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Resistant sources and resources for clubroot at AAFC, Saskatoon

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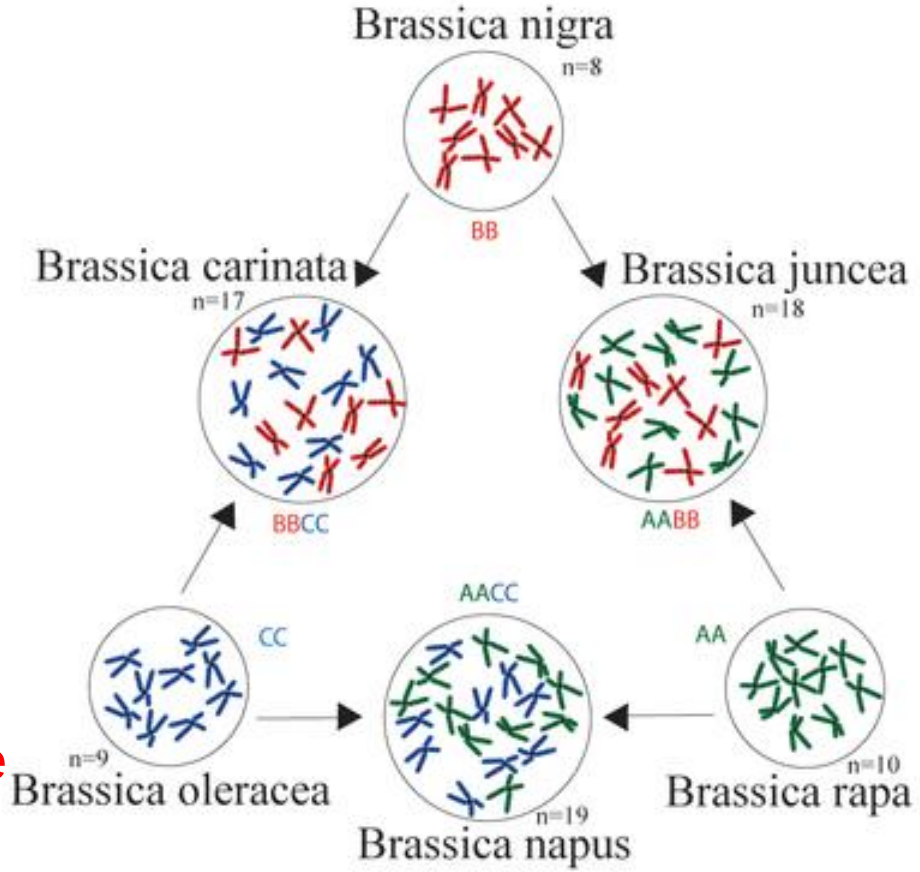
Canada

Resistance to clubroot in *Brassica* species

Black mustard; rich



Biofuel; no

Mustard & canola; no

Vegetables; weak resistance

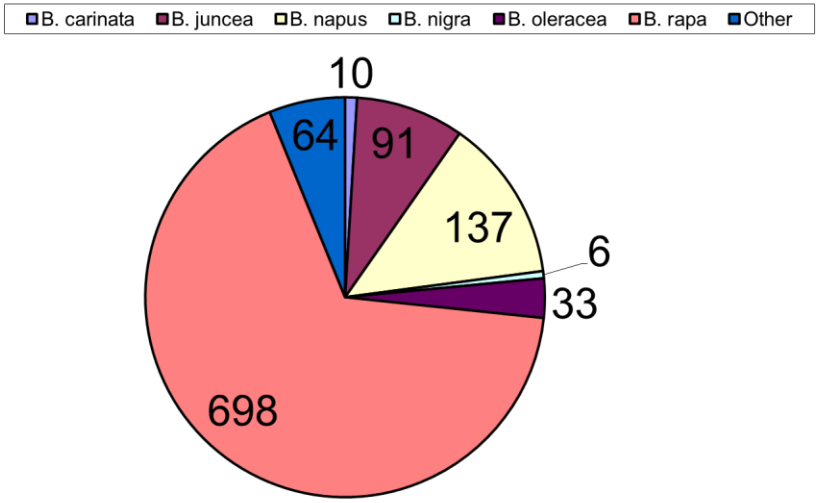
Vegetables; strong resistance originating from turnip

Canola: no

Rutabaga: yes

Identifying sources of resistance at AAFC

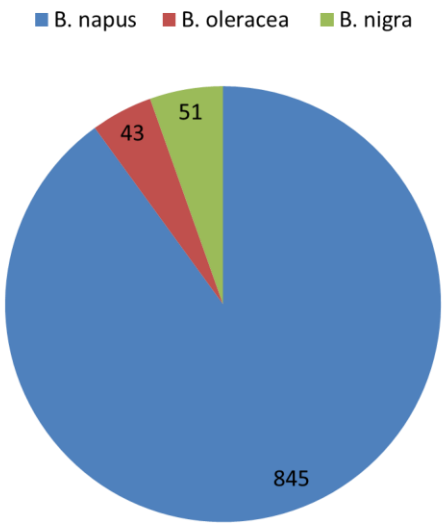
- *P. brassicae* pathotype 3



No. of R lines identified	
B. rapa	24
B. oleracea	2
B. nigra	3
B. napus	0

Peng G, K.C. Falk et al 2014. Can J Plant Pathol, 36: 89-99.

- *P. brassicae* pathotype 5X



No. of R lines	
B. napus	20
B. oleracea	2
B. nigra	7

Yu F et al, unpublished data

Selected *B. napus* lines tested for pathotypes 3A, 2B and 3D

- 162 out of 845 *B. napus* lines were tested.
- Lines resistant to clubroot (0 DSI) were identified:
  - 3 resistant to all of the 4 pathotypes
  - 17 lines resistant to 1-3 pathotypes

	2B	3D	5X-LG2
3A	0.77	0.50	0.31
2B		0.43	0.31
3D			0.29

Nine *B. napus* lines were tested for resistance to more pathotypes

	2B	3A	3D	3H	3O	5C	5G	5K	5L	5X	8E	8J	8P
DH16516	S	S	S	S	S	S	S	S	S	S	S	S	S
Westar	S	S	S	S	S	S	S	S	S	S	S	S	S
AAFC682	S	S	S	S	S	R	R	R	S	R	S	R	R
AAFC693	R	S	S	S	S	R	R	R	S	R	S	R	S
AAFC694	S	S	S	S	S	R	R	R	S	R	S	R	S
AAFC787	S	S	S	S	S	S	R	R	S	R	S	R	S
AAFC692	S	R	R	R	S	R	R	R	R	R	R	R	R
AAFC405	S	R	R	R	S	R	S	S	R	R	R	R	R
AAFC660	R	R	R	R	R	R	R	R	R	R	R	R	R
AAF 665	R	R	R	R	R	R	R	R	R	R	R	R	R
AAFC695	R	R	R	R	R	R	R	R	R	R	R	R	R

- Three *B. napus* lines resistant to all of the pathotypes were identified.

Introgression of clubroot resistance from turnip into canola

B. napus DH16516 **X** *B. rapa*

DH16516 **X** Triploid

DH16516 **X** BC1

DH16516 **X** BC2

BC3

Microspore culture for developing doubled haploid (DH) *B. napus*

Developing DH *B. napus* lines carrying CR genes from turnip

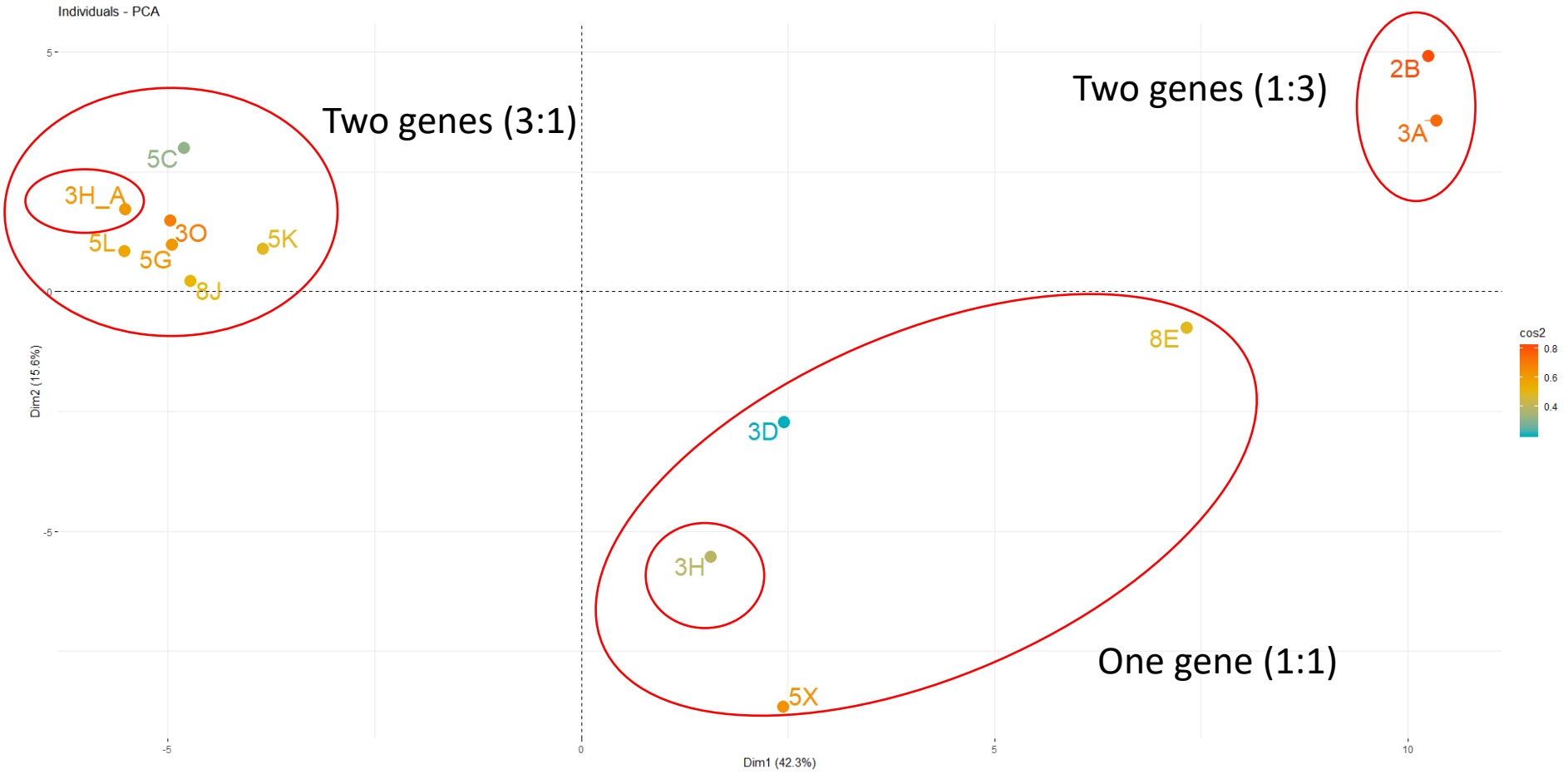
Donor Line	CR gene	Chr	Generation	No. of DH lines developed
Turnip Milan White	*Crr3*	A03	BC3	150
ECD01	*CRb*	A03	BC3	100
ECD02	*CRa*	A03	BC3	150
Debra	*CRc* *CRk*	A02 A03	BC2/BC3	190
Siloga	*Crr1* *Crr2* *Crr4*	A08 A01 A06	BC3	320

- Seed from > 800 DH lines was obtained.
- No vernalization is needed for all of the DH plants.
- Confirmation on the presence of each CR gene and identification of novel genes are in progress.

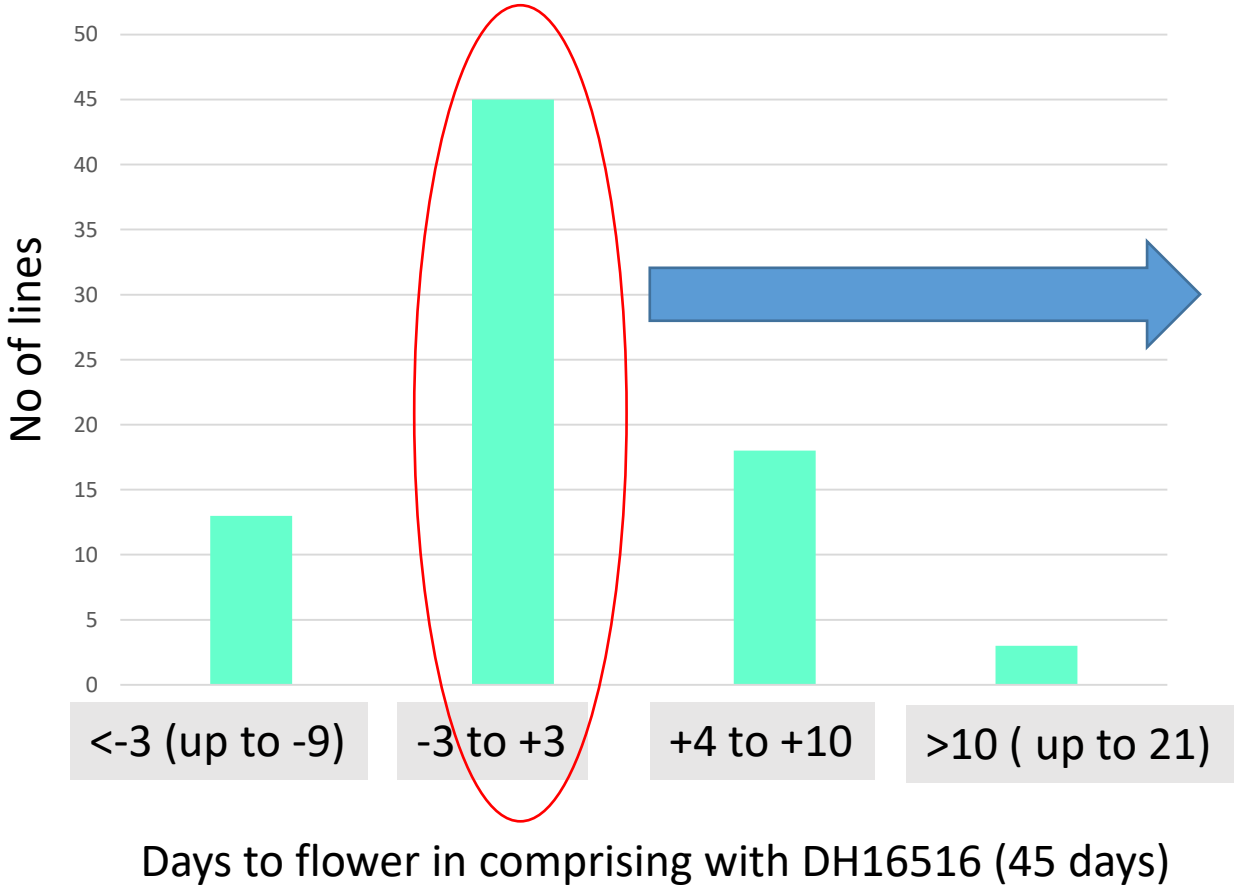
Segregating for resistance and susceptibility in a DH pupation consisting of 84 DH lines from BC2 of DH16516 x Debra

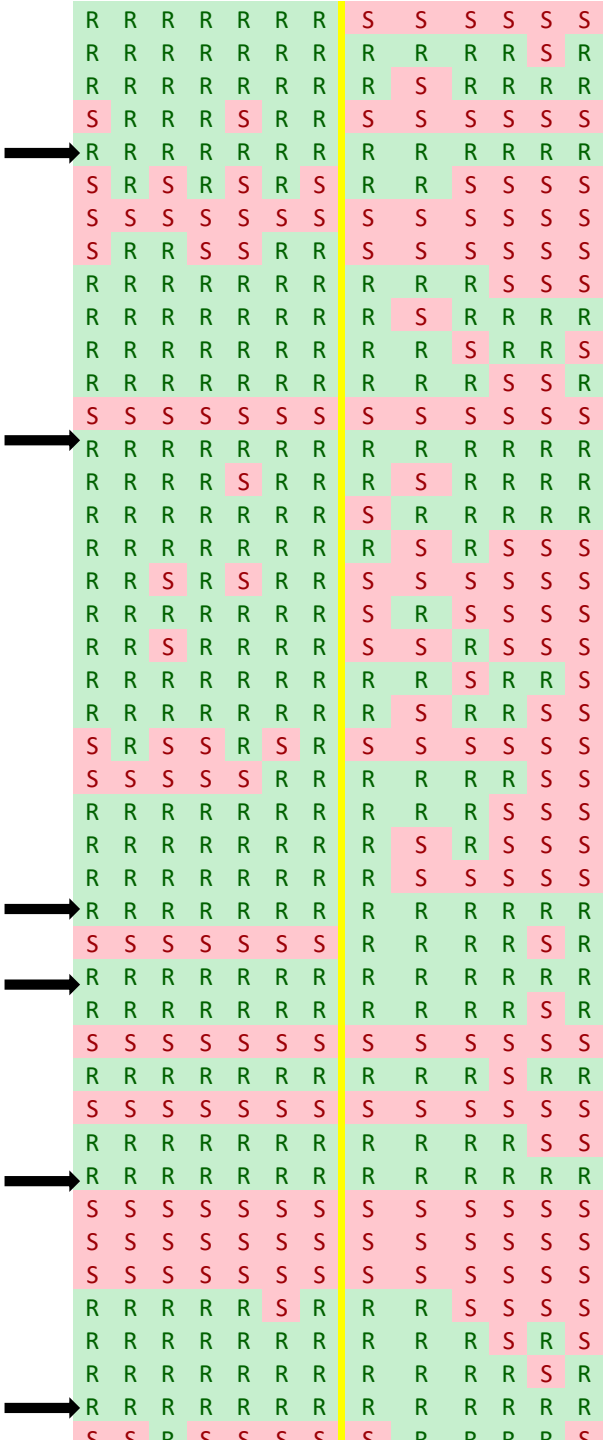
Tested by	Pathotypes	Average DSI	R	S	Expected ratio	*P*	No. of genes predicted
Stephen's group	3O	28.7	56	28	3:1	0.078	2
	5C	29.3	58	26	3:1	0.208	2
	5G	28.7	57	27	3:1	0.131	2
	5L	28.3	58	26	3:1	0.208	2
	5K	31.2	52	32	3:1	0.078	2
	8J	28.9	58	26	3:1	0.208	2
	3H_A	26.8	61	23	3:1	0.614	2
Fengqun's group	3H	34.2	51	33	1:1	0.050	1
	5X	38.7	49	35	1:1	0.127	1
	3D	34.5	48	36	1:1	0.190	1
	8E	47.4	37	47	1:1	0.275	1
	2B	54.3	25	59	1:3	0.313	2
	3A	55.6	27	57	1:3	0.131	2

Relationship of resistance to different phenotypes among 84 DH lines



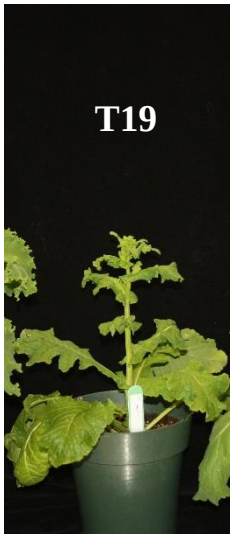
Selection of lines with days to flower similar to the recurrent parent DH16516





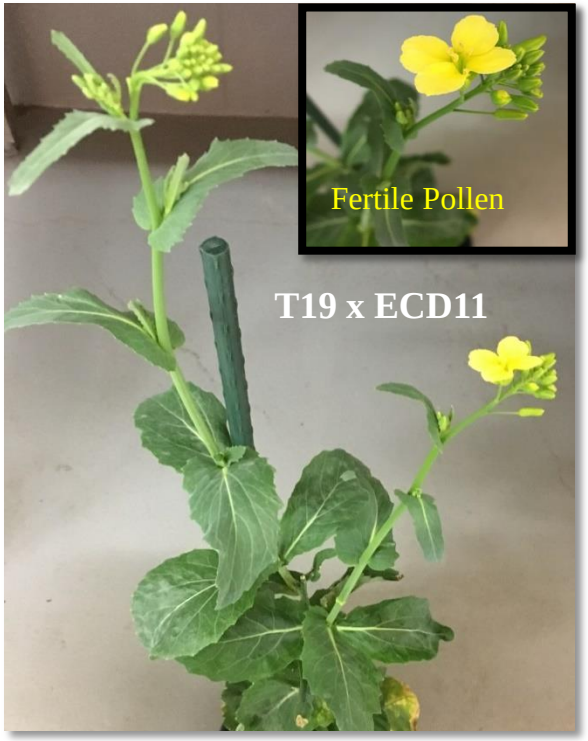
Six DH lines resistant to all of the pathotypes were identified.

Re-synthesizing *Brassica napus* with clubroot resistance from C-genome



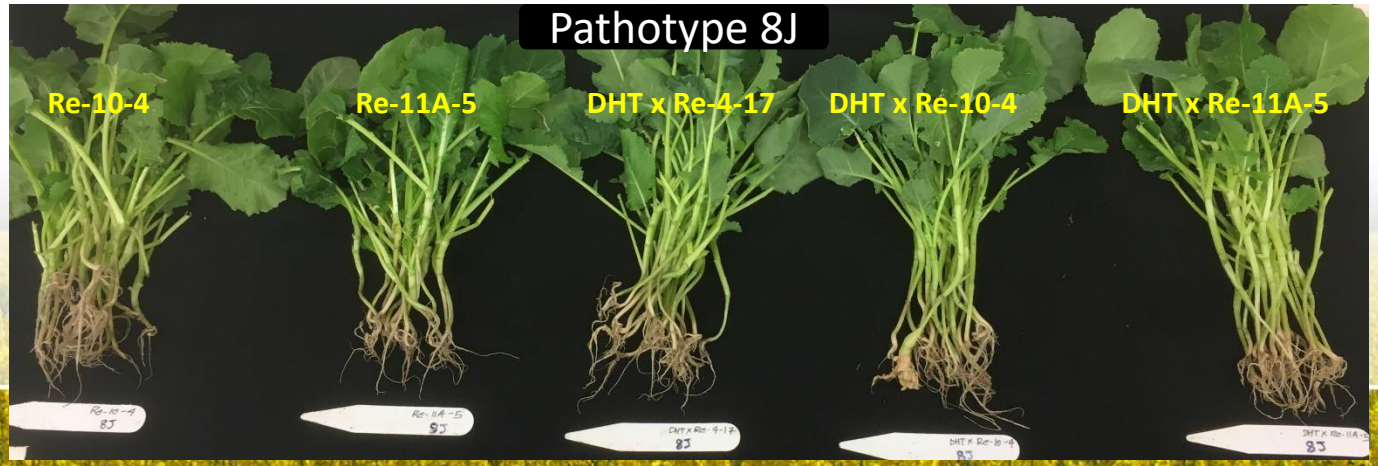
Yu F et al. 2017. Scientific Reports

B. rapa	***B. oleracea***
T19 (*Rcr4, Rcr8 and Rcr9*)	ECD11
	JL04



Evaluation of the re-synthesized *B. napus* lines from T19 x ECD11 for resistance to clubroot

Generation	Line name	3A_DSI(%)	8J_DSI(%)
F3	Re-10-4	41.0	0.0
F3	Re-11A-5	0.0	0.0
F1	DHT x Re-4-17	97.2	0.0
F1	DHT x Re-10-4	100.0	15.8
F1	DHT x Re-11A-5	100.0	0.0
S-control	DHT	100.0	100.0
R-control	45H29	100.0	88.9



Summary on sources and resources for resistance Canadian pathotypes

- Sources of resistance: vegetables (*B. rapa, B. olerace* and *B. napus)* and mustard (*B. nigra)*
- More than 30 lines with good resistance were identified from the species at AAFC, Saskatoon.
- Resources were developed by introgression of resistance from some of the sources into canola/ *B. napus*.
- Genetic resources including SNP markers developed at AAFC have been / will be distributed to canola breeders for developing cultivars for resistance to clubroot.

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