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Natural variation and genetic bases of pod shatter resistance in Brassica species

Rosy Raman, Jia Liu, Brett McVittie, Qiong Hu, Simon Diffey, Jun Zou, Xiaobo Cui, Niharika Sharma, S.S. Banga, Shengyi Liu, Nelson Gororo, and Harsh Raman

Globally, pod shattering is a major issue for canola production

- Windrowing/Desiccants (Reglone/Roundup)
- Pod sealant
- Mechanical harvesting is preferred
- Shatter tolerant varieties
  - BASF

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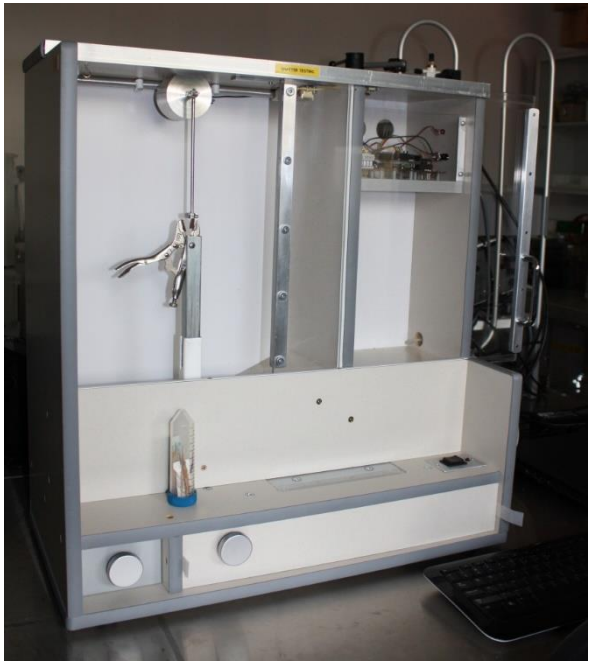
Research outline

- Natural variation for pod shatter resistance
  - *B. napus*
  - *B. rapa*
  - *B. carinata*
- Genetic architecture of pod shatter resistance
  - QTL analysis
  - GWAS
- Introgress pod shatter resistance into *B. napus*
  - *B. rapa/B.carinata*
  - *B. napus/B.carinata*

Phenotypic evaluation of germplasm

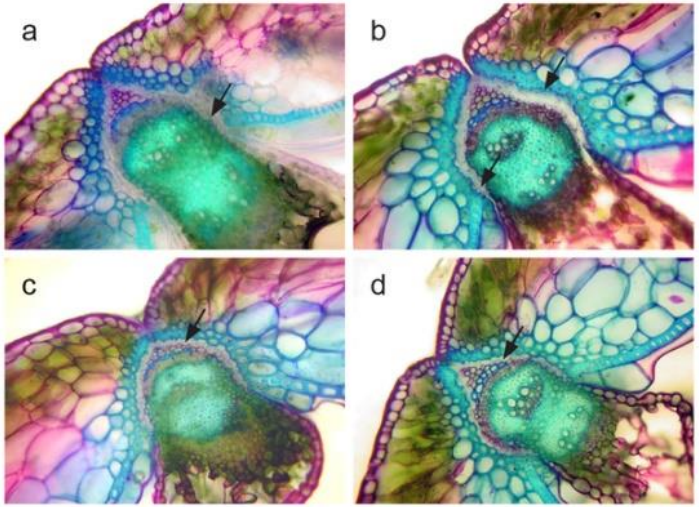
- Growing under natural field conditions
  - Birdcage
  - Field
- Rupture Energy with pendulum test
- Verifying pod shatter resistance with delayed harvest



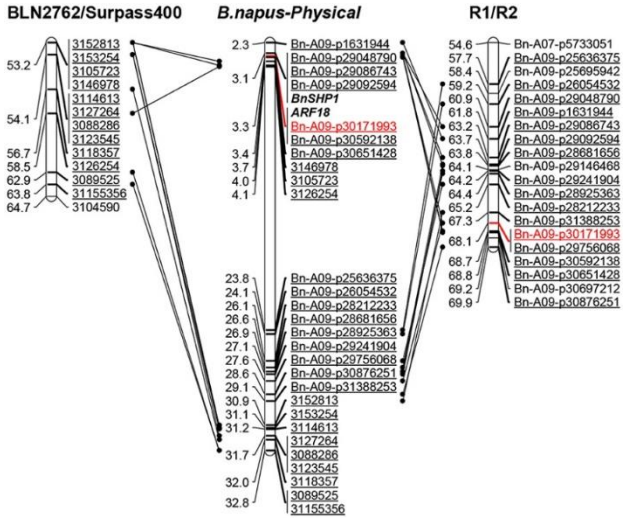
Pod shatter resistance in *B. napus*

- DH populations
  - BLN2762/Surpass400 (Raman et al 2014)
  - R1/R2 (Liu et al 2016, 2021)
- $F_{2:3}$ population
  - ZS11/R1 (2021, 2022, 2023, unpublished)
- GWAS panels
  - 188 Australian diverse panel (Raman et al 2014)
  - 143 Chinese diverse panel/IF_2s (Liu et al. 2016)
  - 300 AHGDS (Raman et al, unpublished)

Consistent QTL and similar pod shatter resistance mechanisms



Raman et al (2014). PLOS ONE 9(7): e101673



Liu et al (2016). Front. Pl. Sci

Our research showed a limited variation for PSR in *B. napus* 2.1 to 4.3mJ

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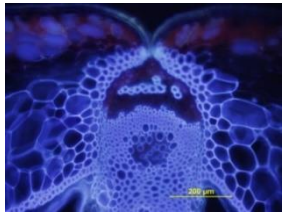
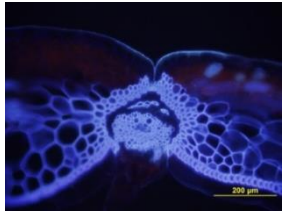
Pod shatter resistance in *B. rapa (unpubl.)*

100 accessions (AGG) → Pendulum test → $F_{2:3}$ population

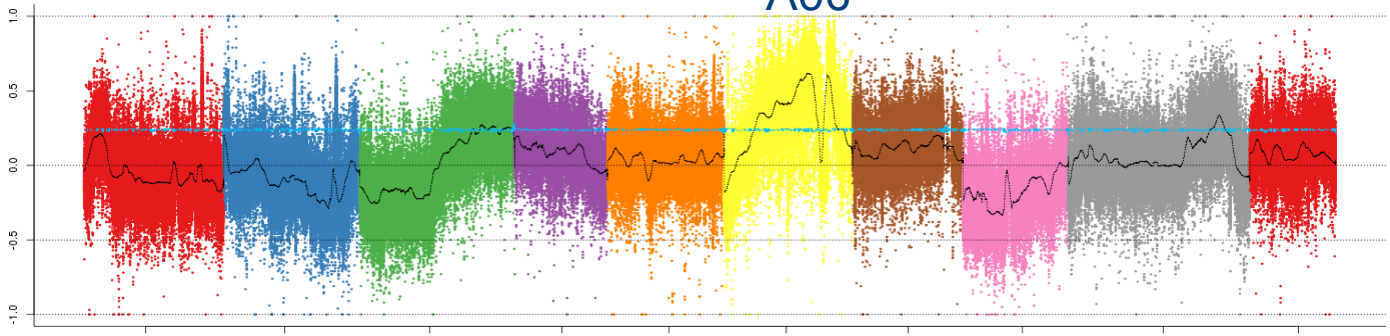


Shatter resistant parent (RE = 8 mJ)

X



Shatter prone parent (RE = 2mJ)



QTLseq + QTL analyses

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Pod shatter resistance in *B. rapa*/*B. napus*

BC95041 x BC95042

↓

F_1

↓

F_2

↓

$F_{2:3}$

ORIGINAL RESEARCH article

Front. Plant Sci., 06 September 2023
Sec. Functional and Applied Plant Genomics
Volume 14 - 2023 | https://doi.org/10.3389/fpls.2023.1233996

This article is part of the Research Topic
Crop Improvement in the Era of Next-Generation Sequencing
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Novel quantitative trait loci from an interspecific *Brassica rapa* derivative improve pod shatter resistance in *Brassica napus*

Harsh Raman[1*], Rosy Raman[1], Niharika Sharma[2†], Xiaobo Cui[3†], Brett McVittie[1†], Yu Qiu[1†], Yuanyuan Zhang[3], Qiong Hu[3], Shengyi Liu[3], Nelson Gororo[4]

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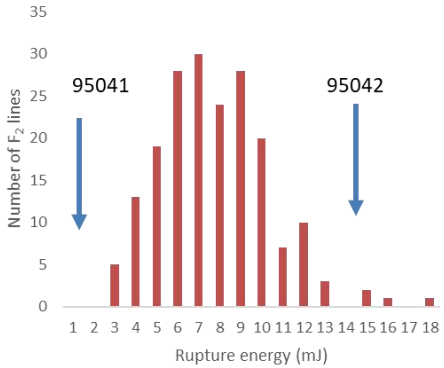
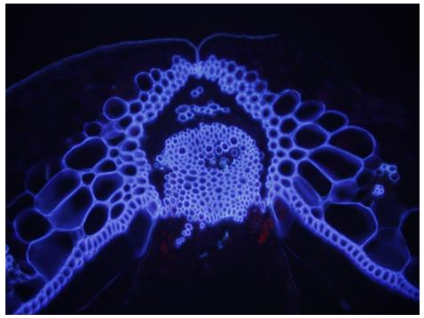
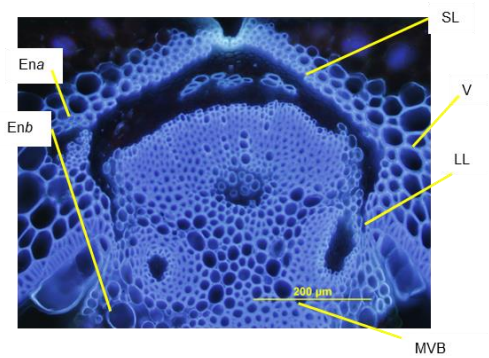
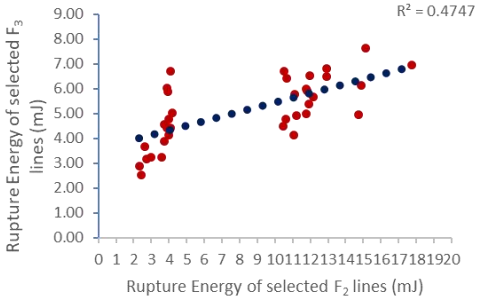
Genetic variation for pod shatter resistance









DArTSeq analysis

↓

Linkage map
(15,498 markers)

↓

QTL analysis

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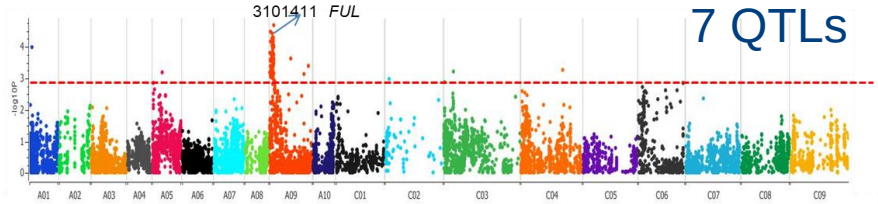
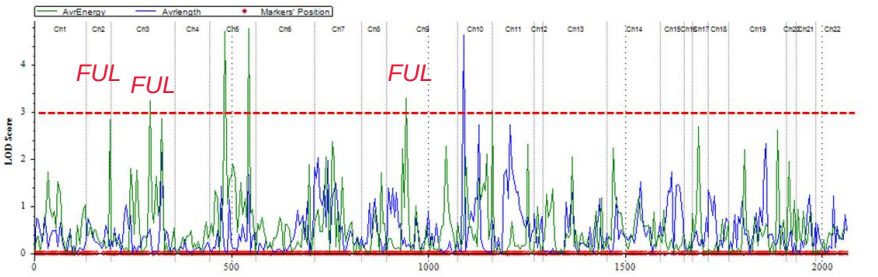
QTL for major and epistatic interactions for pod shatter resistance

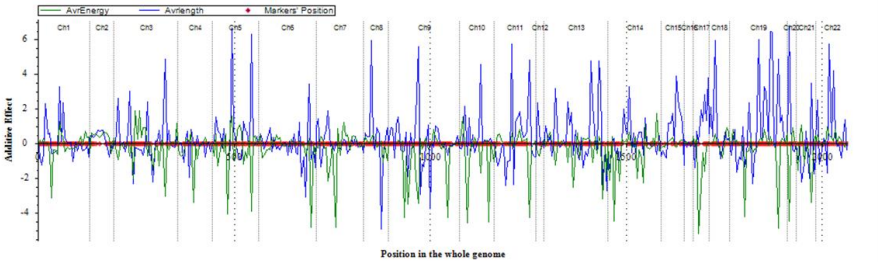
A



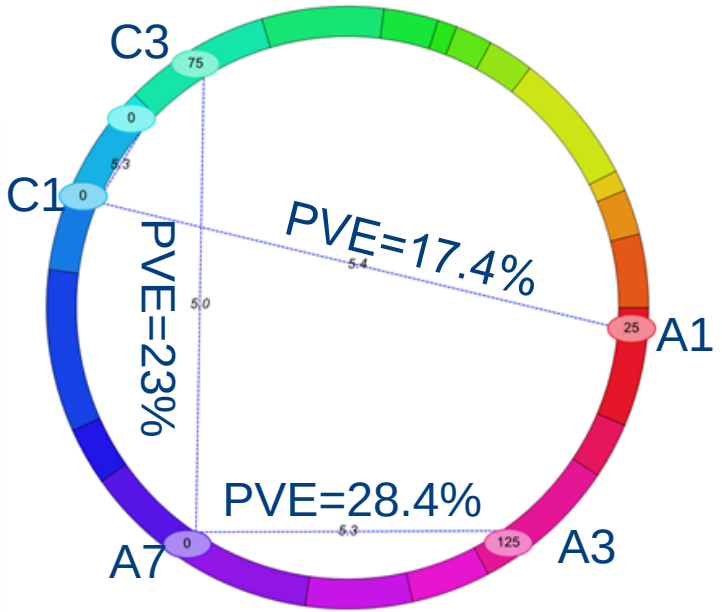
B



C



5 QTLs



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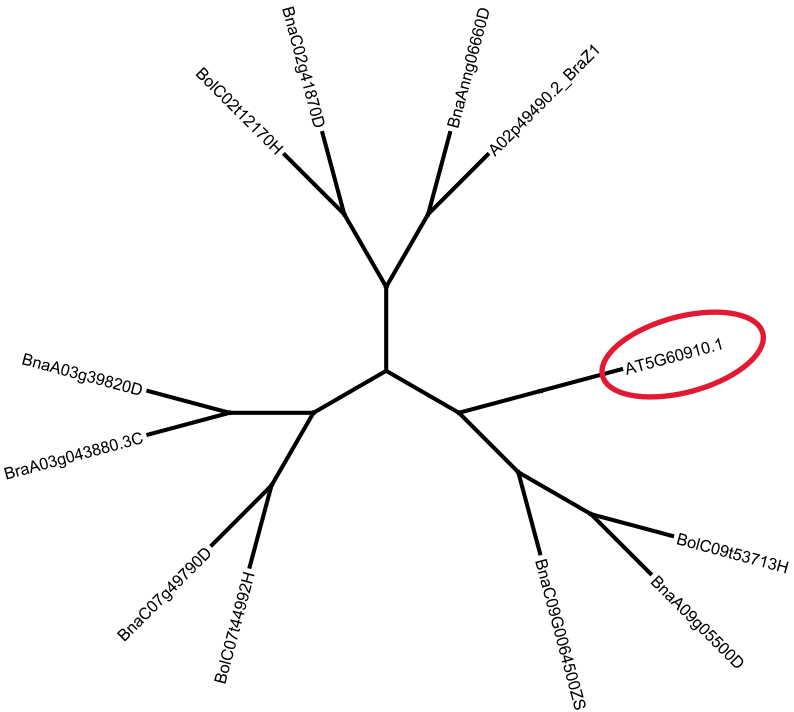
Structural and functional variants in *FUL* (A09) Raman et al (2023)



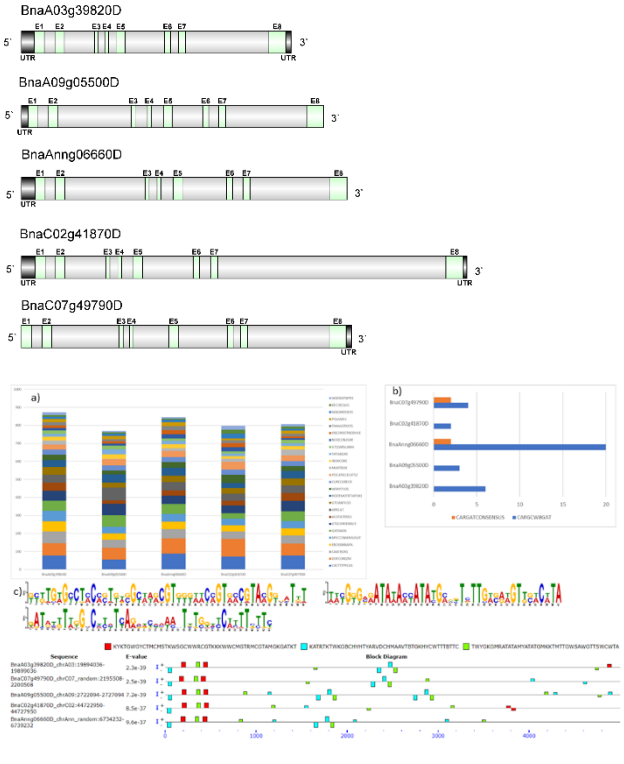


Figure 6

Pod shatter resistance in *B. carinata*

- $F_{2:3}$ population (BC73526/BC73524)
  - Raman et al 2017, Front. Plant Sci.)
- GWAS panel
  - 83 accessions (AGG)
- **DH populations**
  - **Yellowcross/Whiteban (YW)**
  - **2013, 2014, 2023**

ORIGINAL RESEARCH article

Front. Plant Sci., 30 November 2017
Sec. Plant Breeding
Volume 8 - 2017 |
https://doi.org/10.3389/fpls.2017.01765

This article is part of the Research Topic
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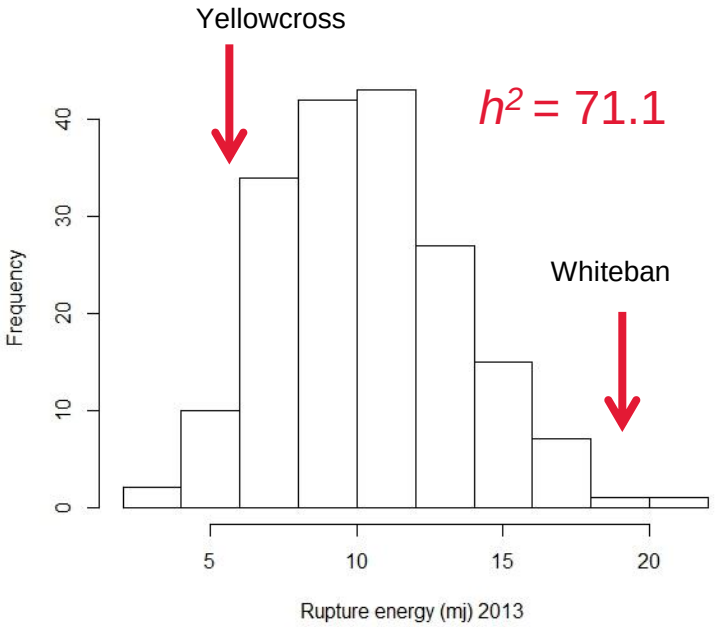
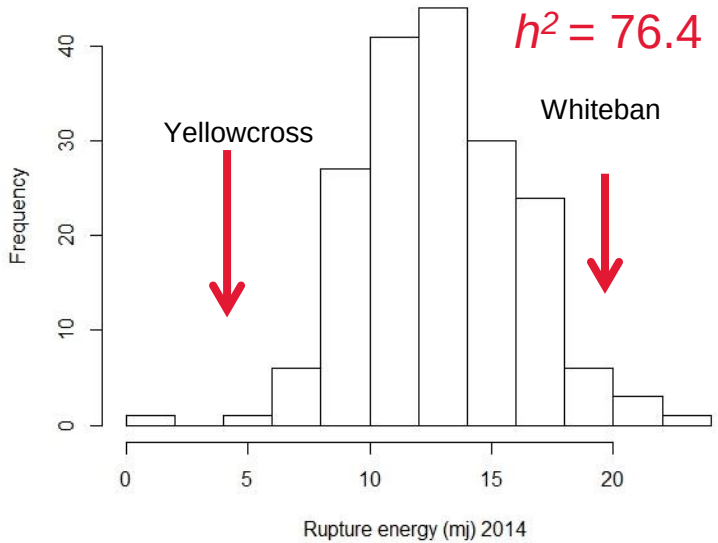
Molecular Diversity Analysis and Genetic Mapping of Pod Shatter Resistance Loci in *Brassica carinata* L.

Rosy Raman[1,2*] Yu Qiu[2] Neil Coombes[2] Jie Song[3] Andrzej Kilian[3] Harsh Raman[1]

Rupture energy of DH population of *B. carinata* derived from Yellowcross/Whiteban (YWDH)





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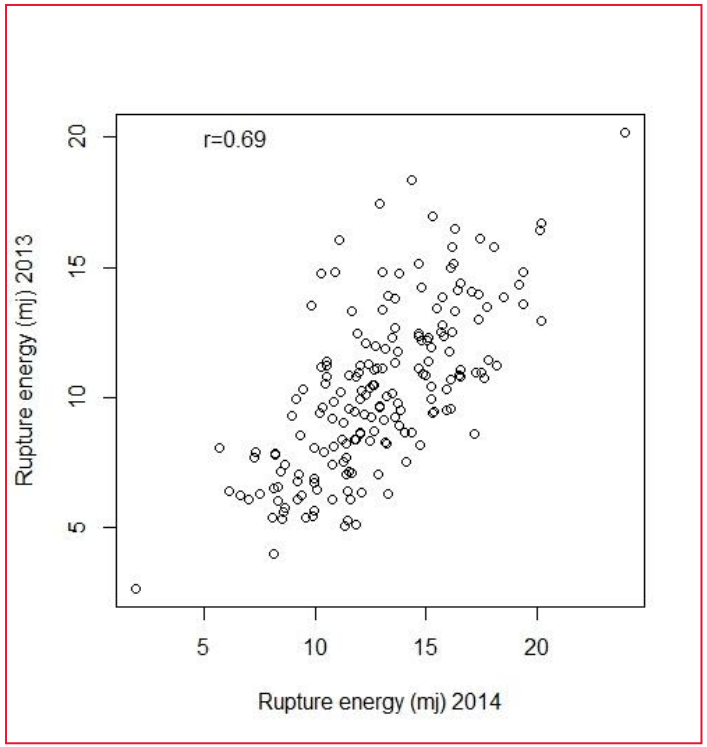
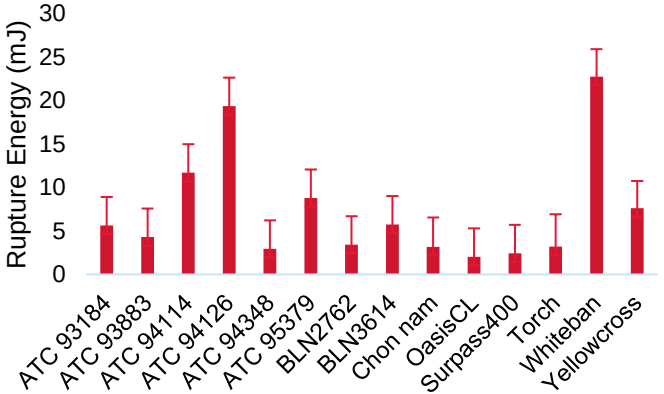
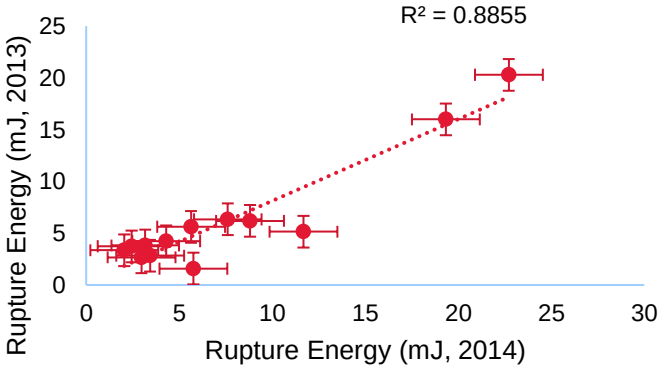
Genetic correlation for rupture energy in a YWDH lines







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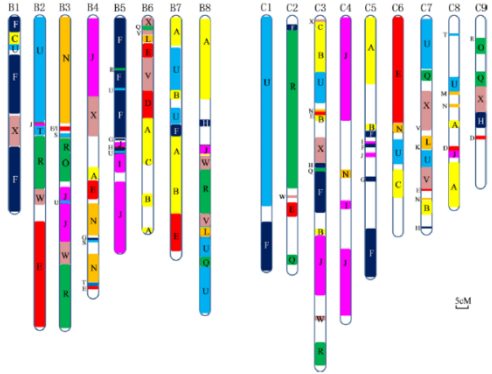
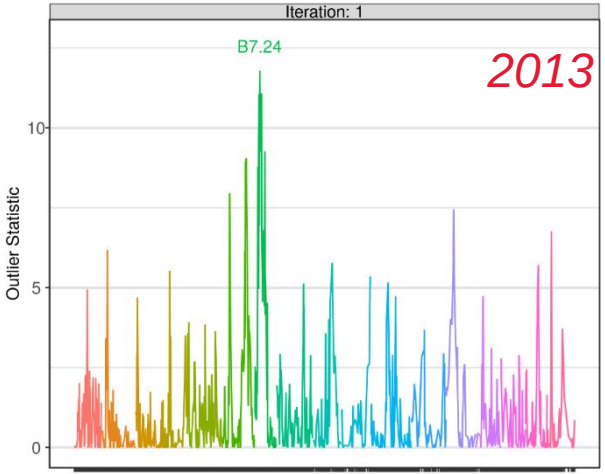
Mapped QTL for pod shatter resistance in *B. carinata* YWDH population (Raman et al, unpubl.)



Zou et al (2014)

BC73526/BC73524
(Raman et al, 2017)

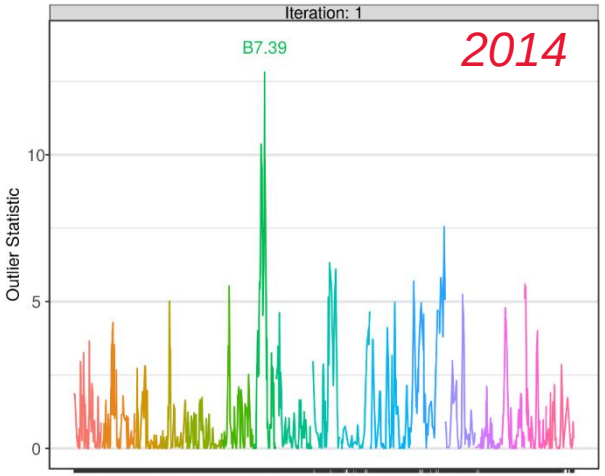
BC95041/BC95042
(Raman et al, 2023)



IciMapping & WINQTL mapping

FRUITFUL

WGAIM
(R^2 ~27%)



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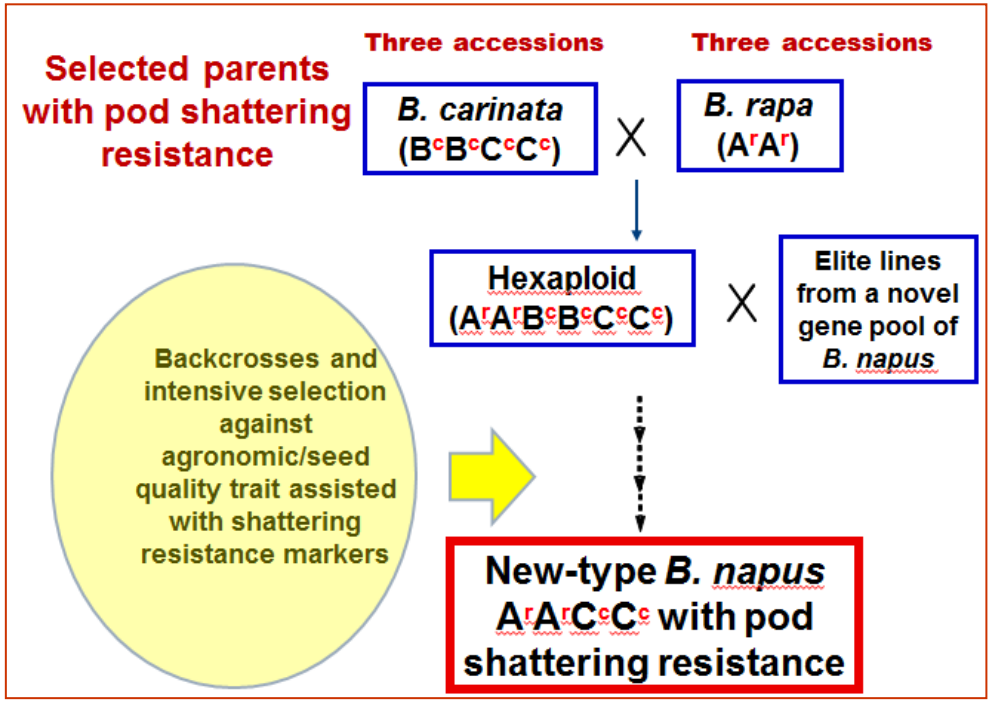
Resynthesis of *B. napus* from *B. rapa/B. carinata*



10 lines with NSW DPI

- Diversify genetic base
- Abiotic stress tolerance
- Biofuel traits

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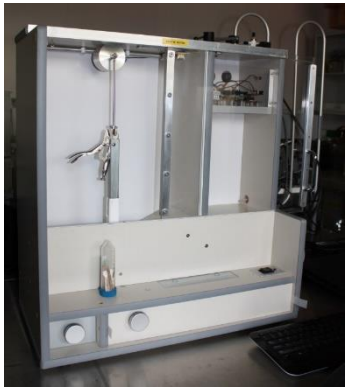
Summary

- Determined the genetic bases underlying pod shatter resistance in *B. rapa*, *B. napus* and *B. carinata*
- Currently validating phenotyping methods for quantifying pod shatter resistance
- Further research is required to pyramid favourable alleles to enhance pod shatter resistance in *B. napus*



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