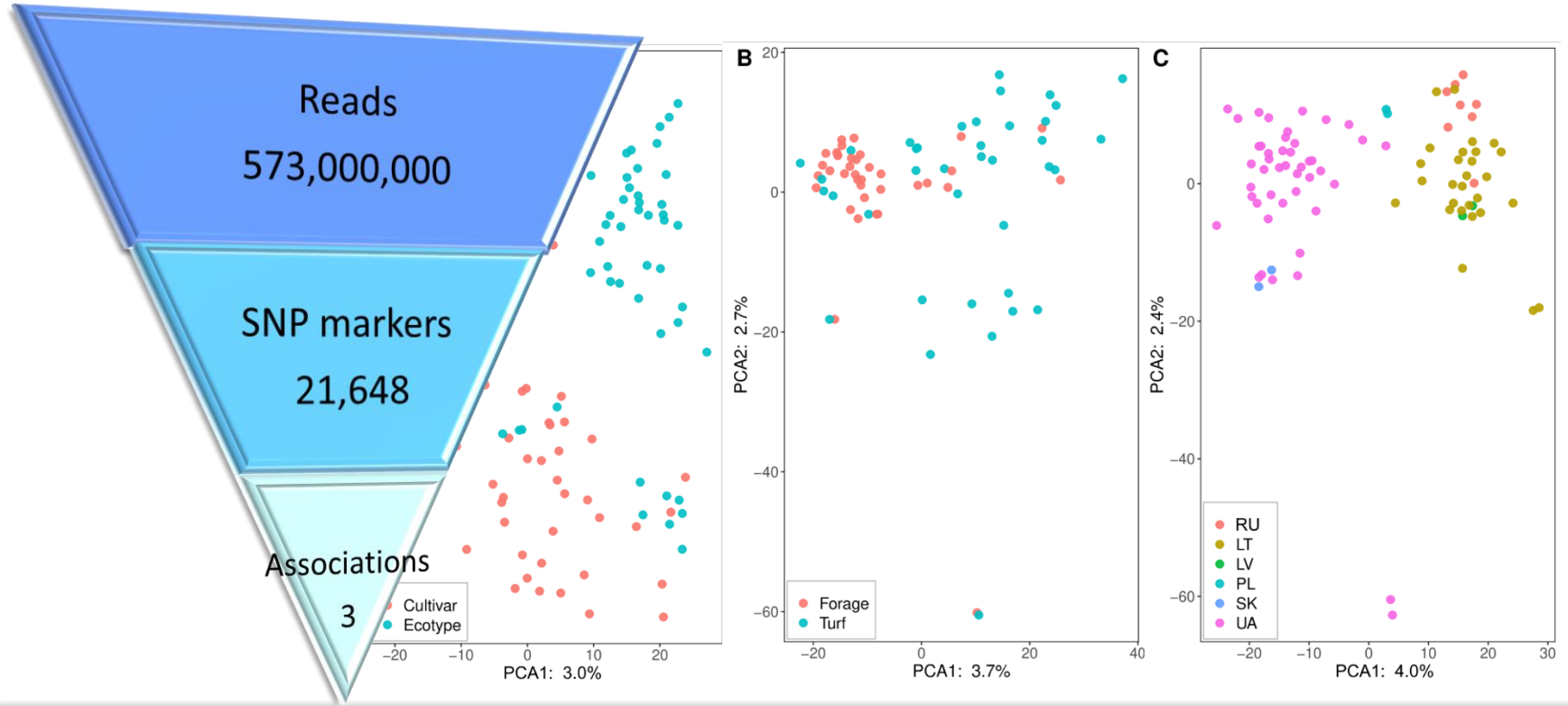
LAMMC

Use of the approach
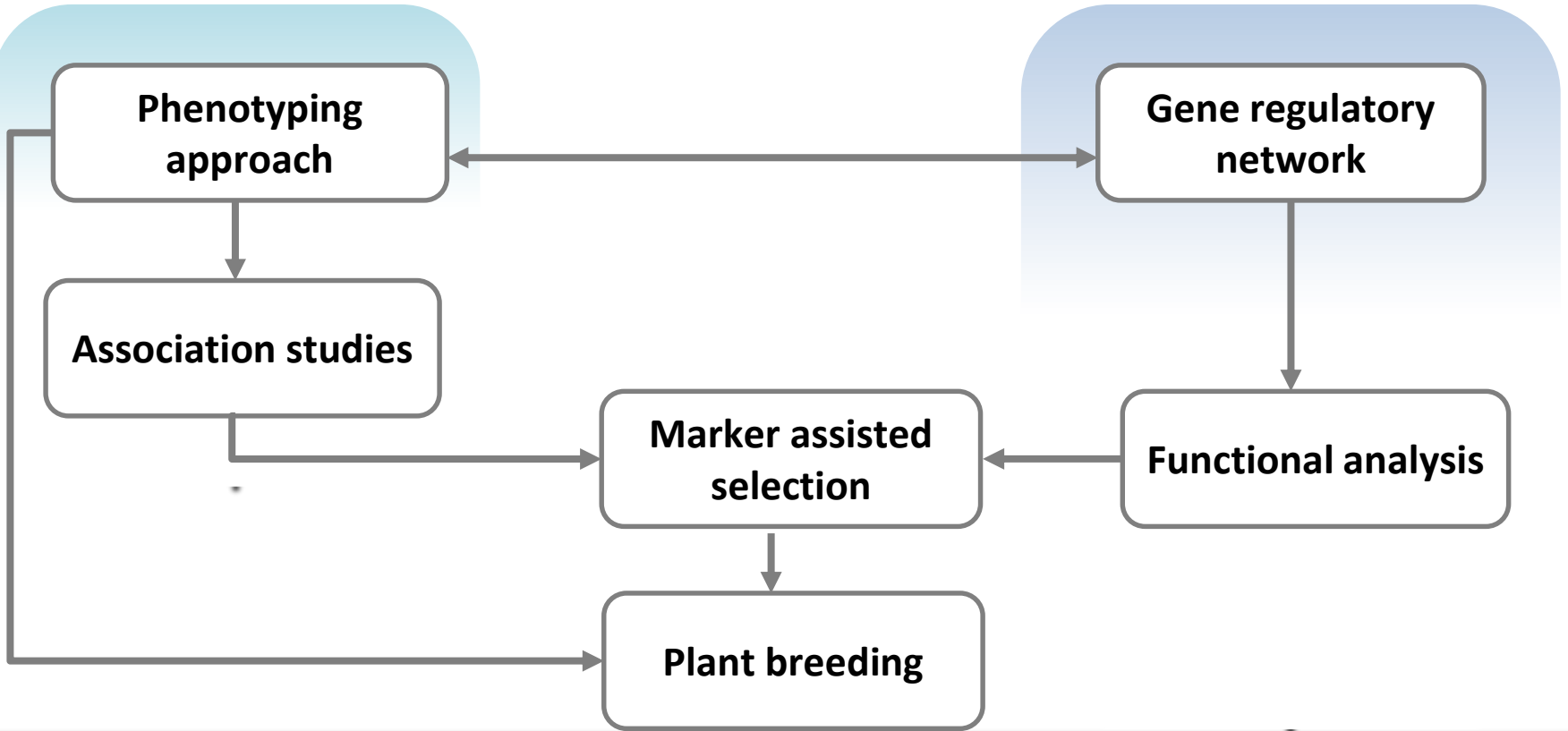
Phenotyping a diverse panel

◉ 197 perennial ryegrass genotypes

- Cultivars – 43 forage and 46 turf
- Ecotypes - 50 maritime and 58 continental origin

Leaf growth · slow · arrest

LAMMC

Genotyping-by-sequencing

LAMMC

GWAS for biomass formation

Scaffold	Position	Gene prediction (blastn)	Location	Scaffold position in barley genome	GWAS method	SNP effect	MAF	P-value	P-values FDR	P-values (Bonferroni correction)
scaffold_20866|ref0045961	1878	Transcription factor MYB41 (XM_003573090.4)	outside gene (708 bp)	Hv_chr6H	FarmCPU	-0.548	0.091	4.19E-07	0.009	0.009
					BLINK	NA	0.091	4.15E-07	0.009	NA
					MLMM	NA	0.091	8.16E-07	0.009	0.018
scaffold_4484|ref0039062	32616	Phytochrome B (XM_020328926.1)	intron	Hv_chr4H	FarmCPU	0.739	0.054	1.79E-07	0.019	0.039
					BLINK	NA		1.78E-06	0.019	NA
scaffold_21802|ref0017195	728	NA	intergenic space	NA	MLMM	NA	0.256	4.43E-07	0.009	0.010

LAMMC

frontiers
in Plant Science

Genome-Wide Association Study to Identify Candidate Loci for Biomass Formation Under Water Deficit in Perennial Ryegrass

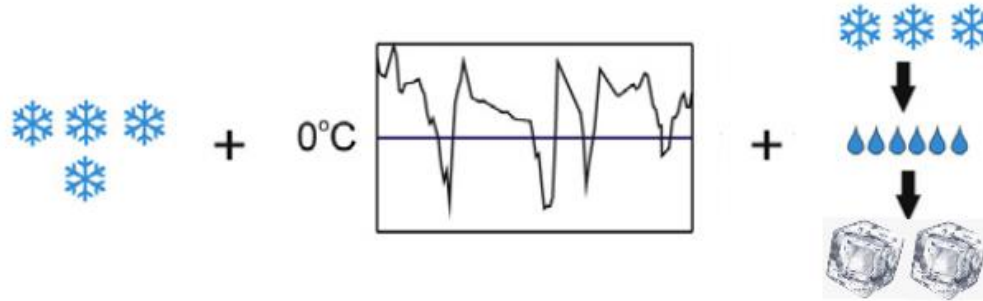Kristina Jaškūnė[1]*, Andrius Aleliūnas[1], Gražina Statkevičiūtė[1], Vilma Kemešytė[2], Bruno Studer[3] and Steven Yates[3]*

LAMMC

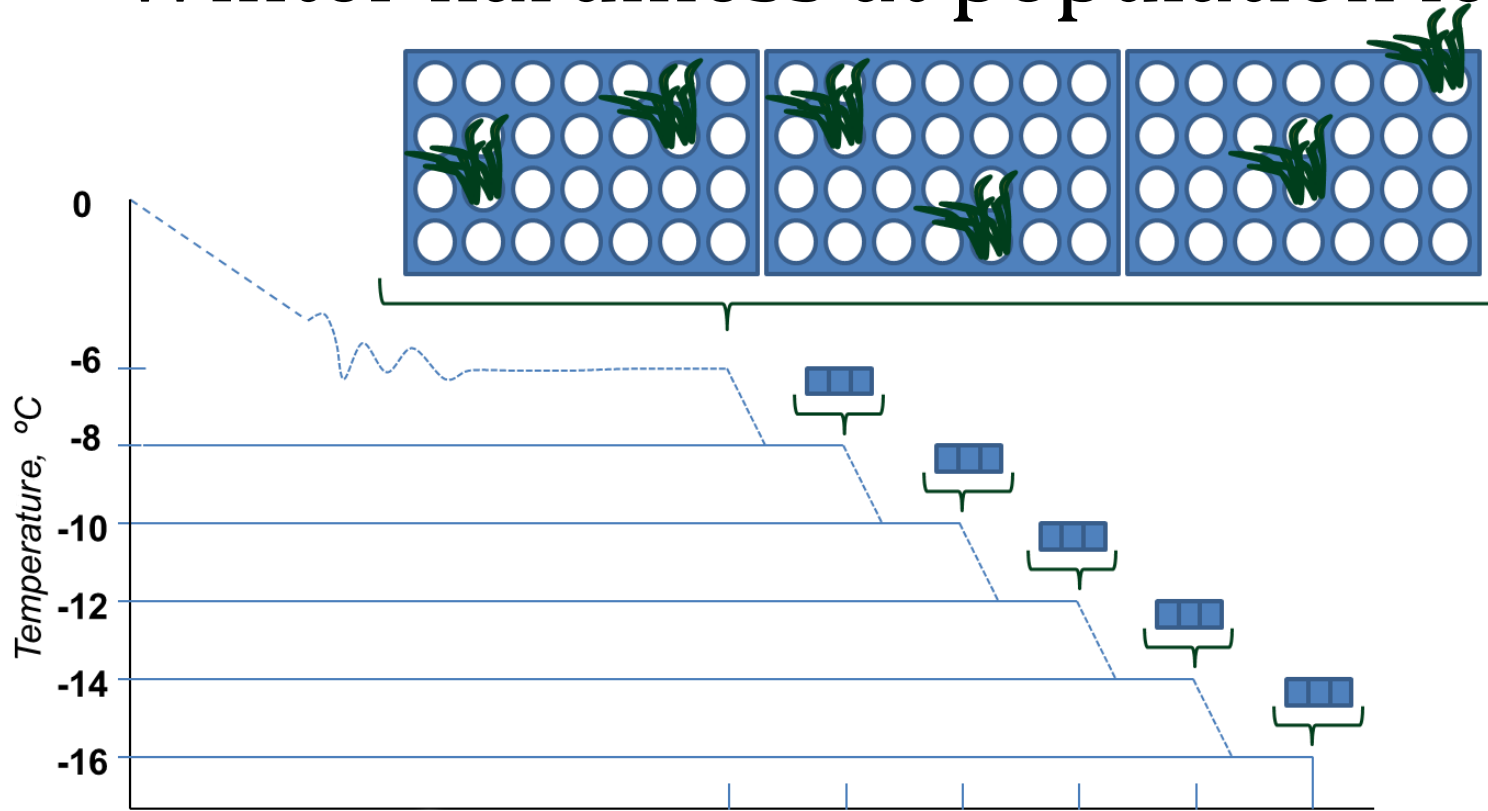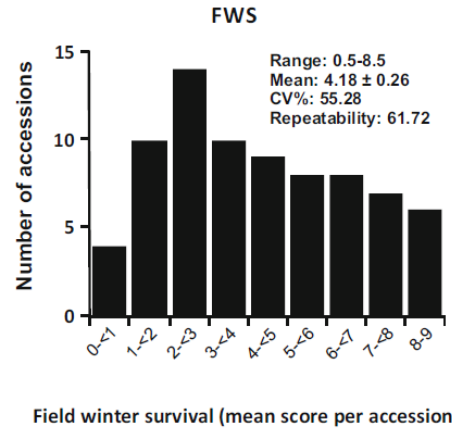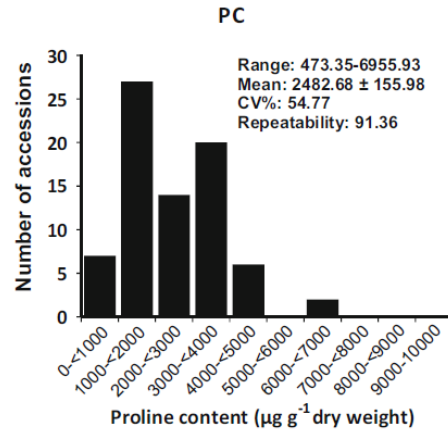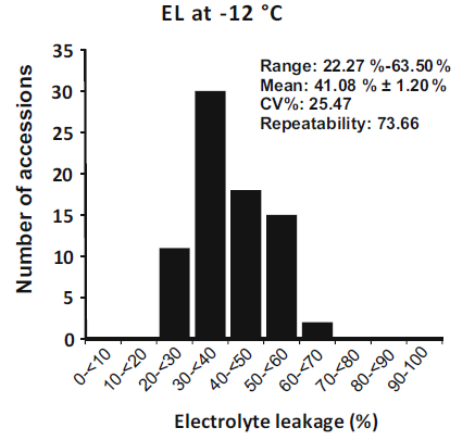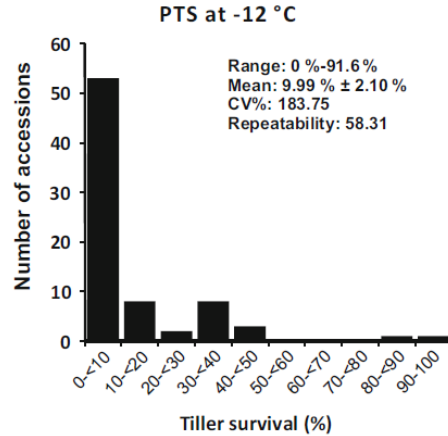# Climate change impact on cold tolerance

LAMMC

Winter hardiness at population level

LAMMC

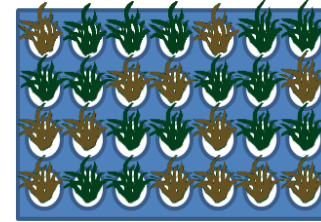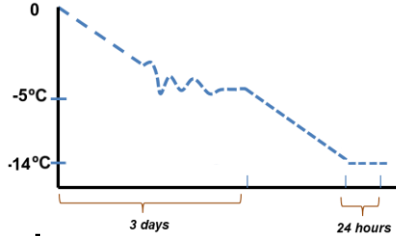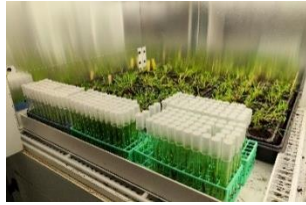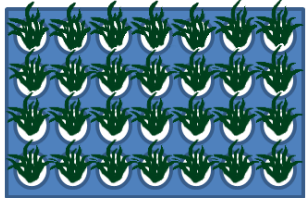# Variation of winter hardiness

Freezing tolerance test

160 genotypes
8 clones per genotype
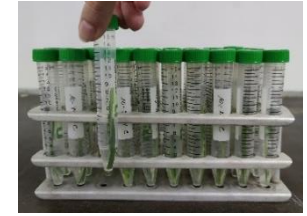
Establishment	Acclimation	Freezing test	Regrowth	Tolerance evaluation
3 weeks +20°C	1 week +5°C 2 weeks +2°C	24 hours -12/-14°C	3 weeks +20°C	Tiller survival Electrolyte leakage

LAMMC

Improving adaptability and resilience of perennial ryegrass for safe and sustainable food systems through CRISPR-Cas9 technology
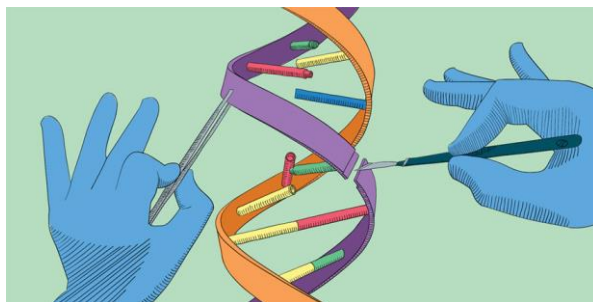
Thanks

- Dr. Kristina Jaškūnė, dr. Andrius Aleliūnas, dr. Vilma Kemešytė
  - Laboratory of Genetics and Physiology, Grass Breeding department, LAMMC

- Prof. Bruno Studer, dr. Steven Yates
  - Plant Molecular Breeding group (ETH Zurich)

Research Council of Lithuania

sciex.ch

Iceland Liechtenstein Norway grants

LAMMC