Investigating root system architectural traits in durum wheat to improve adaptation to drought and crown rot conditions

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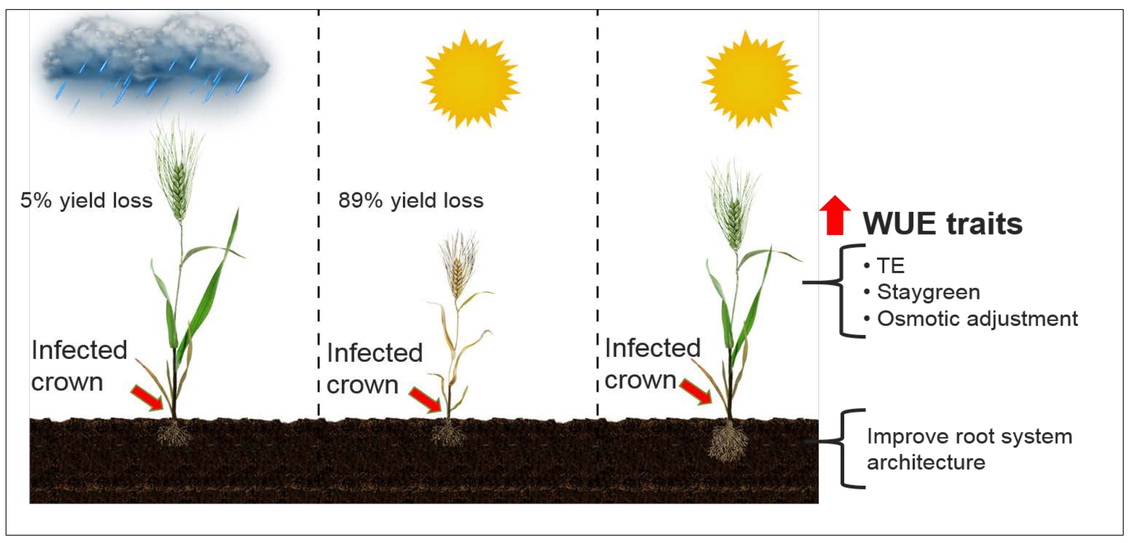
Challenges for durum production

Yield losses due to crown rot (*Fusarium* spp) are exacerbated by drought conditions.
Can traits such as increased transpiration efficiency, staygreen and osmotic adjustment and adapted roots help reduce this?

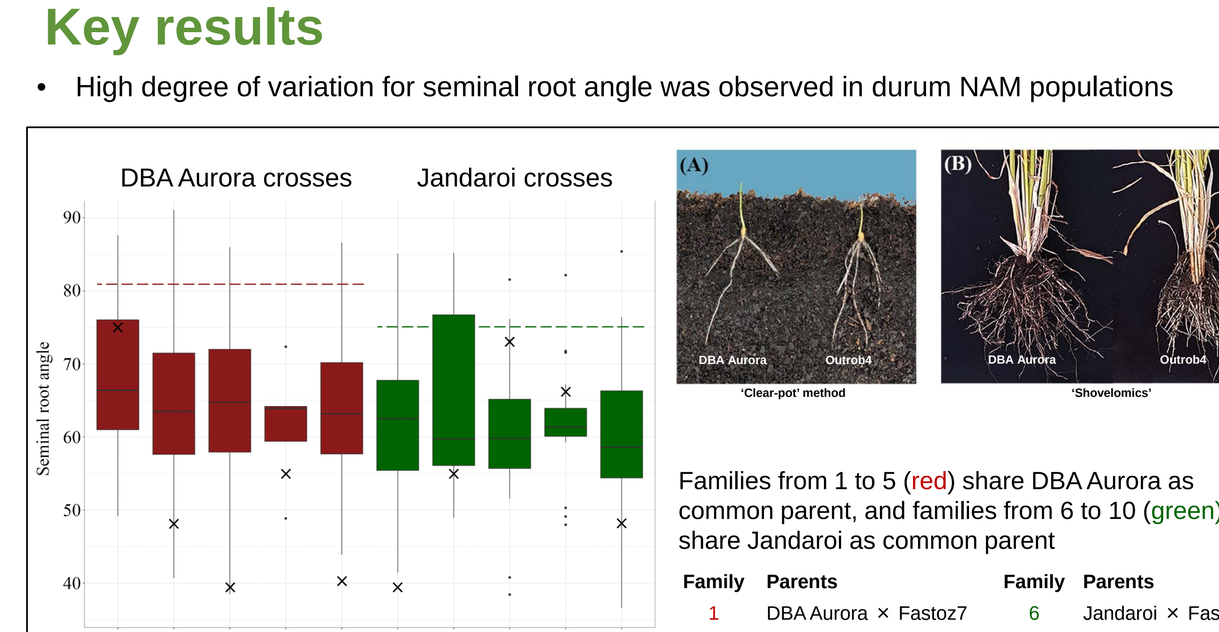


Objective of the study

To investigate root system architecture in durum wheat to improve drought adaptation and minimise yield losses due to crown rot infection

Methods

- Durum multi-parent NAM population development (10 Families)
- Root phenotyping using the 'clear-pot' method and 'shovelomics'
- Crown rot evaluation in the field under drought condition



Data collection & analysis

- Root angle was imaged and measured
- NDVI were recorded weekly to enable modelling of senescence pattern and calculation of stay-green traits in the field
- Genome-wide association studies were performed using 2,541 high-quality polymorphic DArTseq markers and analysed using GenABEL in R

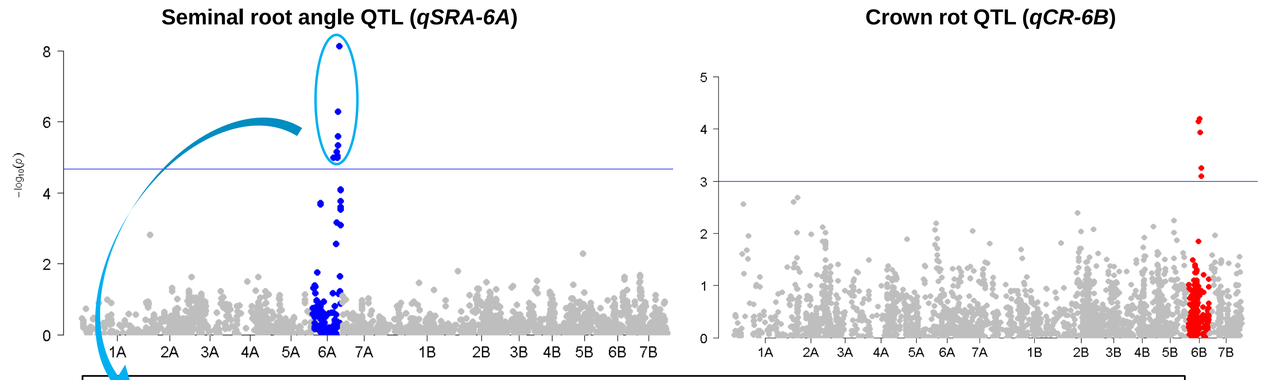
Key results

- High degree of variation for seminal root angle was observed in durum NAM populations

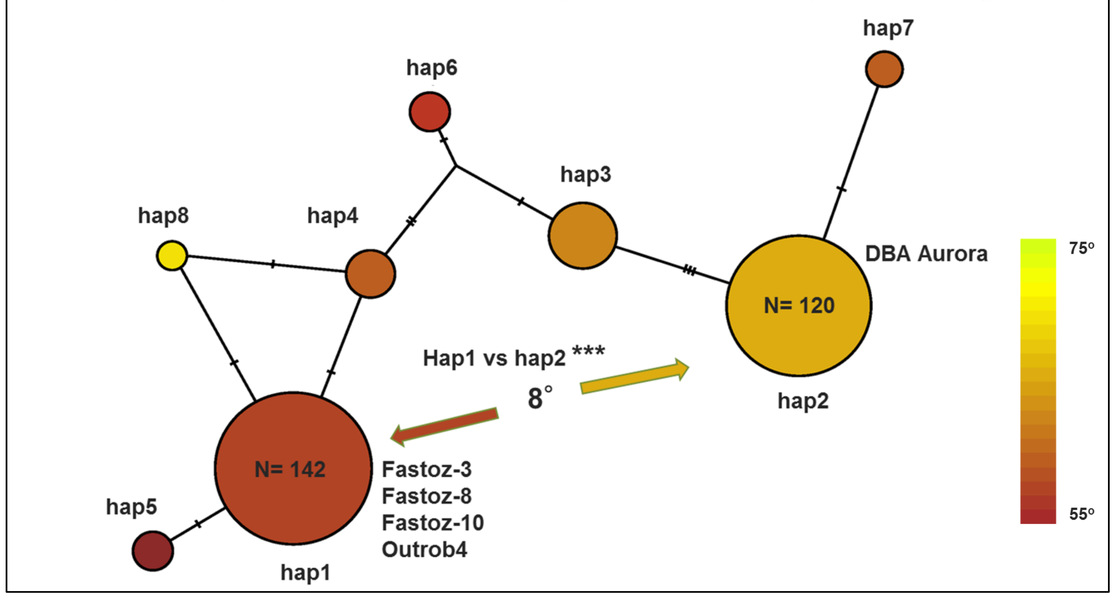
Families from 1 to 5 (red) share DBA Aurora as common parent, and families from 6 to 10 (green) share Jandaroi as common parent

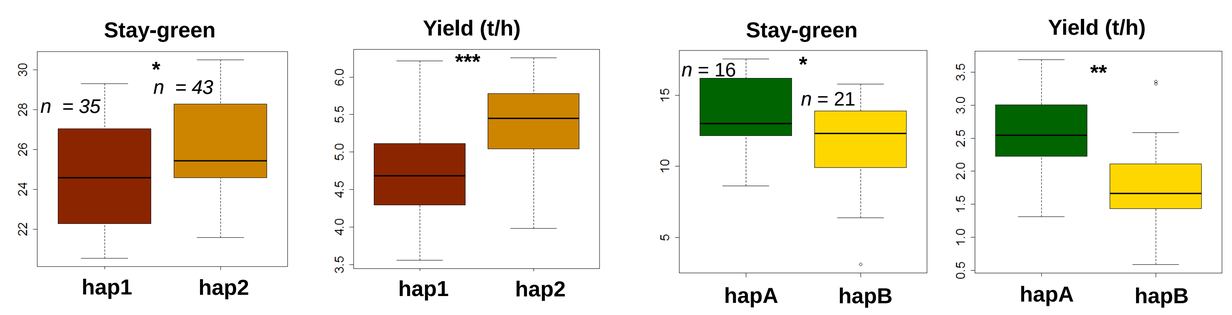
Family	Parents	Family	Parents
1	DBA Aurora × Fastoz7	6	Jandaroi × Fastoz8
2	DBA Aurora × Outrob4	7	Jandaroi × Fastoz10
3	DBA Aurora × Fastoz8	8	Jandaroi × Fastoz6
4	DBA Aurora × Fadda98	9	Jandaroi × Fastoz2
5	DBA Aurora × Fastoz3	10	Jandaroi × Outrob4

- GWAS identified QTL for seminal root angle ***qSRA-6A*** and crown rot response ***qCR-6B***



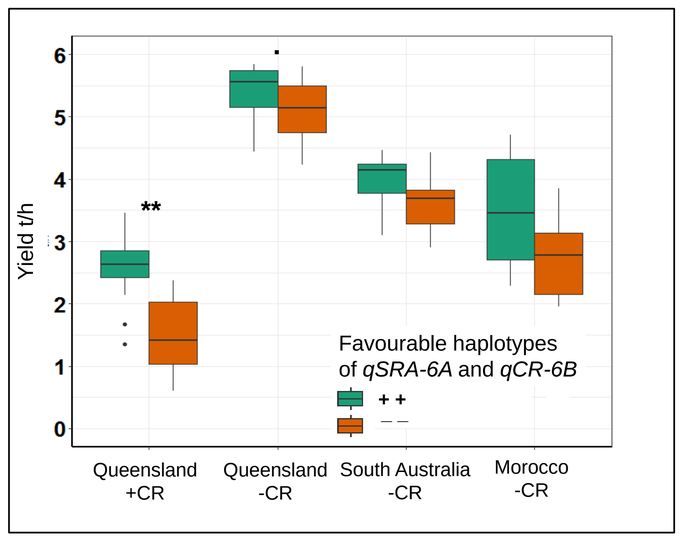
Haplotype analysis of *qSRA-6A* for root angle revealed two major haplotype groups





- hap2 for *qSRA-6A* enhance staygreen and yield under drought conditions
- hapA for *qCR-6B* significantly improved staygreen and yield under crown rot conditions

Can we combine root and crown rot QTL?



Average yield benefit under drought conditions in Australia and Morocco resulted in 0.57 t/h in yield difference

Average yield benefit under crown rot and drought conditions in Queensland resulted in 1.1 t/h difference

Take home message

Our study highlighted the potential to combine above- & below-ground physiological traits to enhance adaptation to drought and crown rot conditions

References

Alahmad et al. (2018) Plant Methods, 14:36
Richard et al. (2015) Plant methods, 11(1), 13
Trachsel et al. (2011) Plant and Soil 341, 75-87

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