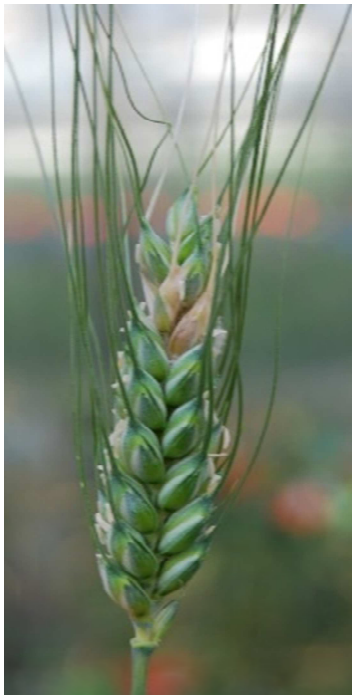
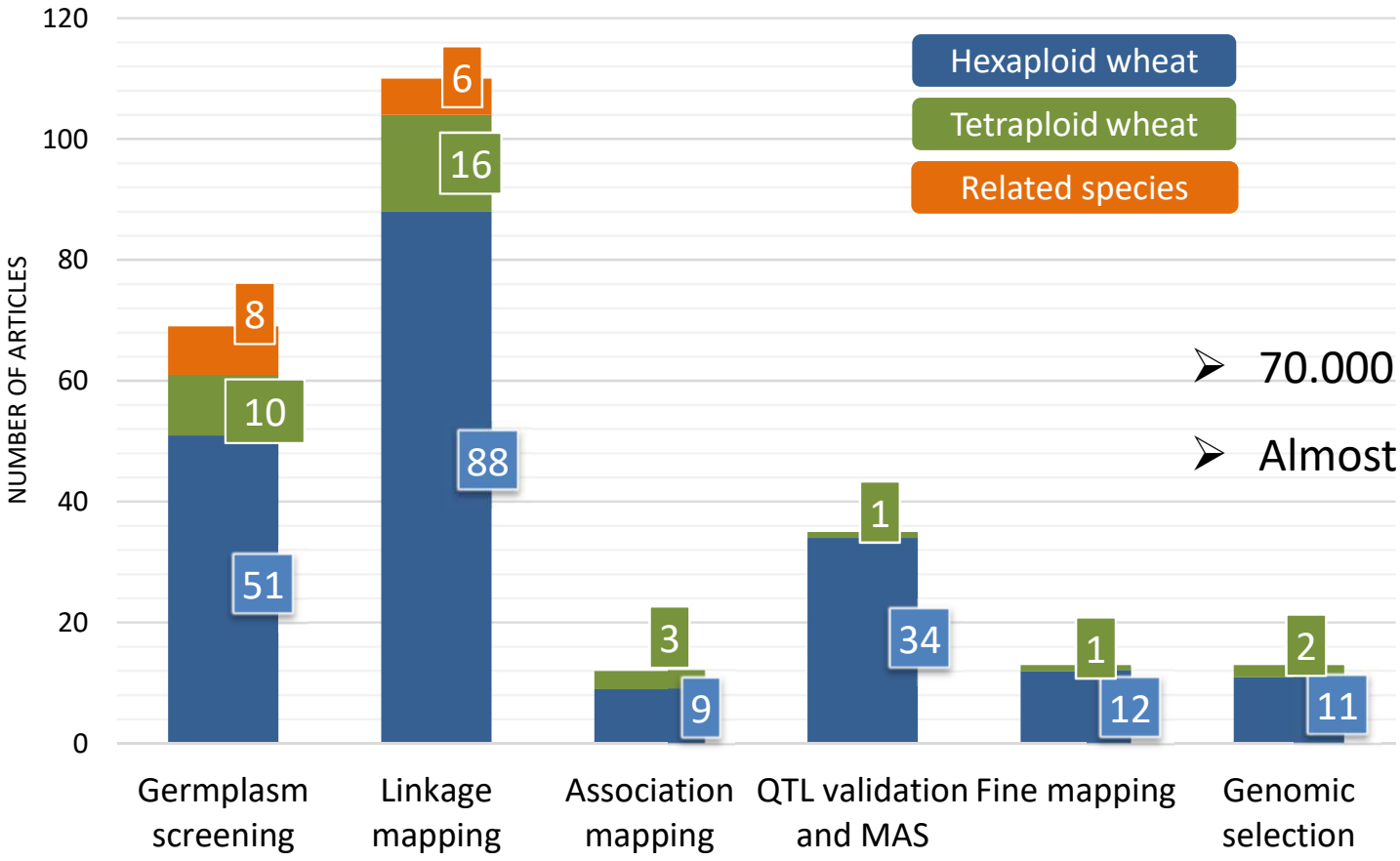


Update on research activities for Fusarium resistance in durum wheat

Barbara Steiner, Kirana Rizky Pasthika, Sebastian Michel, Marco Maccaferri, Roberto Tuberosa, Maria Buerstmayr, Marc Lemmens, Hermann Buerstmayr

BOKU-University of Natural Resources and Life Sciences Vienna, Department IFA-Tulln, Institute of Biotechnology in Plant Production, Konrad Lorenz Str. 20, A-3430 Tulln, Austria

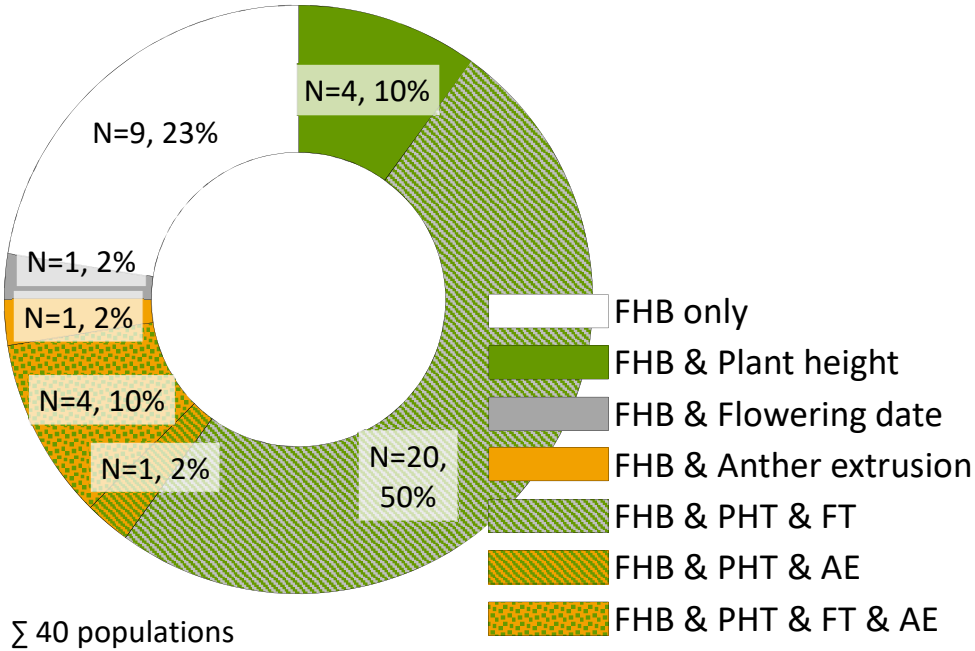
‘FHB resistance breeding articles’ published up to 2019

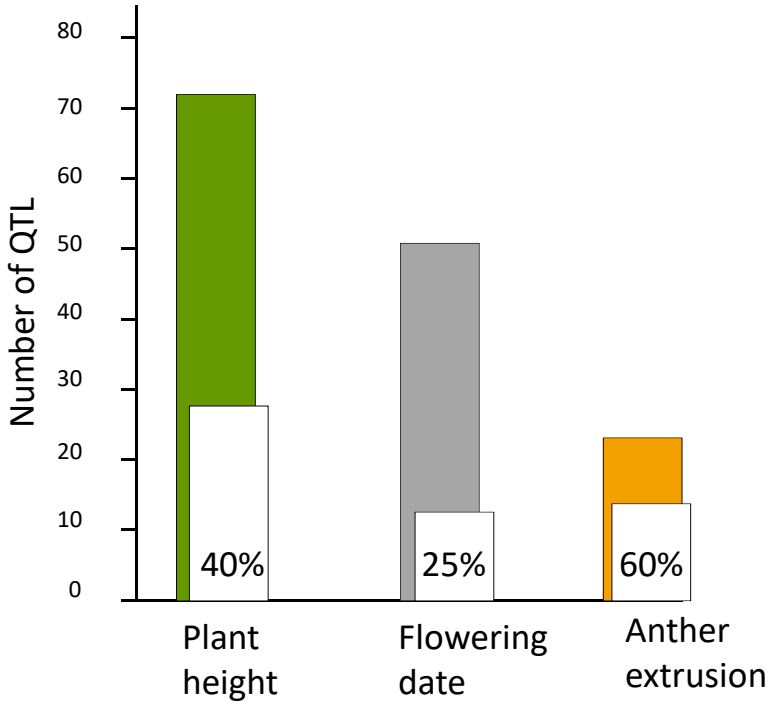


- 70.000 accessions screened
- Almost no resistance in durum wheat

Buerstmayr M, Steiner B, Buerstmayr H 2020 *Plant Breed* 139:429

FHB resistance and plant height, flowering date, anther extrusion





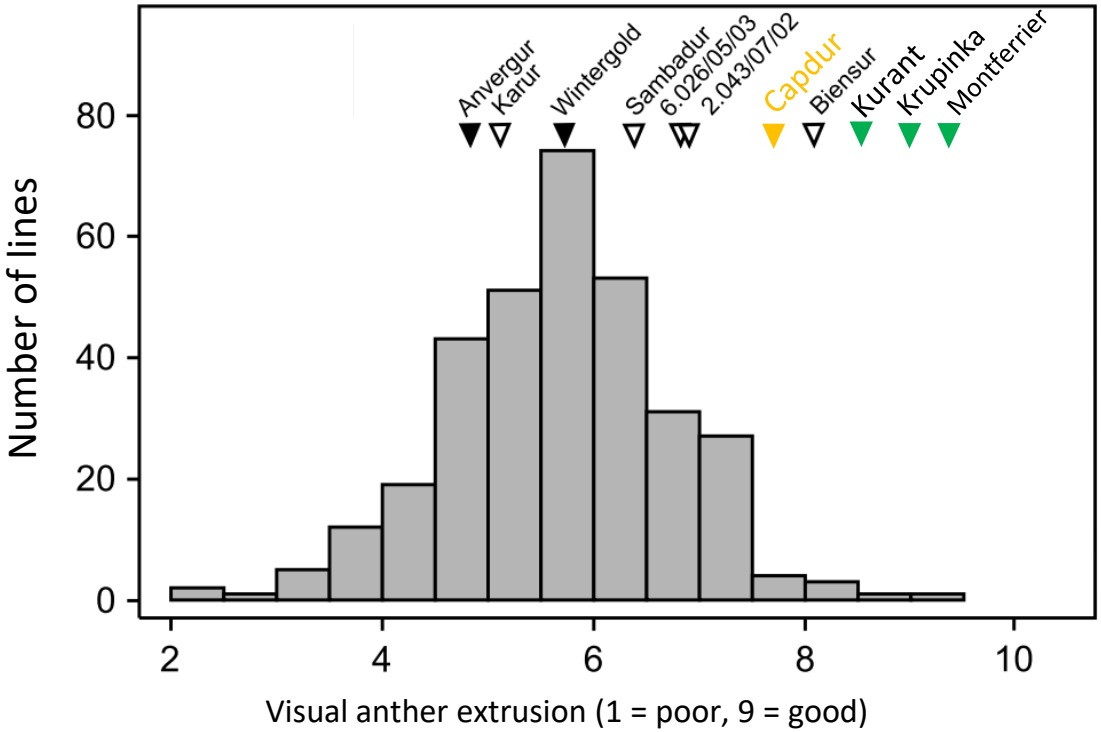
- 60% of the QTL for anther extrusion overlap with QTL for FHB resistance
- Role of anther extrusion in FHB resistance of durum wheat is unknown

Buerstmayr M, Steiner B, Buerstmayr H 2020 *Plant Breed* 139:429

Variation for anther extrusion in durum wheat

Akel W, Rapp M, Thorwarth P, Wurschum T, Longin CFH, 2019 TAG 132:921
Hybrid durum wheat: heterosis of grain yield and quality traits and genetic architecture of anther extrusion

- 315 elite durum cultivars evaluated
- quantitative inheritance



Improving FHB resistance in durum wheat

1) Investigate the role of anther extrusion in FHB resistance
2) Enhance the FHB resistance level by introgressing resistance alleles from *T. aestivum, T. dicoccoides, T. dicoccum*
3) Investigate the genetic architecture of FHB resistance in the elite durum wheat gene pool

Plant Material

Characterize elite durum		Deployment of *Fhb1*	Pyramide *Fhb1* with other resistance QTL	Combine high anther extrusion, *Fhb1*, *Rht-B1b*
world-wide collection of elite durum cultivars	Durum cultivars	Karur, Durobonus, SZD1029K, Floradur		Capdur (high anther extrusion)
	Resistance donors	DBC480 *Fhb1* (Sumai3) BC_5 in Semperdur *Rht-B1a*	DBC480 Mt.Hermon22 (*T. dicoccoides*) Mt.Gerizim36 (*T. dicoccoides*) BC_1 lines in Helidur Td161 (*T. dicoccum*) BC_1 lines in Helidur and Floradur	P17.29 P17.54 Both carry *Fhb1*, *Rht-B1b*
228 cultivars	Number of lines/populati	311 RILs 3 bi-parental	450 RILs 10 four-parental	220 RILs 2 bi-parental

Phenotyping for FHB resistance

FHB nursery with mist-irrigation system, spray-inoculation at anthesis
Visual disease assessment 4 time-points post anthesis -> AUDPC

Additional traits: plant height, anthesis date
anther retention (Capdur crosses)
% florets with at least one anther retained
~7 days post anthesis (20 florets/plot)

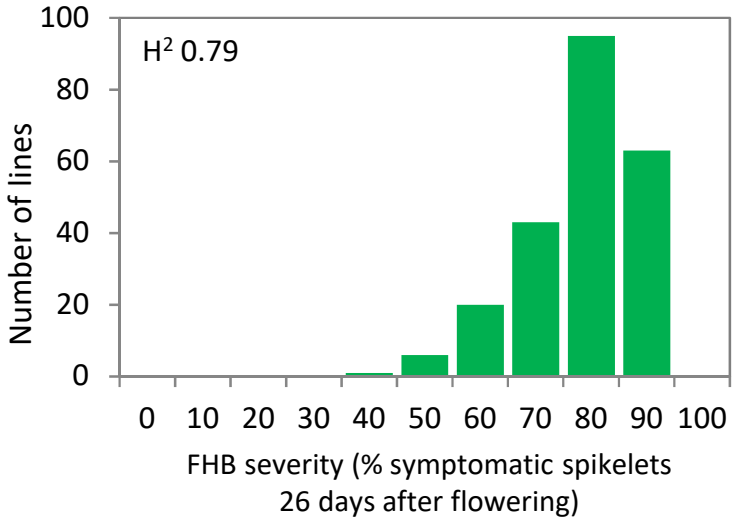
Evaluations over 3 years -> durum cultivars, 2-way crosses
5 years -> 4-way crosses
1 year -> Capdur crosses

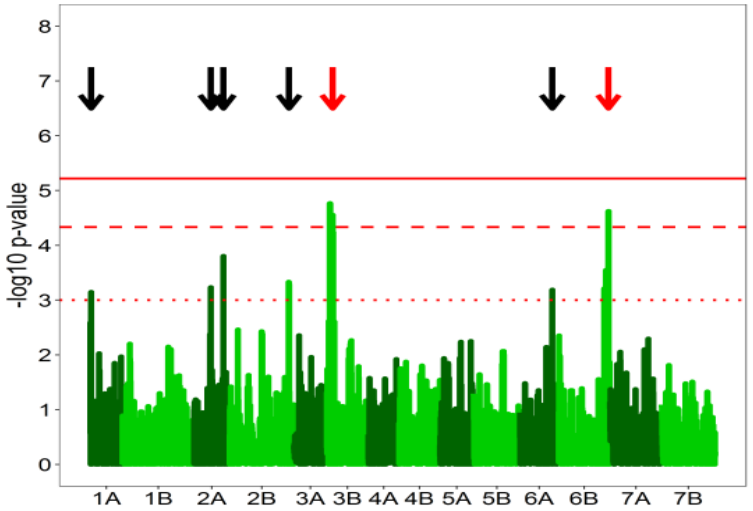
Genotyping

Elite spring durum cultivars: 90K SNP assay (Univ. Bologna) ~ 8K polymorphic markers

Experimental lines: GBS with the DArTseq platform ~5K polymorphic per population

Characterize elite durum wheat - phenotypic variation and mapping FHB resistance





Associations of FHB resistance with

Flowering date r=0.09^{ns}

Plant height r=-0.29**

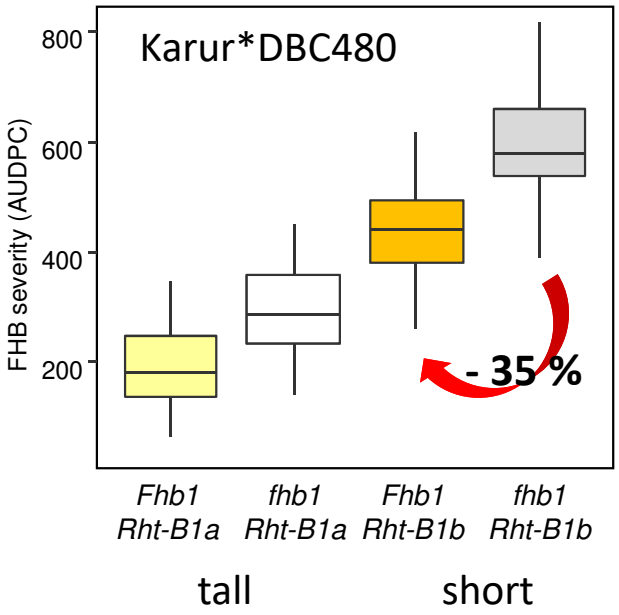
- Seven minor QTL for FHB resistance
- Co-localization with plant height QTL
- Independent resistance QTL on chr 3B in *Fhb1* interval

Steiner B, Michel S, Maccaferri M, Lemmens M, Tuberosa R, Buerstmayr H 2019 TAG 132:969

Deployment of *Fhb1* in durum wheat

Noemie Prat

	DBC480 *Karur		DBC480 *Durobonus		DBC480 *SZD1029K	
Chr.	%PV	LOD	%PV	LOD	%PV	LOD
Rht-B1	64.2	35.0	38.4	18.6	19.4	10.7
Fhb1	11.1	10.8	14.0	8.7	5.0	3.3
2BL	4.3	4.8				
4AL					18.8	10.4
5AL			6.2	4.3		
6AS					24.9	12.9



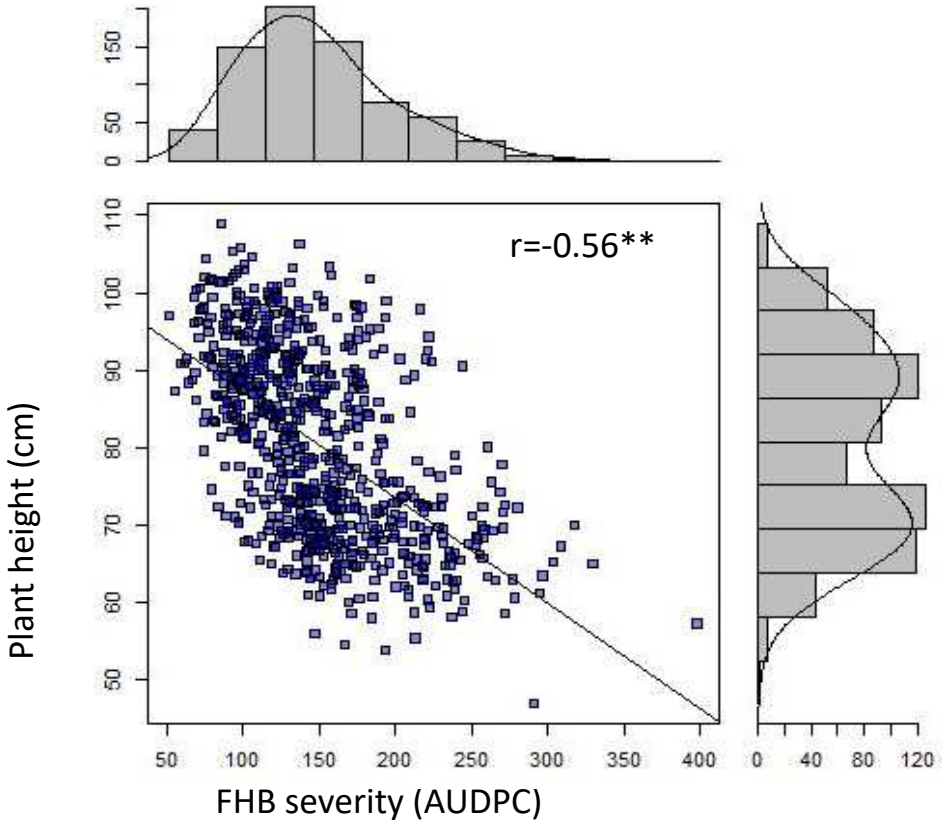
Despite strong plant height effect ->
short lines carrying *Fhb1* show enhanced resistance

-> *Fhb1* also effective in durum wheat

Prat N, Guilbert C, Prah U, Wachter E, Steiner B, Langin T, Robert O, Buerstmayr H 2017 TAG 130:13–27

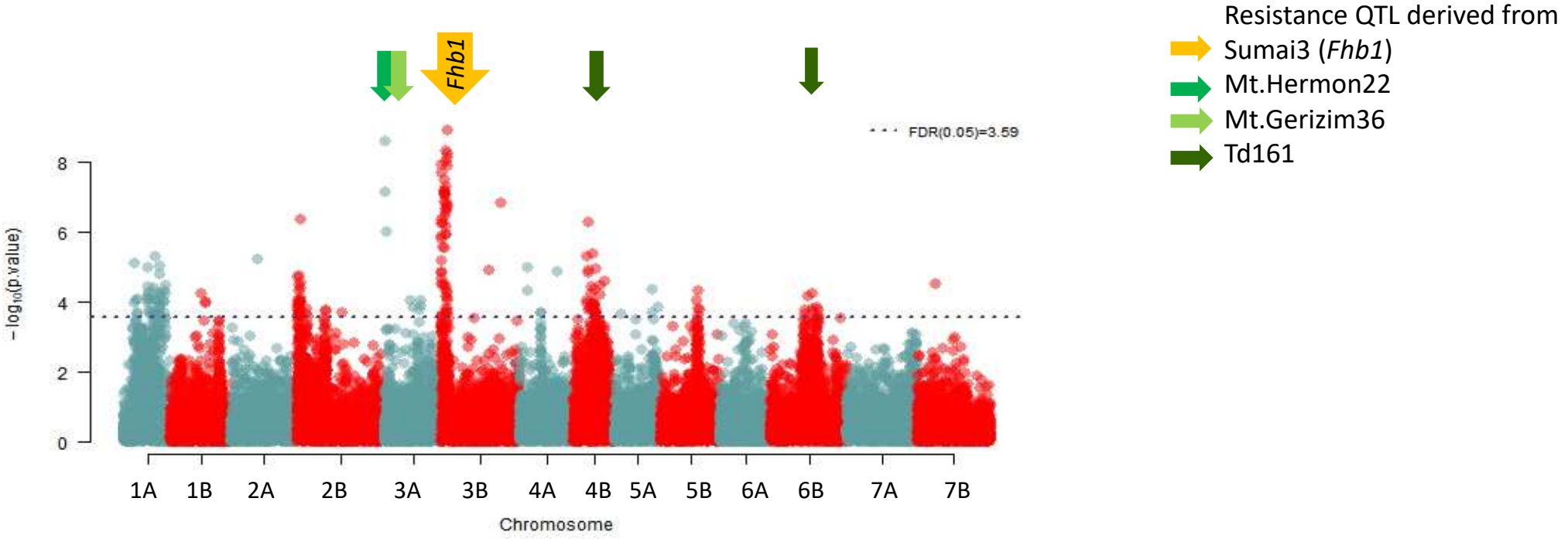
Pyramidisation of *Fhb1* with resistance QTL derived from *T. dicoccoides* and *T. dicoccum* – phenotypic variation

Kirana Rizky Pasthika



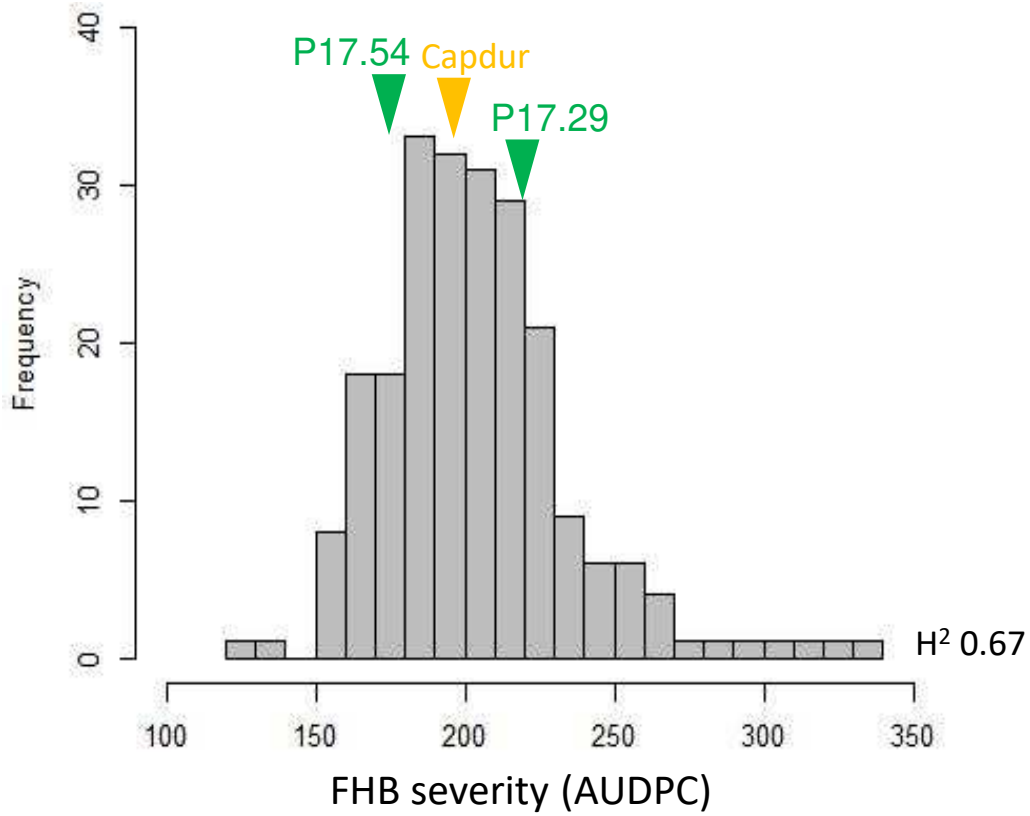
- High heritability for all traits (0.81 – 0.94)
- correlations between: FHB resistance – plant height/flowering date

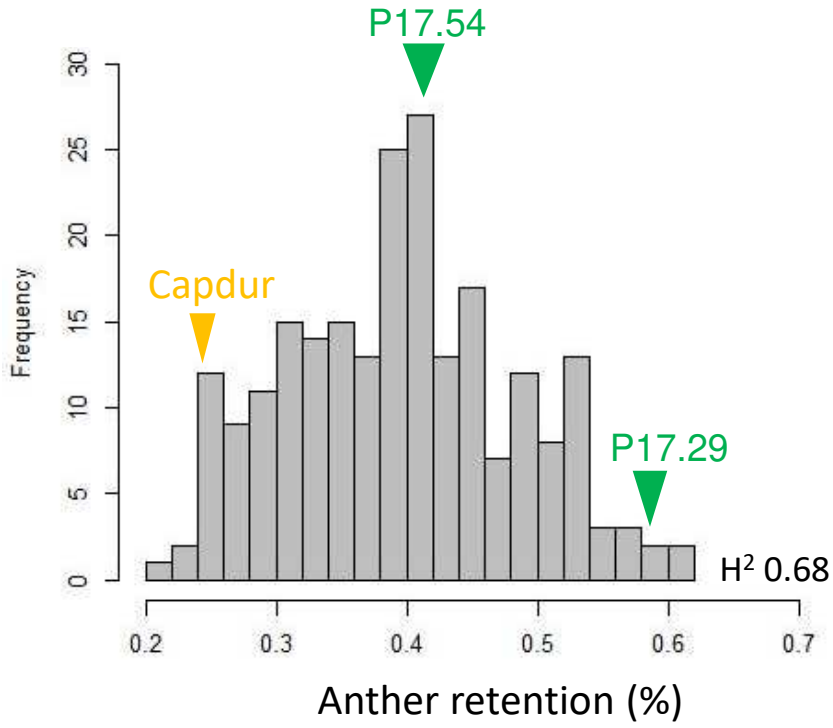
Pyramidisation of *Fhb1* with resistance QTL derived from *T. dicoccoides* and *T. dicoccum* – mapping FHB resistance



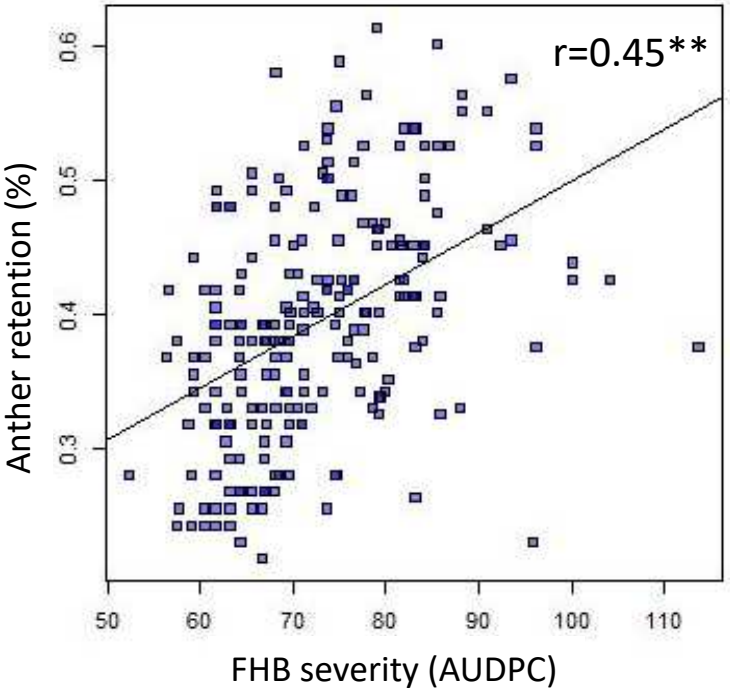
-> *Fhb1* effective in diverse durum backgrounds and combination with other resistance QTL

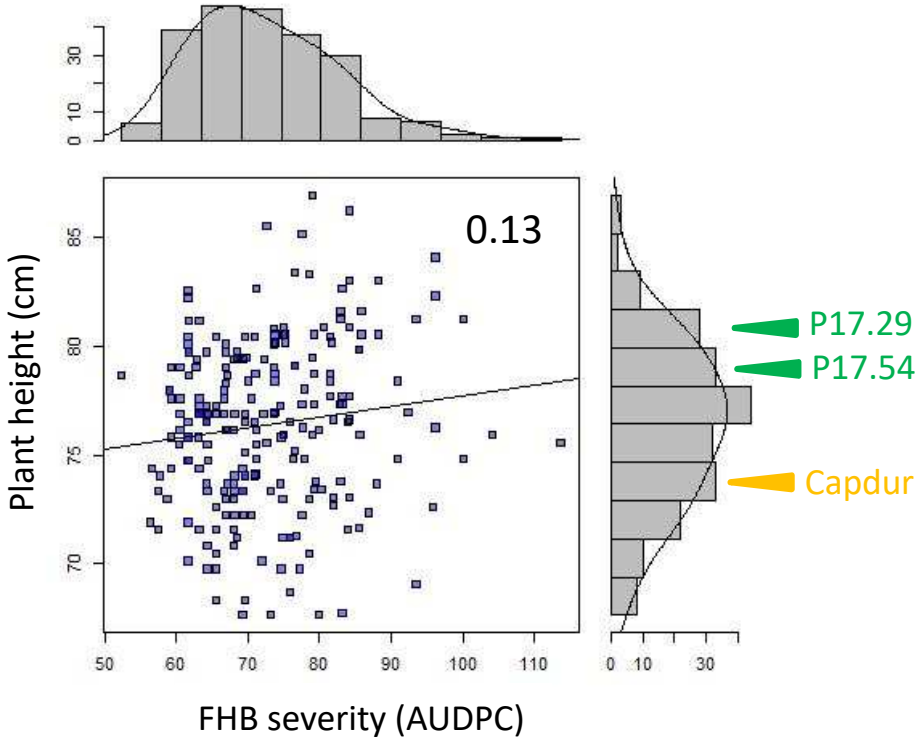
Combine high anther extrusion, *Fhb1* and *Rht-B1b* – 'Capdur crosses'





Combine high anther extrusion, *Fhb1* and *Rht-B1b* – 'Capdur crosses'





Also in durum wheat -> high anther extrusion can be used as indicator trait for resistance to initial infection

FHB resistance breeding in durum wheat: summary and conclusions

- Exotic germplasm can enhance resistance levels
- Anther extrusion is associated with FHB resistance -> low-cost indirect selection
- Combine higher anther extrusion with resistance against fungal spread (e.g. *Fhb1, Fhb7*)
- Integrate trait associations in breeding decisions and GS approaches
  -> Poster 51 Jose Moreno-Amores: Phenological and Environmental Influences on the Genomic Prediction of FHB Resistance
- Lines with favorable allele combinations implemented in breeding programs

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