

Genomics-Driven Development of Drought Tolerant Wheat Cultivars

Neha Vaid
nehavaid21@gmail.com



Marcus Samuel



Agriculture and
Agri-Food Canada

Raju Soolanayakanahally



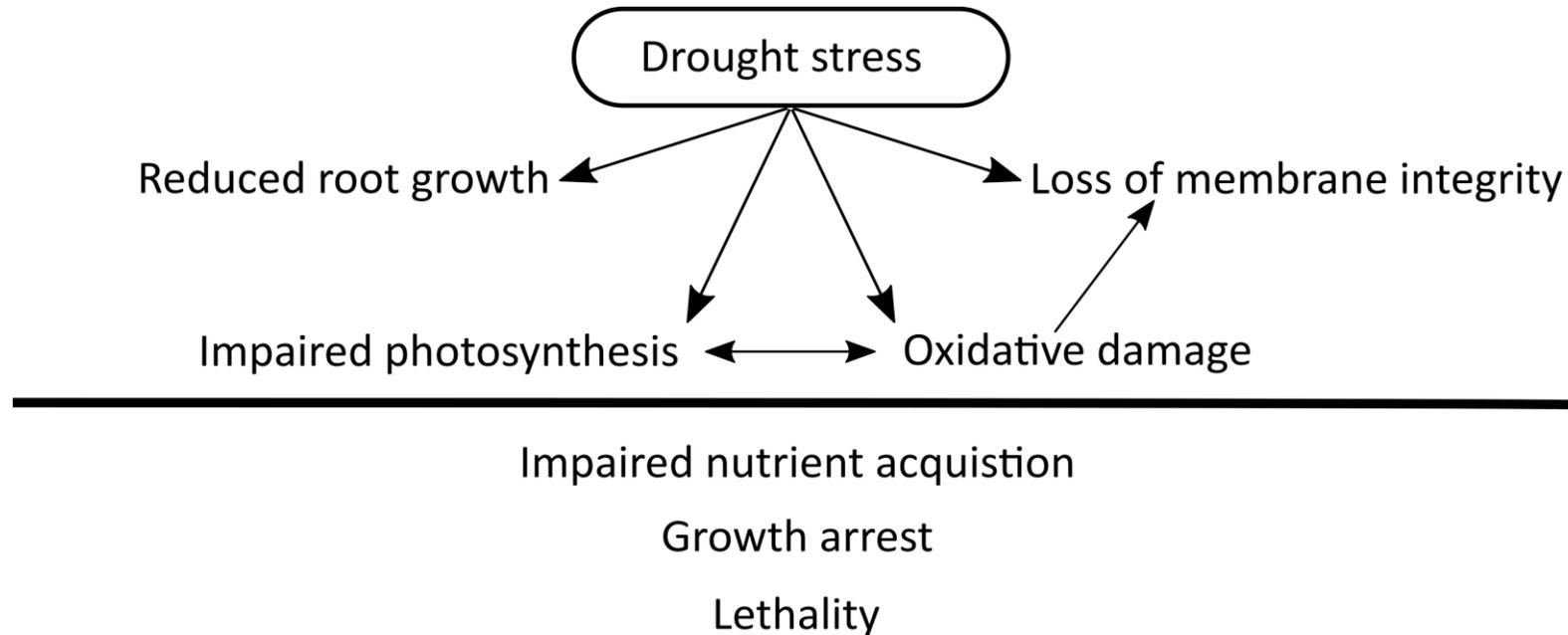
Sateesh Kagale



Julian Northey

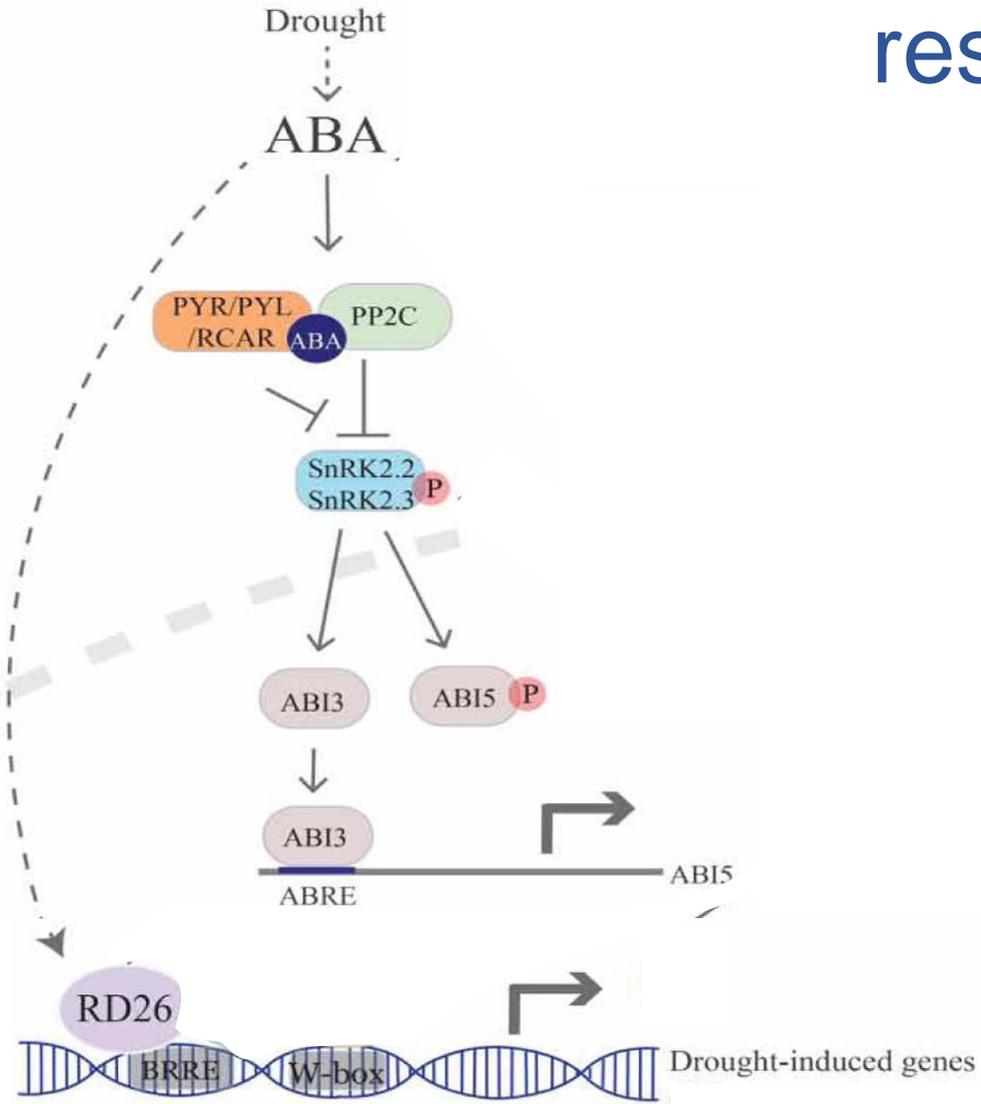
Drought stress is detrimental to agriculture

Drought and temperature stresses are the major environmental factors affecting agriculture



Improving plant stress resistance is critical for agricultural productivity, food security and economic stability

Abscisic acid (ABA) directs the most well-defined drought response signaling



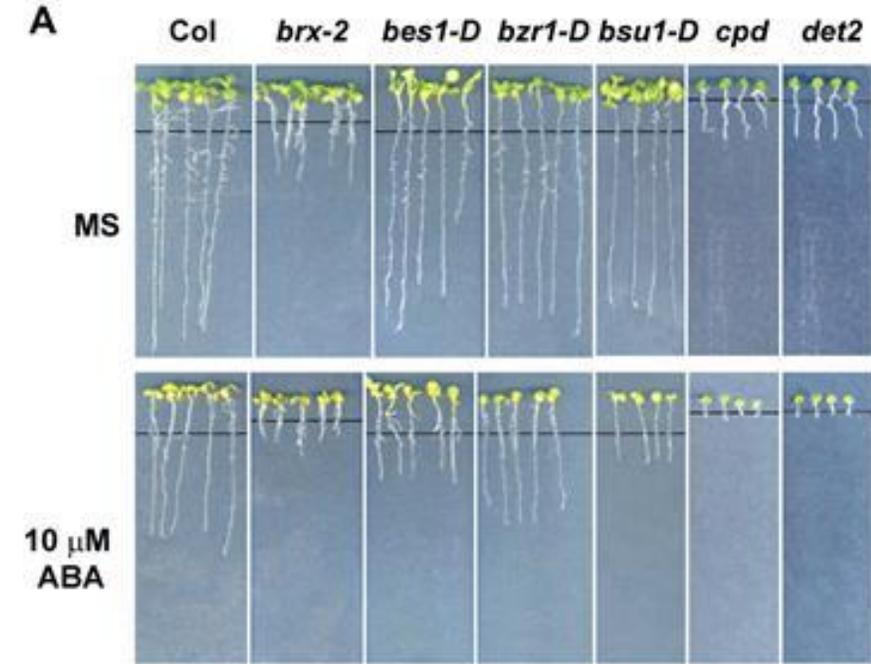
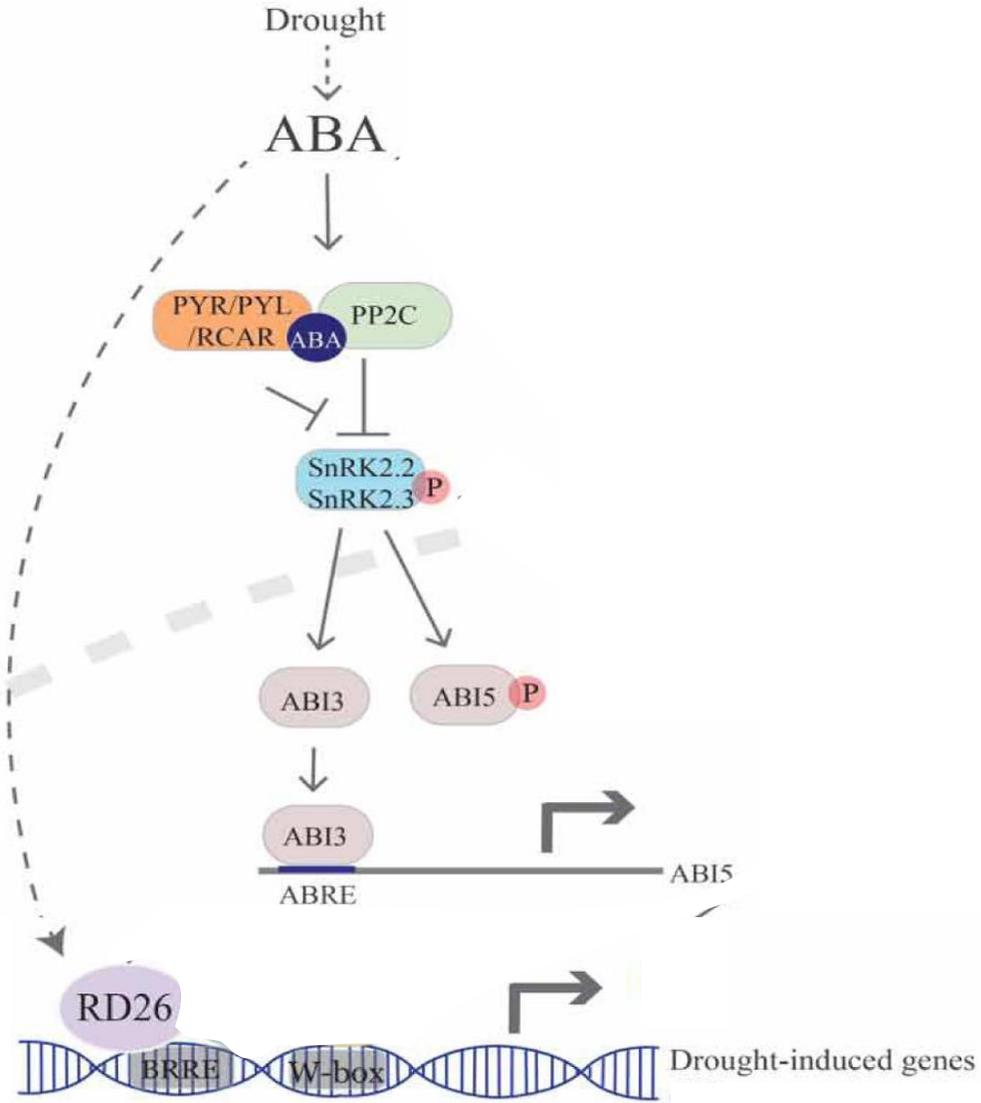
Modulation of plant growth

Inhibition of stomatal opening

Induction of stress-responsive genes

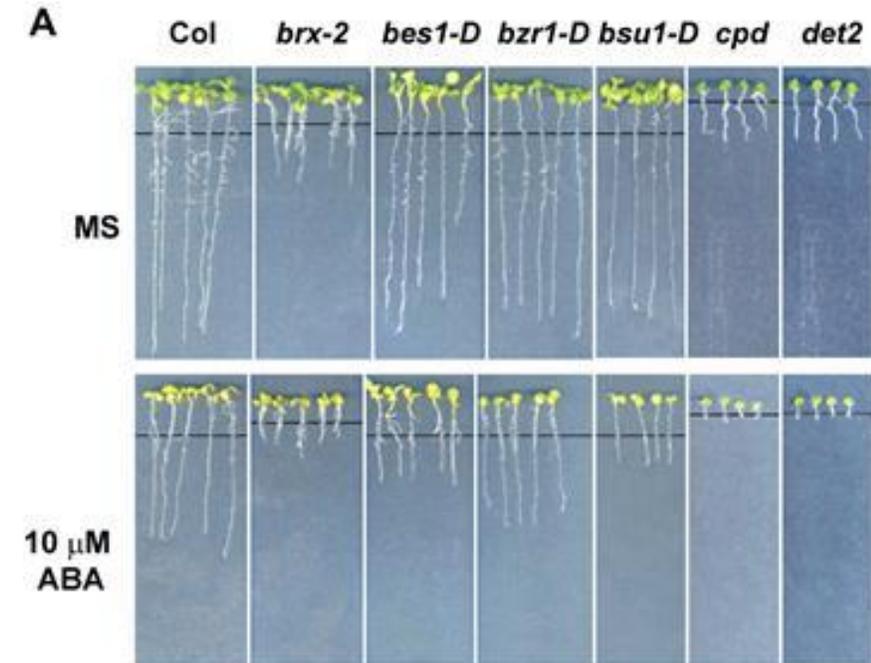
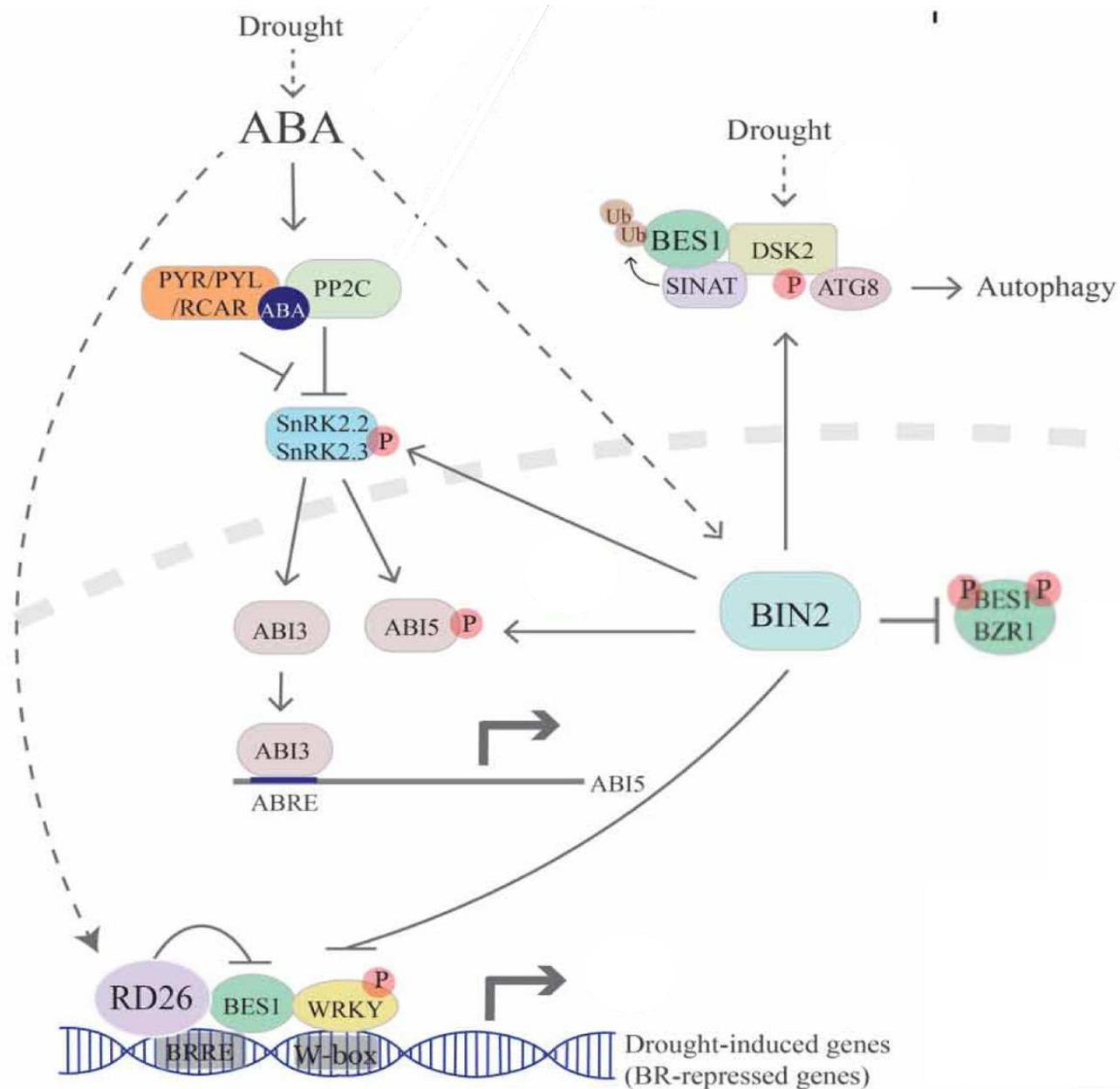
Cross-talk with other hormonal and physiological pathways

ABA and BR pathways interact antagonistically



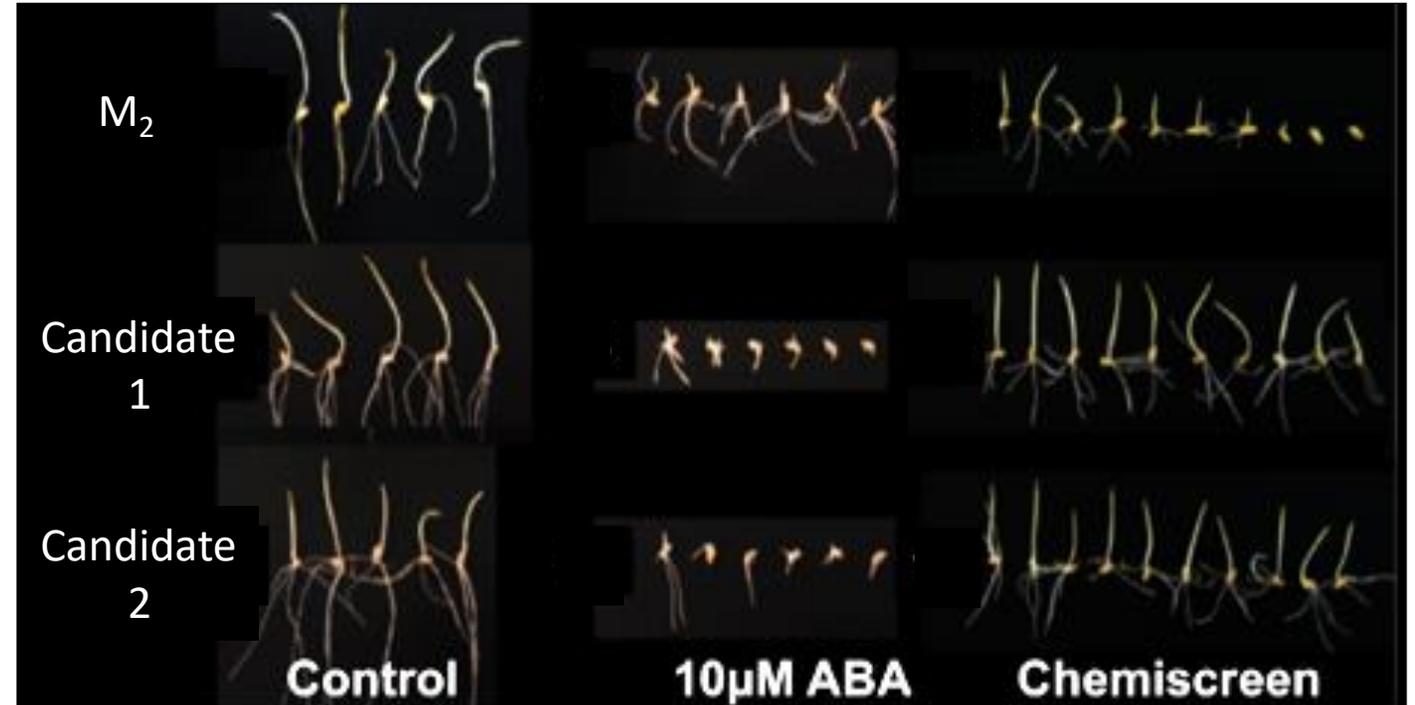
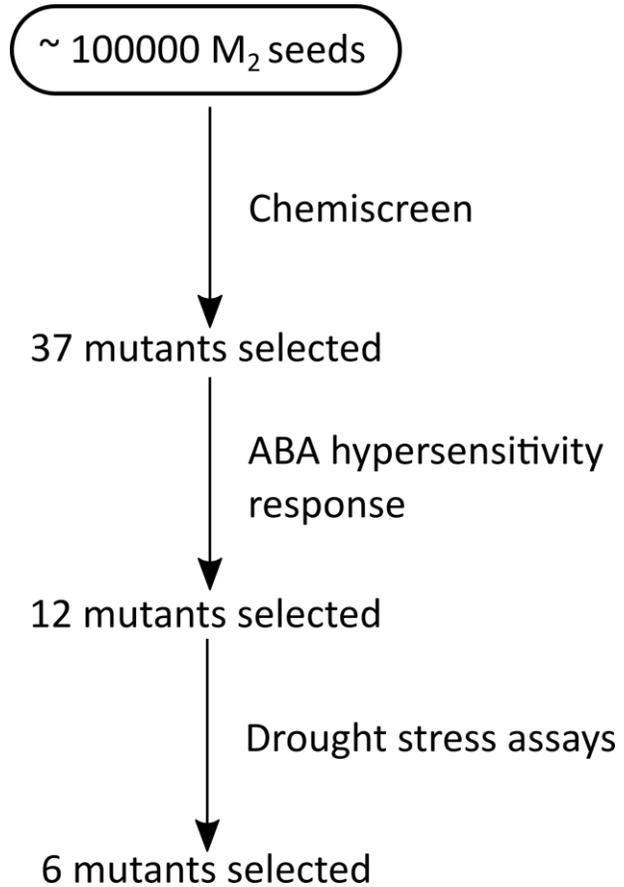
Rodrigues et al., 2009; PMID: 19201913

ABA and BR pathways interact antagonistically



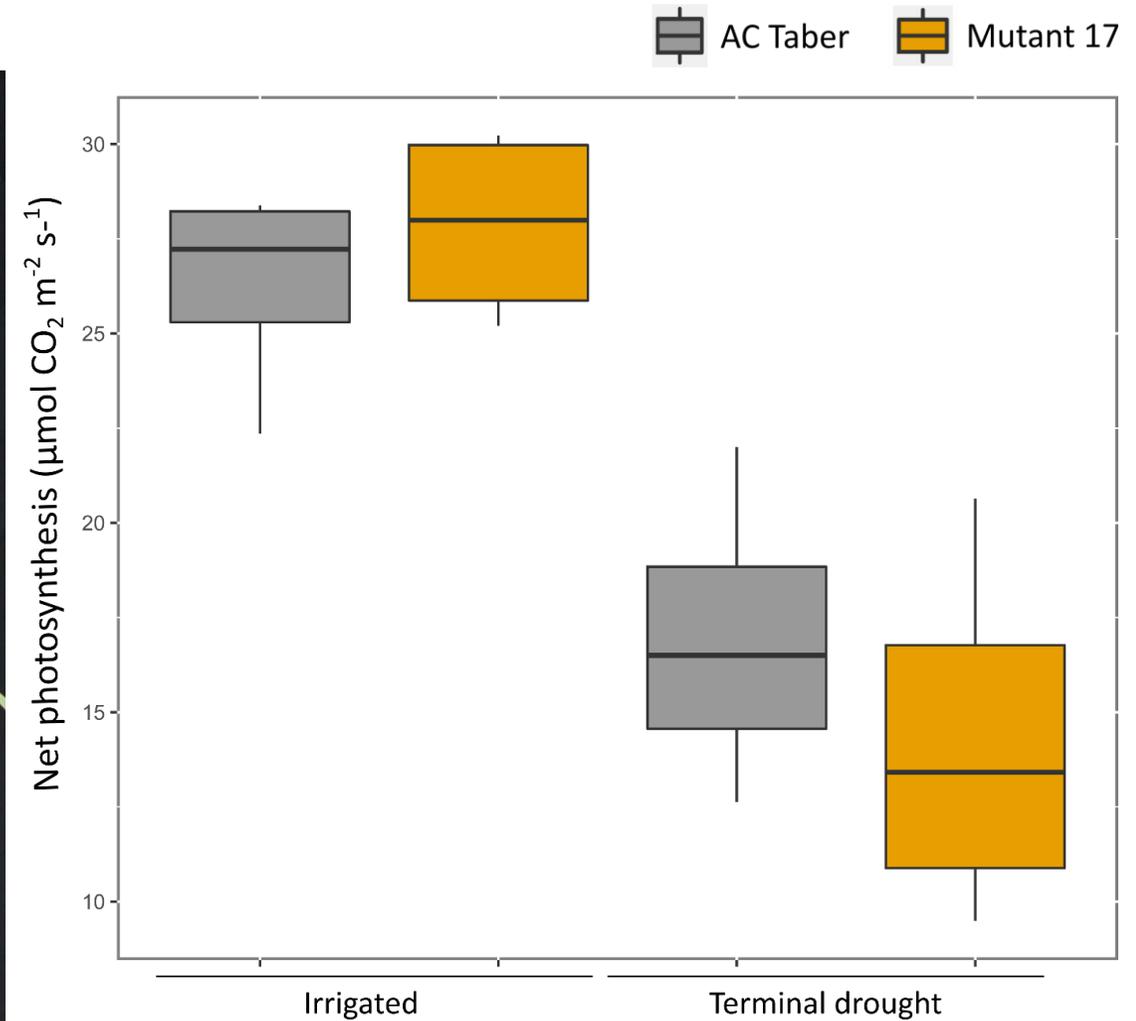
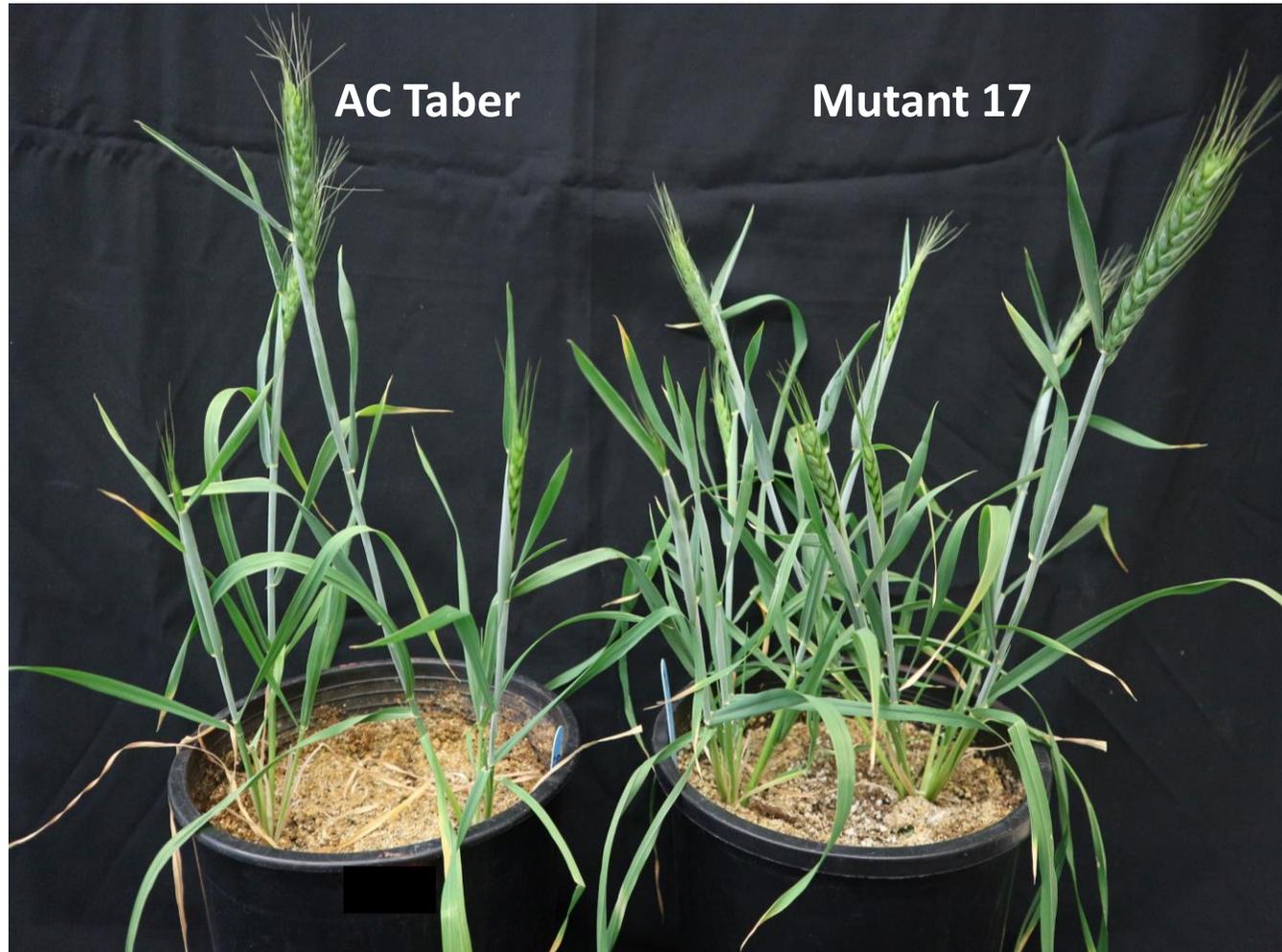
Rodrigues et al., 2009; PMID: 19201913

Mutagenesis screen to identify drought tolerant wheat lines through modulated ABA and BR signalling pathway

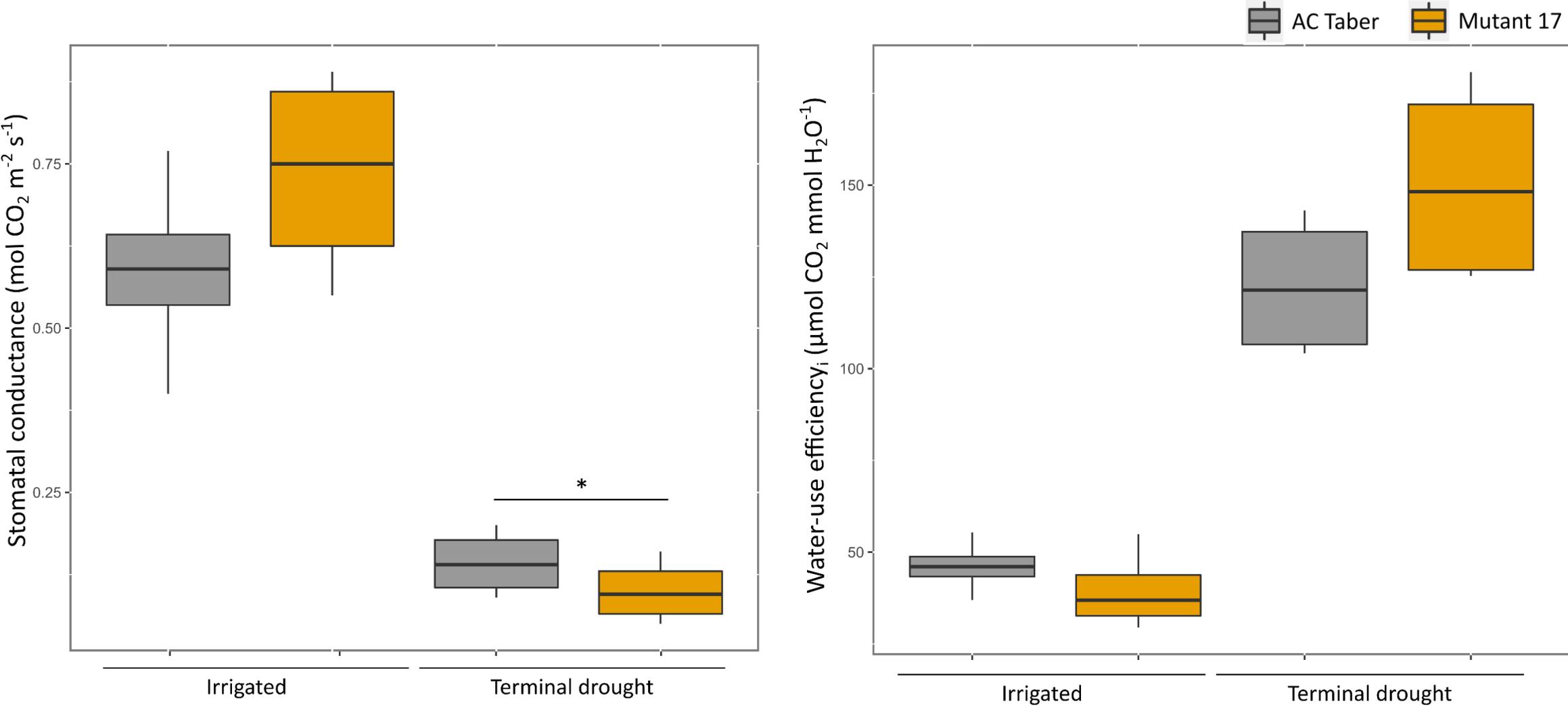


Six candidate lines identified for ABA hypersensitivity, effects on BR- pathway & drought tolerance phenotype

Mutant 17 shows higher biomass than parent under drought stress



Mutant 17 shows stress adaptation features under drought stress

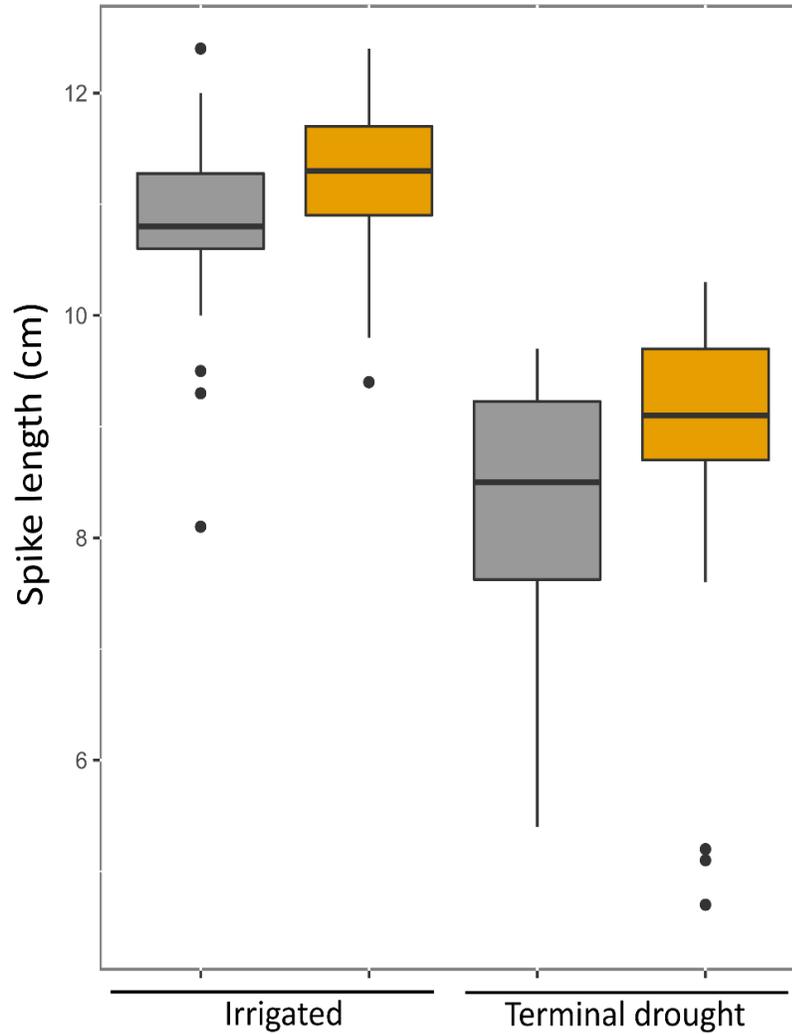


Mutant 17 has comparable spike length as the parent under drought stress

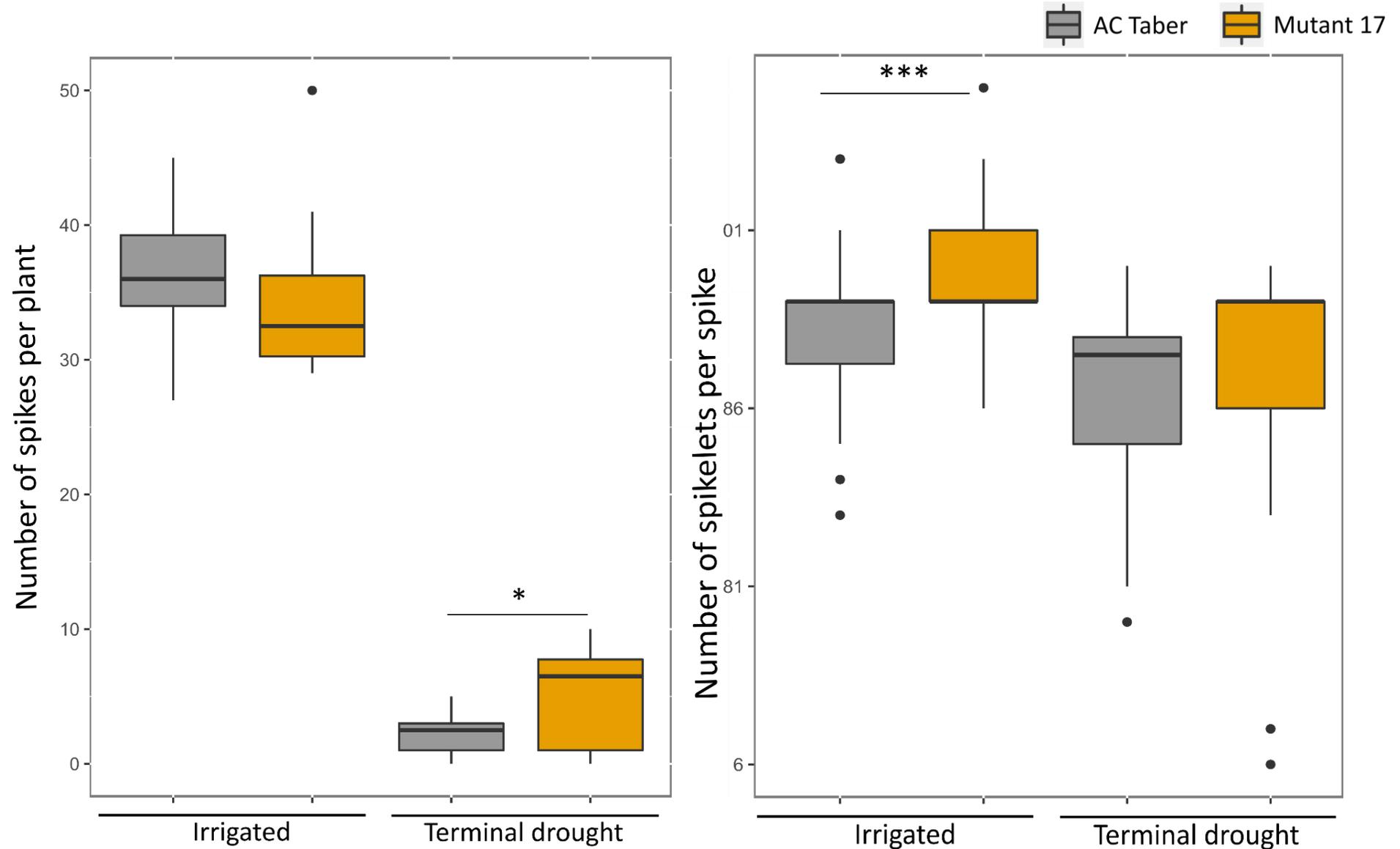
AC Taber Mutant 17



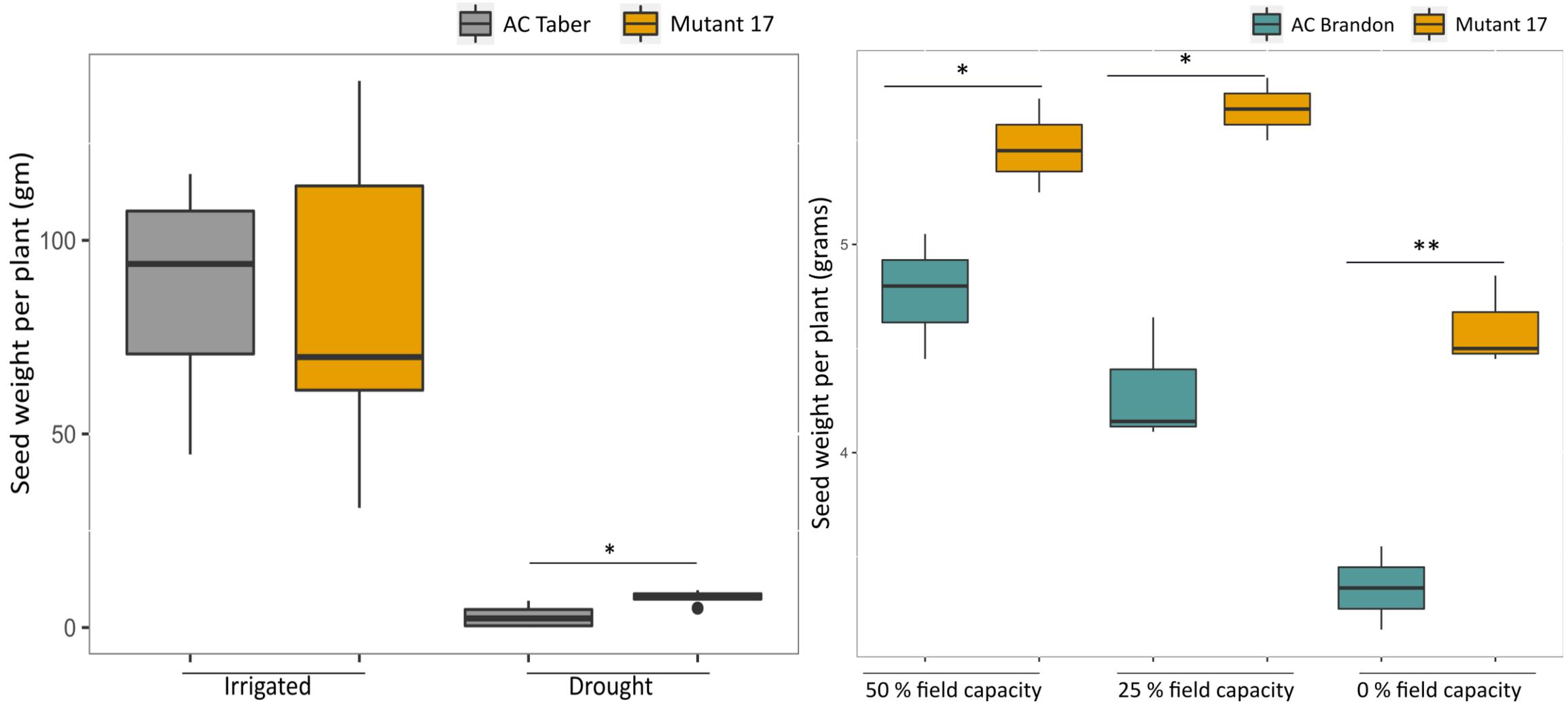
Wheat spike



Mutant 17 has more spikelets than parent under drought stress



Mutant 17 has higher seed weight under drought stress



Mutant 17 has higher seed weight than AC Taber under drought stress in field and greenhouse conditions

Genomic analysis of Mutant 17 using Exome capture



Criteria for shortlisting polymorphisms

Unique to the mutant line

EMS- associated mutations

Mutations in exonic region

SNPeff analysis

~ 700,000 polymorphisms



~15300 polymorphisms



~9000 polymorphisms



3333 polymorphisms



~2000 polymorphisms

IWGSC website

- Functional annotation
- Arabidopsis and rice homolog



40 genes of interest

Top candidates identified for Mutant 17

Gene ID	Ara homolog	function
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TF

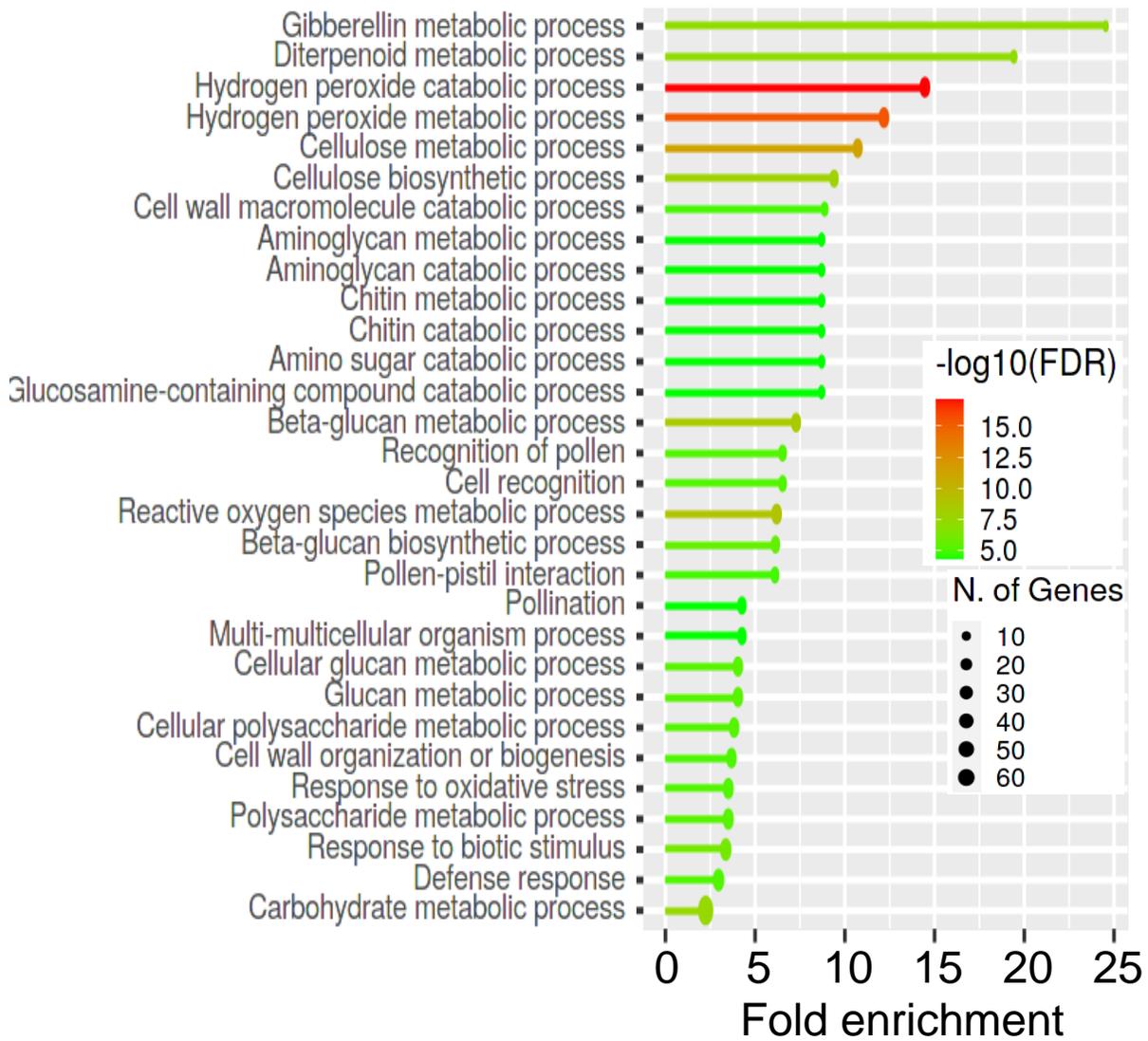
Stress/ABA responsive proteins

BR synthesis/ signalling proteins

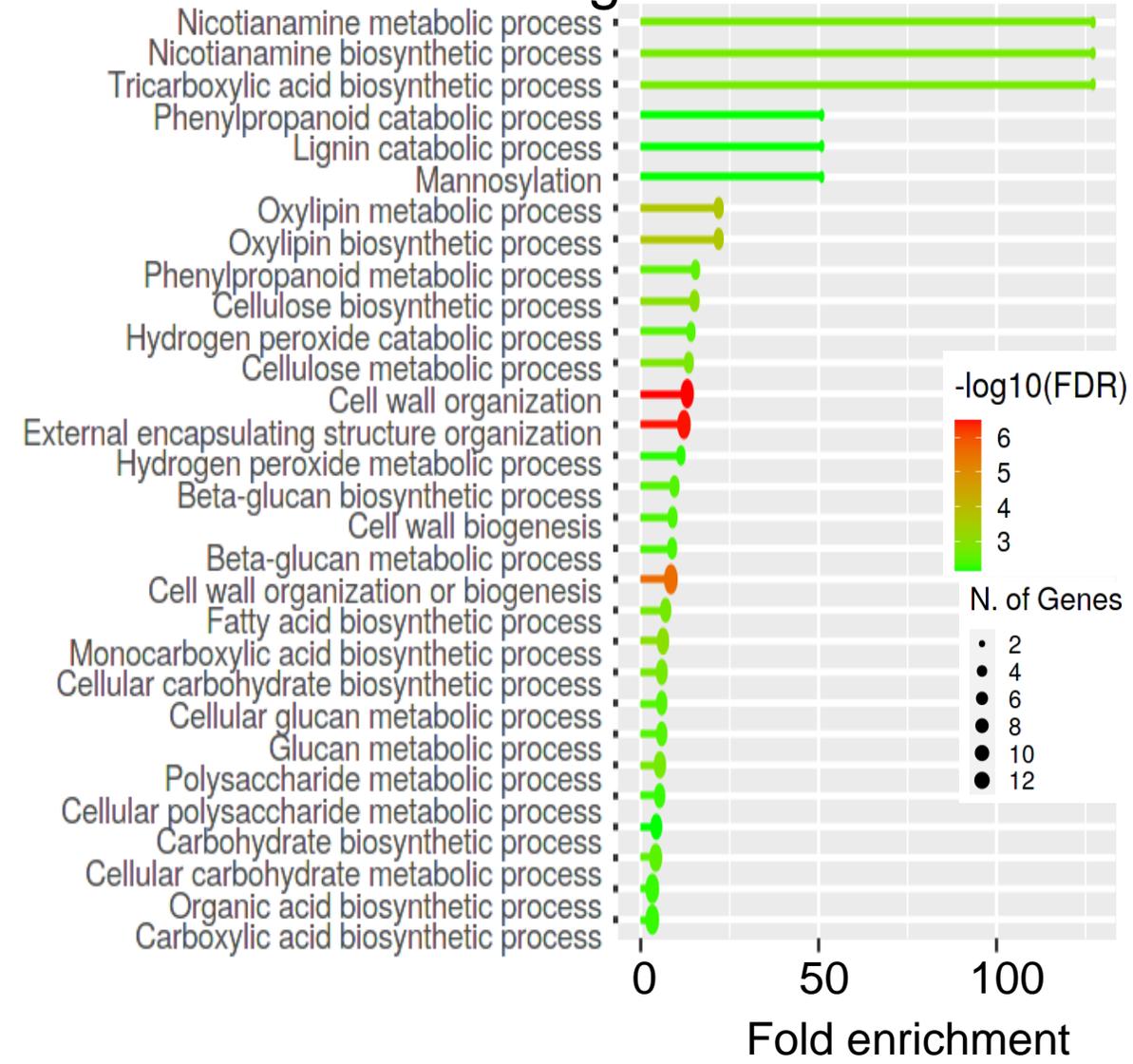
Unpublished data!!!

Carbohydrate, cell wall metabolism and stress-responsive genes are DE in Mutant 17

Irrigated conditions



Drought conditions



Future plans

- Validation of the top candidates/ polymorphisms for their role in drought tolerance
 - Phenotyping Brachypodium/ Arabidopsis T-DNA mutants of identified candidate genes
 - Silencing and overexpression analysis of shortlisted candidates in wheat/ Brachypodium
- Metabolomic analysis and hormonal profiling of the mutants
- Characterization of molecular pathways underlying drought tolerance phenotypes
- Introgression of identified polymorphisms in wheat breeding lines and their field assessment

Acknowledgements



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Agriculture and
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Shankar Pahari (Saskatoon)
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Sateesh Kagale

Industry partner

Julian Northey



Funding Agencies



THANK YOU

Experimental set-up for analysis of mutants

8 plants/ genotype/ condition

