

Development of molecular markers for application in Australian Canola breeding

Canola Molecular Marker Program
(harsh.raman@industry.nsw.gov.au)

Mapped Blackleg Resistance loci

- ❖ Skipton/Ag-Spectrum (191 lines) ✓
- ❖ BLN2762/Surpass400 (139 lines) ✓
- ❖ Columbus*3/Westar 10 (76 lines) ✓
- ❖ Maxol*1/Westar 10 (101 lines) ✓
- ❖ Ag-Castle/Topas ✓
 - Ag-Castle*4/Westar10 (173 lines)

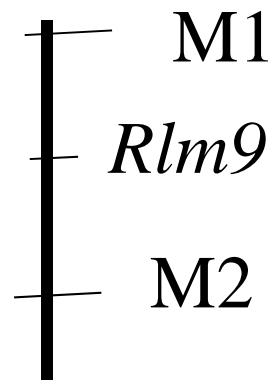
Mapped blackleg resistance loci in the DH population from BLN2762/Surpass-400

Screened with three isolates

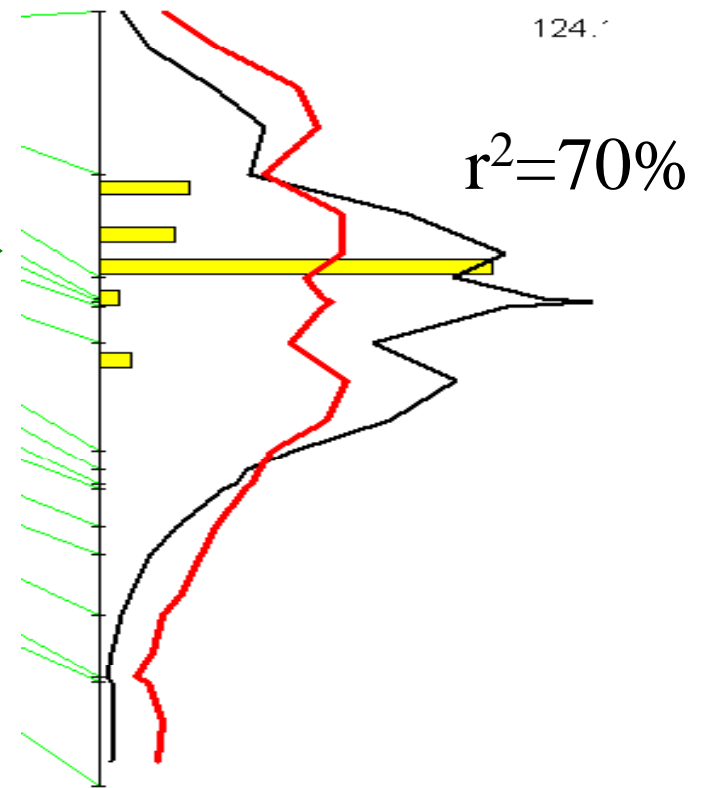
D1 (*AvrLM2,5,6,9*)

D7 (*AvrLM1,3,5,6,8*) →

D10 (*AvrLM5,6,8,9,S*)



A7



A10

Mapping of Ag-Castle/Topas

- Population is developed by International Blackleg Consortium, Canada
- F_1 -1
- F_1 -2
- Mapped with SSR (Canada, Wagga) and DArT markers (Wagga)
- Qualitative Resistance Genes
- Quantitative Resistance Genes
 - 3-4 QTLs

Strong Evidence of novel genes

- QTL on chromosome X: $r^2 = 28\%$
 - Field conditions
- QTL on chromosome X: $r^2 = 25\%$
 - Seedling stage

Validation of Loci for BLR

- Bi-parental populations
 - Evaluate two alleles/locus
 - Known ancestry
 - Association mapping
 - Evaluate more alleles/locus
 - Historic recombination
- Skipton/Ag-Spectrum
 - Maxol/Westar
 - Ag-Castle/Westar
 - Surpass/Topas
 - BLN3347/Carousel-10

Digital Image analysis

The screenshot displays a Windows desktop environment with several open applications for digital image analysis:

- ImageJ:** The main application window showing a color-coded image of a plant cross-section. The menu bar includes File, Edit, Image, Process, Analyze, Plugins, Window, and Help. The toolbar includes various tools like the Pencil Tool. The status bar indicates the image size is 2000x2000 pixels, RGB, and 15MB.
- Results:** A window displaying a table of analysis results:

	Area	Mean	Min	Max
1	1824673	125.047	6	227
- B&C:** A window showing a histogram and sliders for adjusting image properties:
 - Minimum: 14€
 - Maximum: 148
 - Brightness
 - Contrast
 - Buttons: Auto, Reset, Set, Apply
- IMG_1197.JPG (25%):** A smaller window showing the original image with a yellow outline around the plant cross-section. The status bar indicates the image size is 4272x2848 pixels, RGB, and 46MB.

The desktop background features the 'EH G' logo. The taskbar at the bottom shows the start button, several open applications (Document1 - Microsoft..., Tools - Microsoft Inte..., 5 Java(TM) Platfor...), and the system tray with the time 10:01 AM.

BR Scores of 188 Lines Using Differential Set

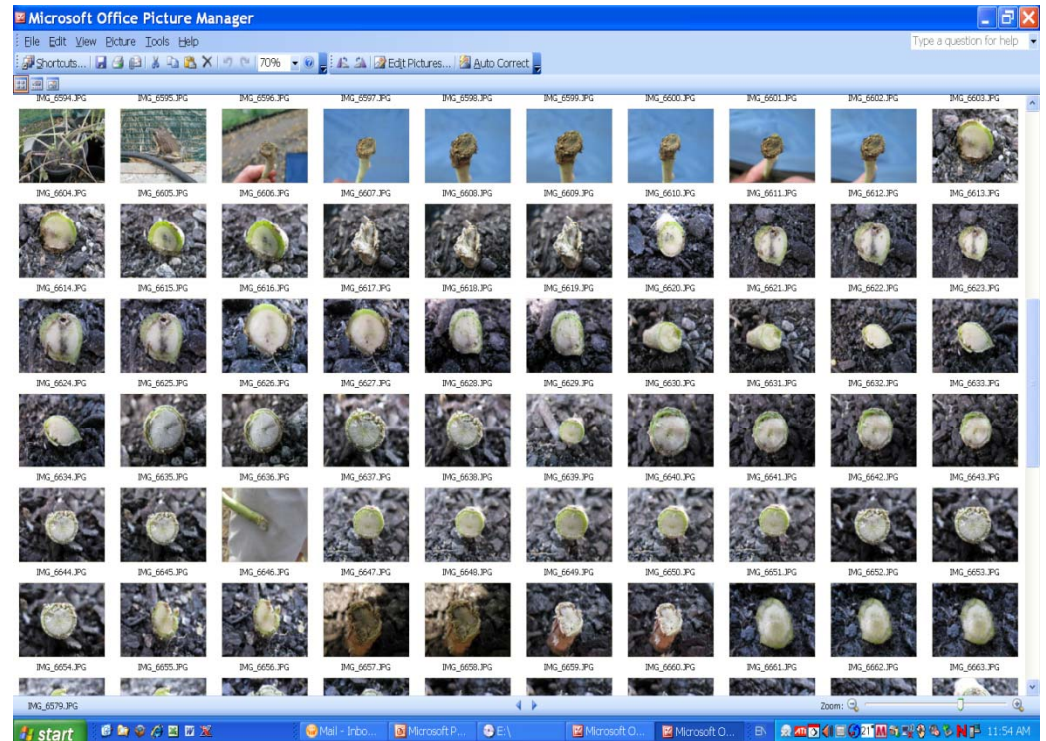
D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
4.730140304	7.646925	7.128249	6.971014	1.836446	2.285203	2.115384	3.319144	4.757586	6.789557
7.097330341	6.618246	7.920466	6.133153	4.431464	6.812594	5.135307	3.122412	3.744606	7.372861
4.356579722	7.232666	7.533186	6.021005	4.989769	4.887729	5.961428	3.576325	3.821709	6.558984
3.668504598	6.394026	6.921822	6.13768	3.952241	5.087057	4.581889	3.161766	4.912204	6.454949
4.522183939	6.229967	6.028761	6.361742	2.957218	1.091836	2.472812	1.323677	5.722262	4.500186
6.015414023	6.040849	6.505169	6.073434	2.411565	2.724239	4.632233	3.208622	3.200387	5.417817
5.591654768	7.413355	7.361577	6.63768	3.654039	2.698503	2.850807	2.183013	5.962158	6.839883
4.423611703	6.555453	7.396042	5.633161	1.550735	3.589092	5.679019	3.309156	4.056738	6.270415
6.886679493	7.023896	7.984523	6.358386	5.292574	6.127917	4.005167	4.99292	6.186199	7.152023
6.135385064	7.462896	7.961975	6.679347	4.994903	6.960856	4.823716	4.126742	5.141677	7.428624
4.129040146	5.409193	6.290693	4.01268	2.825122	3.857382	1.85182	2.110125	5.153192	6.457673
5.431069152	5.915106	4.398745	1.204228	1.863305	4.074617	4.304964	2.816818	3.277779	4.295161
5.614302808	6.066947	7.552231	5.31672	3.201049	6.393255	4.565232	3.339089	5.958782	5.880304
2.826531339	6.369425	6.558874	4.349931	3.370806	3.242903	1.600677	3.854578	4.823295	3.60767
4.073260062	6.035585	7.189969	4.833161	3.093878	4.880359	5.526491	3.301663	2.586679	6.747776
3.520257892	6.004412	5.034623	6.961948	2.380899	5.700361	1.953367	1.297054	3.235428	5.006055
2.362642866	5.175833	6.251495	3.34907	3.678294	3.312643	3.117591	3.749729	3.562106	3.181641

Evaluated 188 lines for Adult Plant Resistance

- AV-Garnet (*Rlm1,9*)
- Monola76 (*RlmS*)
- ATR-Cobbler (*Rlm 4,9*)
- CB-JardeeHT (*Rlm2,3*)
- Hyola50 (Unknown)

Results:

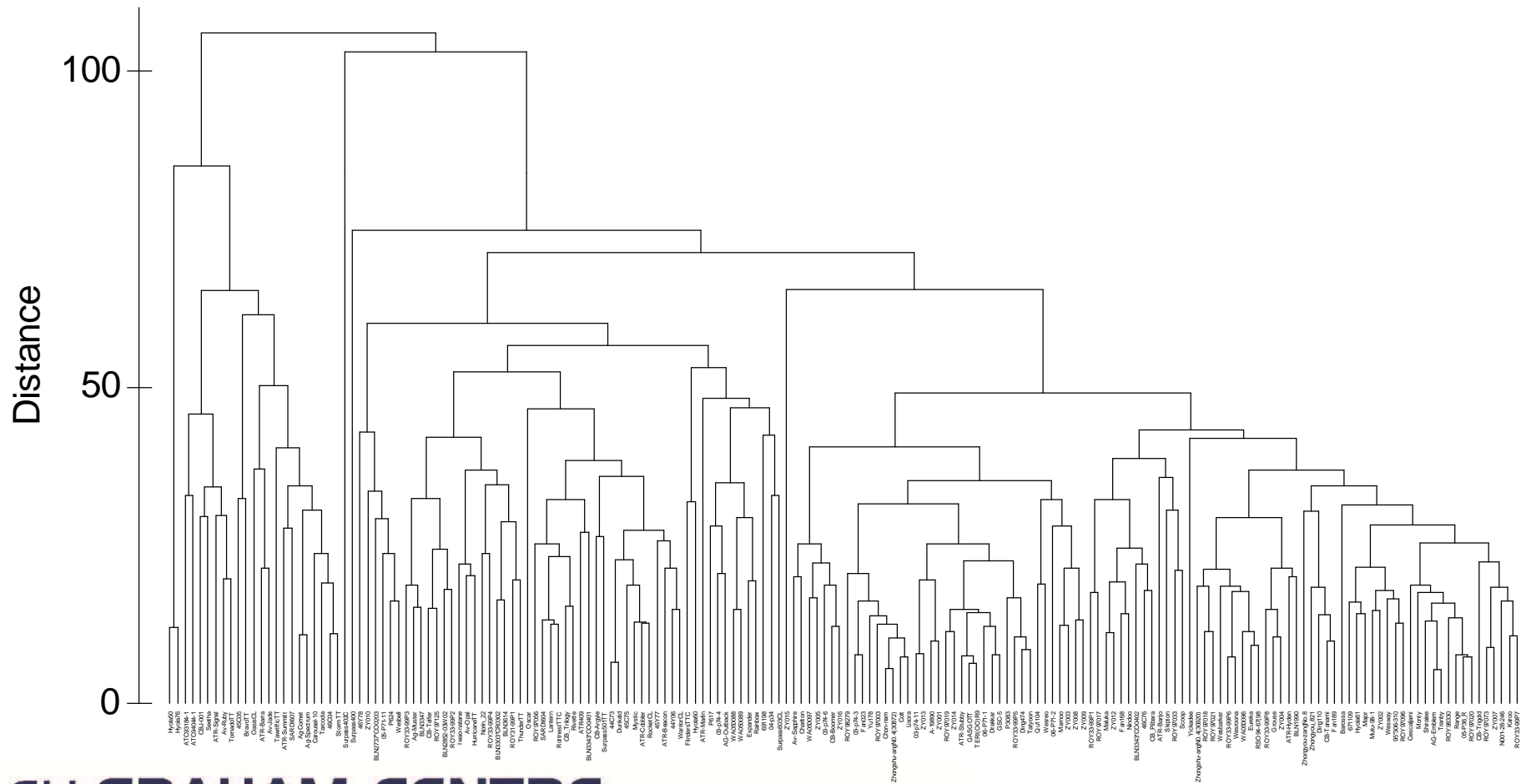
- Some *B. juncea* and *B. carinata* lines were resistant to all stubbles



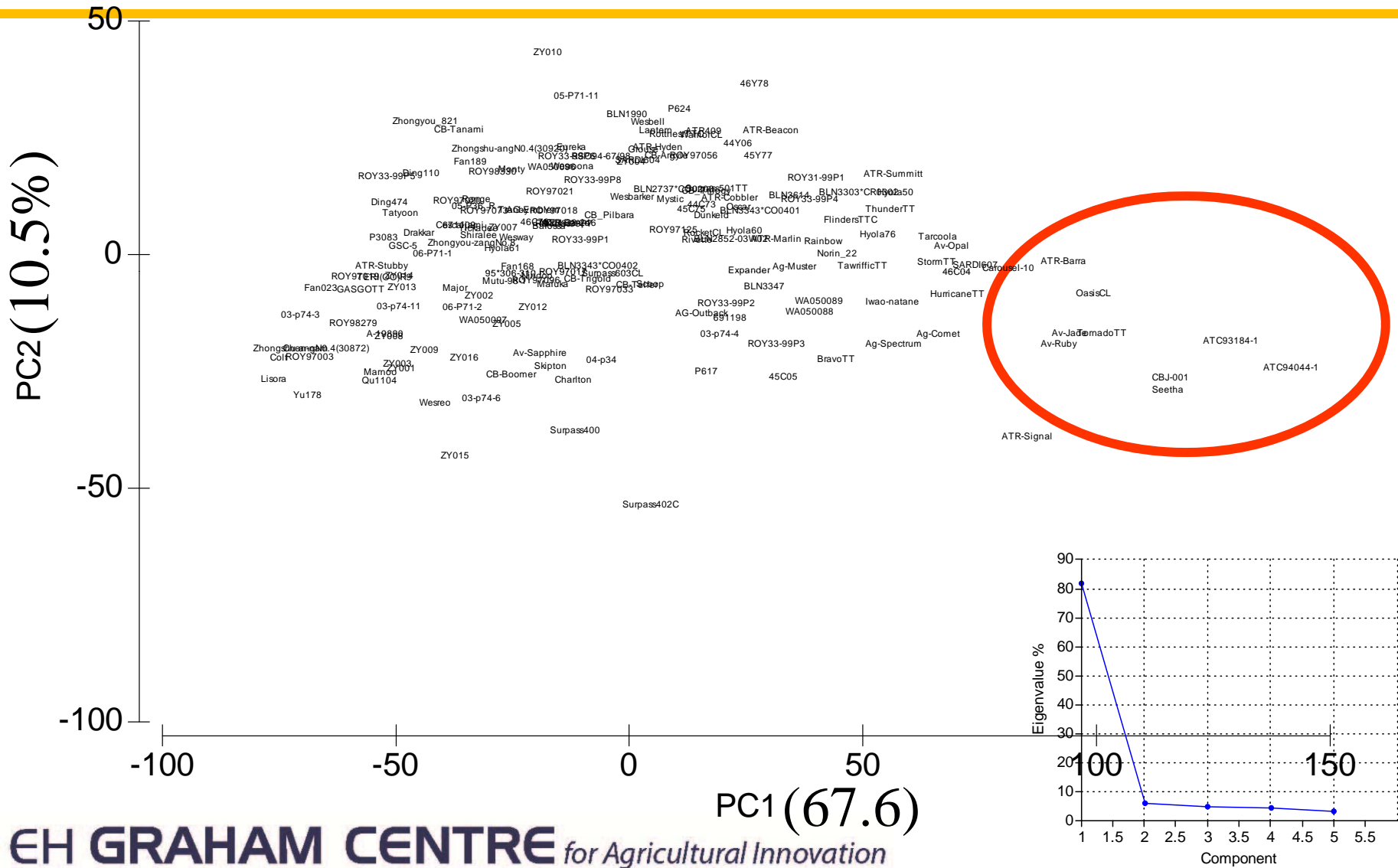
Phenotypic Relationships for BLR

Group average

Resemblance: D1 Euclidean distance



Principal Component Analysis



Characterisation of APR lines

- Differential set was used to characterise APR lines
- All lines were resistant to all isolates
- Loci remains to be characterised

Conclusions

- Mapped and validated known RIm and other loci associated with blackleg resistance
- Characterised germplasm for blackleg resistance at seedling and adult plant stages
 - Identified new sources and loci for blackleg resistance

Acknowledgments

Canola Molecular
Marker Program

I&I NSW

- Rosy Raman
- Belinda Taylor
- Ata Rehman
- Neil Coombes
- David Lockett

UQ

- Jacqui Batley
- David Edwards
- Jiri Stiller

Collaborators

- Simon Diffey (NSWDPI)
- Steve Marcroft (MGP)
- Kurt Lindbeck (I&I NSW)
- Angela Van de Wouw (UM)
- Paul Eckerman (UA)

- Ray Cowley (I&I NSW)
- Dave Roberts (I&I NSW)

- Shanoor Hossain (VicDPI)
- Phil Salisbury (UM)
- Bob (VicDPI)

- Australian Canola Breeding Programs
- International Blackleg Consortium, Canada



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

