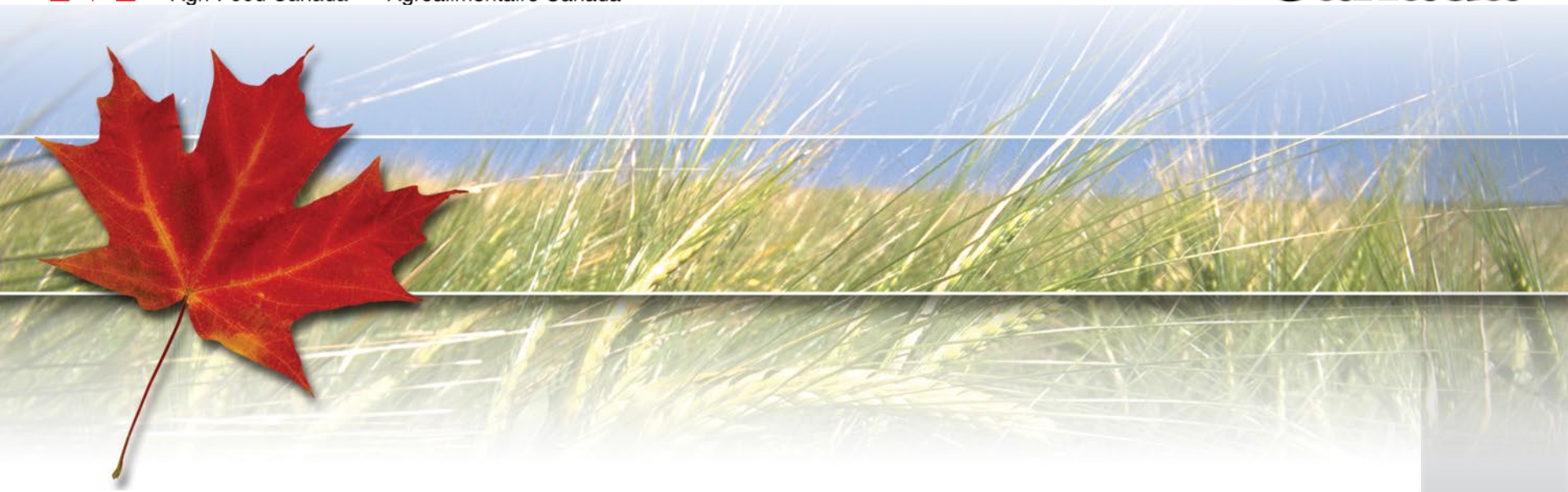

Mapping common bunt resistance in Canadian wheat cultivar AAC Tenacious

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Canada in the World

- Produces about 4% of the global wheat supply
- Accounts for about 15% of global wheat trade
- Overall, it generates about $7 billion annually, and about $11 billion when value-added food processing is considered

COMMON BUNT OF WHEAT

Caused by:
- *two species of fungi genus* ***Tilletia [T. tritici (syn. T. caries)*** *and* ***T. laevis (syn. T. foetida)]***

Cause:
- substantial yield losses in caused significant crop damage in the Canadian prairies

Risk level:
- listed as Priority 1 disease in the registration testing system

Preferred approach to manage:
- Growing **resistant cultivars** is the most economical and environmentally safe approach, particularly for organic farming

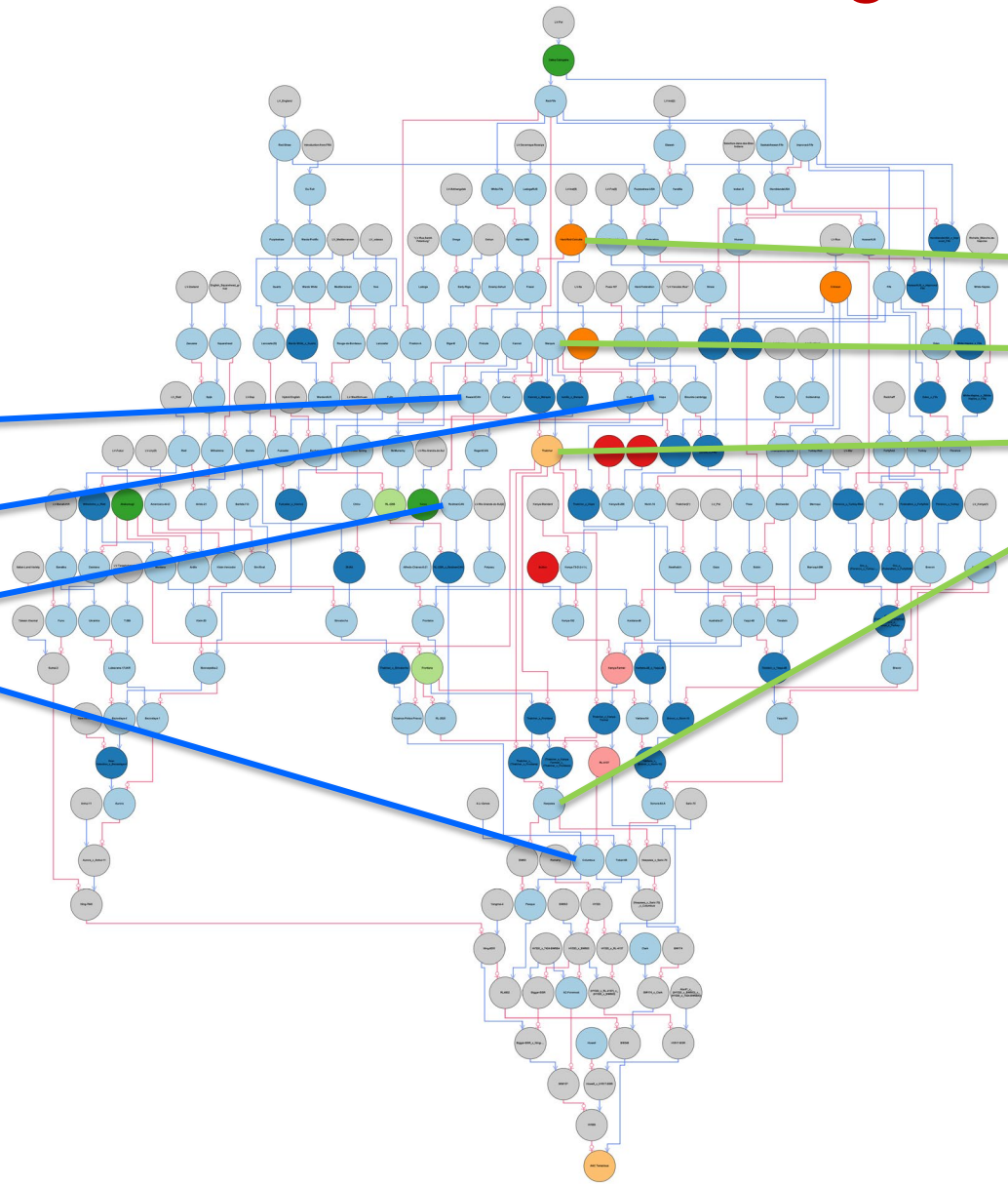
Previous findings

- Several major and minor genes have been identified in wheat for common bunt resistance
- In our germplasm, we detected common bunt resistance QTLs on chromosomes 1A (*QBt.lrc-1A*) and 6A (*QBt.lrc-6A*) and 7A (*QBt.lrc-7A*), which co-segregate with stem rust resistance and stripe rust resistance
- Plant height is also reported to be associated with common bunt resistance
- Canadian breeding programs utilized *Bt10*
- Reliance on one major gene presents unnecessary risk to the wheat production

AAC Tenacious Pedigree

Highly resistant and stable over environments:

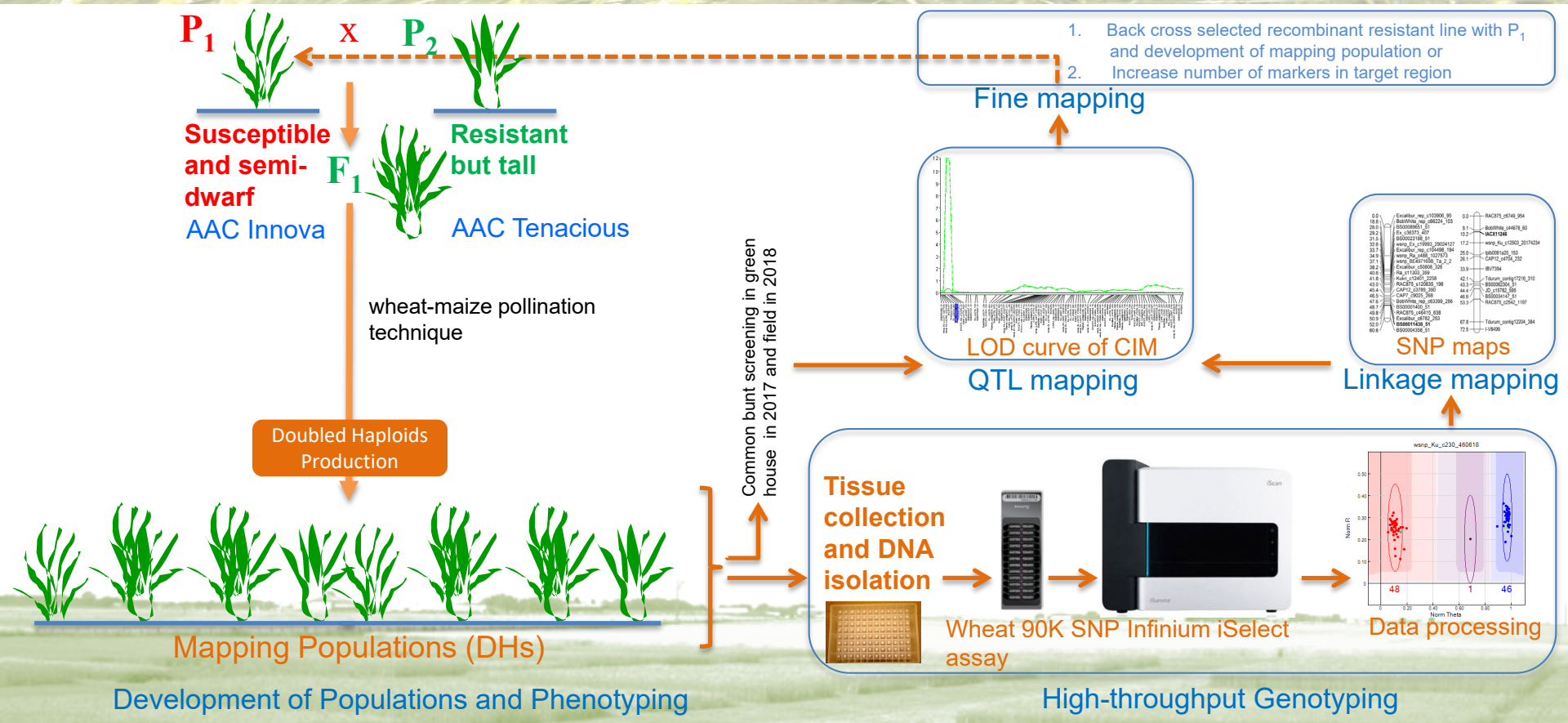
- Reward
- Hope
- Redman
- Columbus



Intermediately resistant:

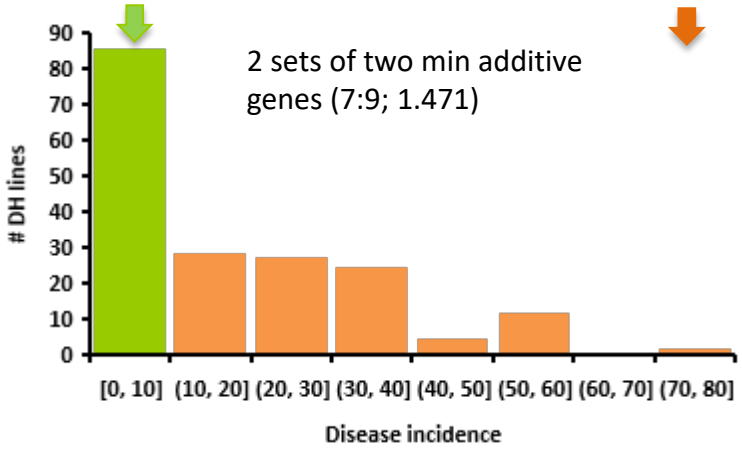
- Hard Red Calcutta
- Marquis
- Thatcher
- Neepawa

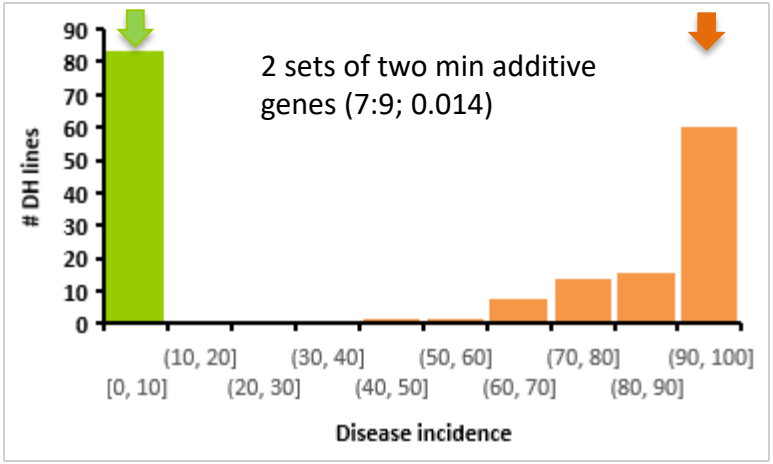
QTL mapping


P1
x
P2
Susceptible and semi-dwarf
AAC Innova
F1
Resistant but tall
AAC Tenacious
wheat-maize pollination technique
Doubled Haploids Production
Mapping Populations (DHs)
Development of Populations and Phenotyping
Common bunt screening in green house in 2017 and field in 2018
Tissue collection and DNA isolation
Wheat 90K SNP Infinium iSelect assay
Data processing
High-throughput Genotyping
1. Back cross selected recombinant resistant line with P1 and development of mapping population or
2. Increase number of markers in target region
Fine mapping
LOD curve of CIM
QTL mapping
SNP maps
Linkage mapping

Screening of Parents, Checks, and Population for Common Bunt Incidence

Cultivar	Disease incidence (range)
Parents	
AAC Innova	88.9 (77.71 – 100) %
AAC Tenacious	0 %
Check cultivars	
Sadash	100 %
Indus	94.25 (75 – 100) %
Foray	93.83 (66.66 – 100) %
Neepawa	90.84 (44.44 – 100) %
Fielder	89.15 (44.44 – 100) %
Carberry	70.17 (33.33 – 92.30) %
Foremost	4.64 (0 – 30) %
Penhold	0.78 (0 – 6.25) %





$r = 0.76$

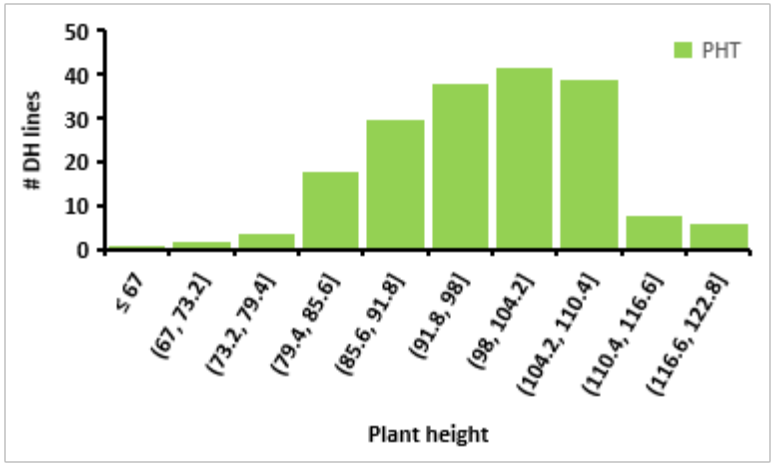
Disease Incidence

A representative figure of reactions of resistant (left panel) and susceptible (right side panel) DH lines.

Healthy heads and seeds

Diseased heads and seeds

Genetic variation for plant height

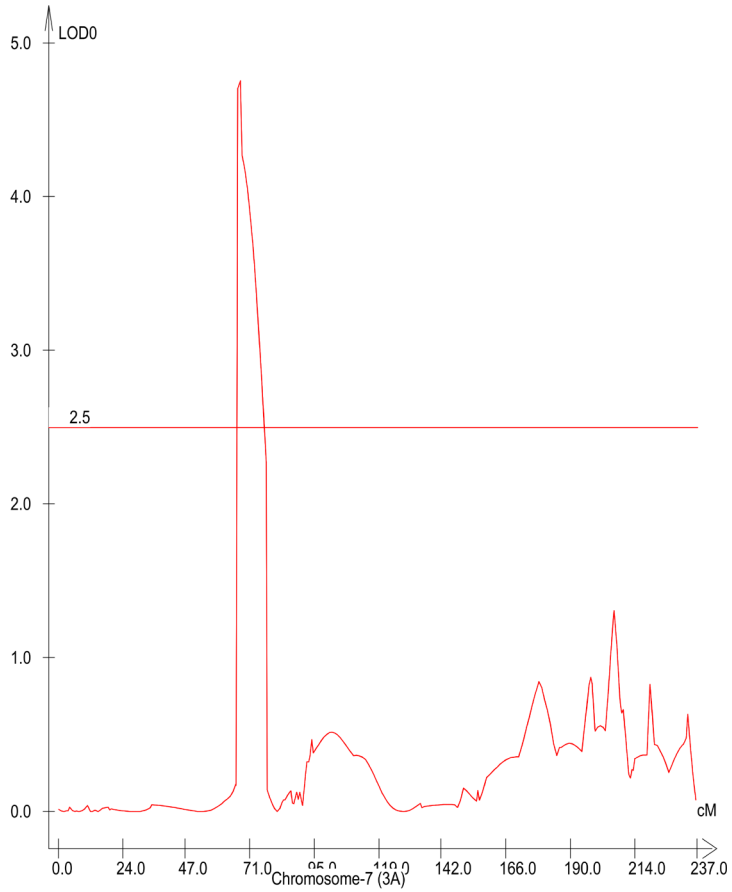


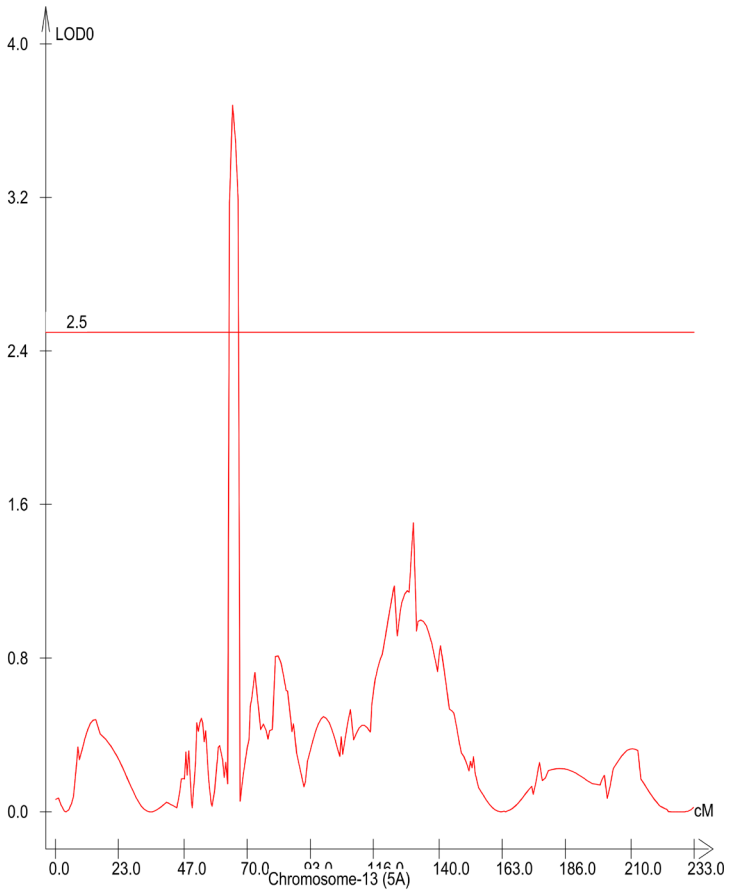
- AAC Tenacious (tall)
  - carry a gibberellic acid (GA)-sensitive (*Rht-B1a*), tall allele
  - the brassinosteroid-sensitive tall allele *Rht8a*
- AAC Innova is semi-dwarf
  - carry a gibberellic acid (GA)-insensitive (*Rht-B1b*), semi-dwarf allele
  - the brassinosteroid-sensitive semi-dwarf allele *Rht8c*

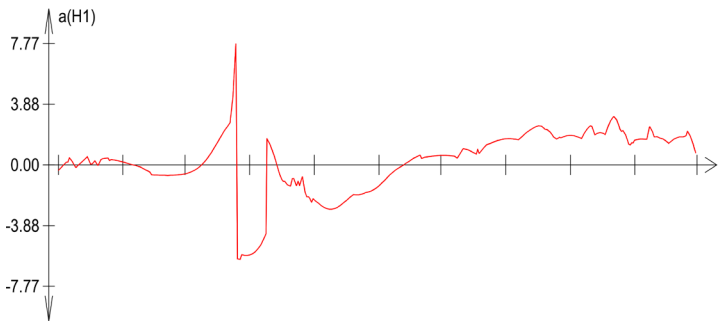
Quantitative trait loci

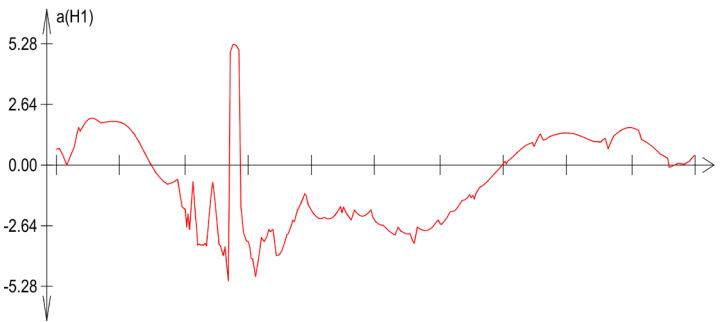
QTL	Chr	Position	Interval	LOD	Additive effect	PVE	Closest marker	Donor
Common bunt								
QBnt.lrdc-3A	3A	67.7	66.4 - 76.5	4.76	-6.11	9.8	GENE-1533_226	AAC Innova
QBnt.lrdc-5A	5A	64.7	63.2 - 67.0	3.68	5.22	7.8	wsnp_BE443187A_Ta_2_3	AAC Tenacious
Plant height								
QPht.lrdc-5A	5A	45.3	41.7 - 47.9	3.1	-1.77	0.8	RAC875_c25072_389	AAC Innova

Quantitative trait loci

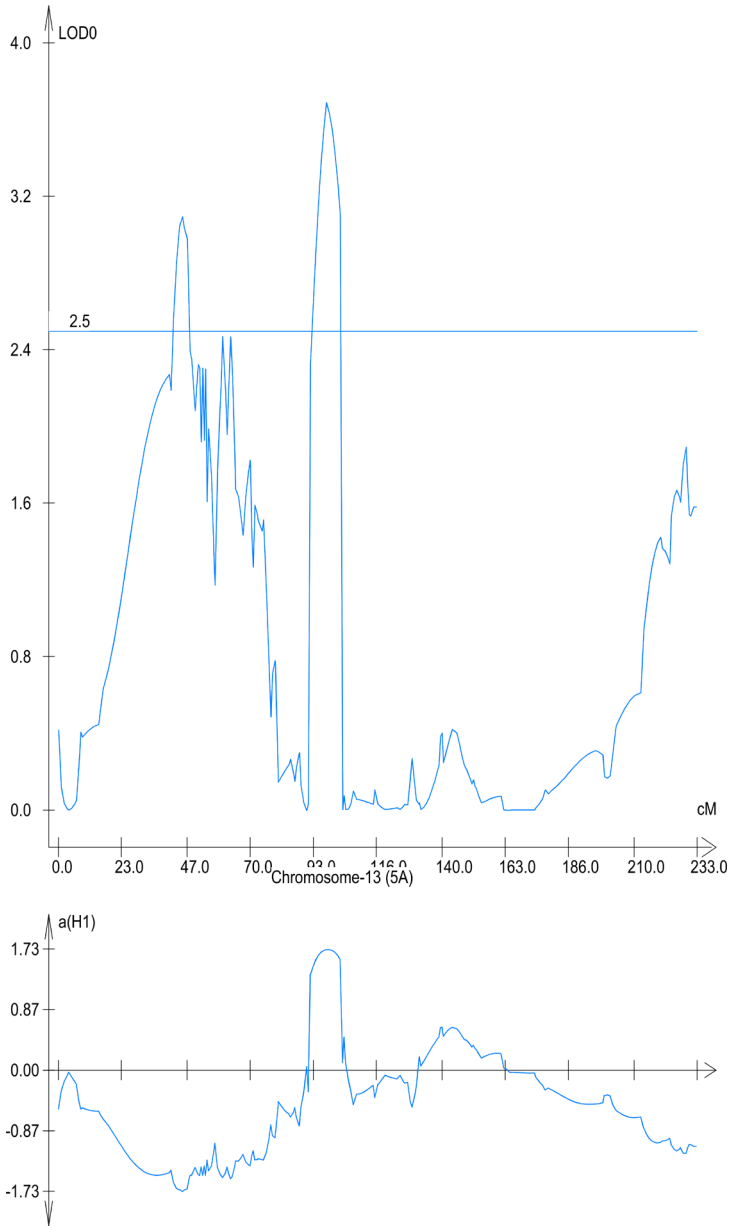








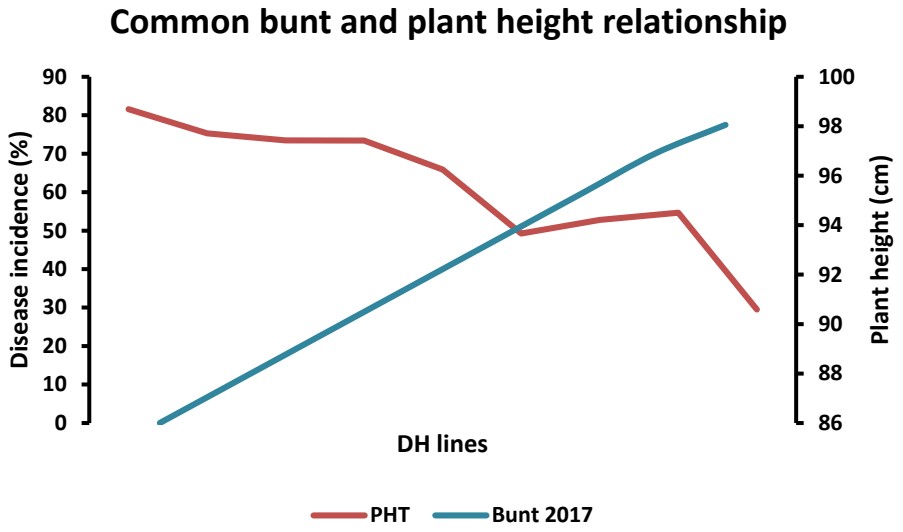
Quantitative trait loci



QPht.lrdc-5A.1 overlap almost same region as *QBnt.lrdc.5A*

QPht.lrdc-5A.1 detected only in disease nursery

QPht.lrdc-5A.2 is stable QTL and detected in multiple environments



Future Perspectives

- QTL mapping involving multiyear data.
- Fine mapping of identified QTLs.

Summary

- Both AAC Tenacious and AAC Innova contribute resistance QTL for common bunt
- Resistance is governed by minor additive genes/QTLs; however large scale study is required
- Though it is not clear but it seems 3A QTL pleiotropically reduces plant height

Acknowledgements

Harpinder S. Randhawa

Thérèse Despins

Leslie Bihari

Zafrin Akter

Mark Virginallo

Kelly Ryan

Thanks