

# New sources of resistance to UK isolates of *Hyaloperonospora parasitica* in *Brassica oleracea* L.

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## Downy mildew of brassicas

- Caused by the oomycete *Hyaloperonospora parasitica* subsp. *brassica* (*HpB*)
- Can affect plants at all stages, but seedlings and young plants are most susceptible
- Fungicides can be used to control the disease, but repeated applications can lead to insensitive variants in the pathogen population; resistant cultivars could provide a practical, environmentally friendly alternative
- The aims of this study are to characterise three new *Brassica oleracea* sources of resistance, transfer resistance to crop-types and to search for new sources of resistance in other C-genome species

## Sources of broad spectrum resistance

- Three accessions identified with strong resistance at the cotyledon stage:
  - Two borecoles (*B. oleracea* var. *acephala*)
  - One Summer cabbage (*B. oleracea* var. *capitata*)
- Doubled-haploid (DH) lines were produced from outcrosses with a rapid-cycling parent (DH525 and 550 from borecole; DH544 from Summer cabbage)
- The three DH lines were broadly resistant when tested with 25 *HpB* isolates collected from major vegetable growing areas of the UK

## Allelism tests

- Crosses were made between the three sources of resistance
- F<sub>2</sub> populations were produced
- All lines were tested with a representative *HpB* isolate from the UK

Allelism tests of resistance to <i>HpB</i>		
F <sub>2</sub> derived from cross	Number of tested plants	Result
DH525 x DH544	523	Resistant
DH544 x DH525	592	Resistant
DH550 x DH544	502	Resistant
DH544 x DH550	520	Resistant
DH525 x DH550	531	Resistant
DH550 x DH525	540	Resistant

## Inheritance of resistance

- Crosses were made between the three sources of broad spectrum resistance and
  - A susceptible DH broccoli (Cal18b)
  - A susceptible rapid flowering cauliflower (cv. Lateman)
- F<sub>1</sub>s, F<sub>2</sub>s and back-cross populations were tested



DH544, resistant



F<sub>1</sub>, resistant



Broccoli Cal18b, susceptible

Example of segregation for resistance to *HpB* in F<sub>2</sub> and BC<sub>1</sub> generation

Line	Result	Proposed segregation	X <sup>2</sup> probability
F <sub>2</sub> (broccoli Cal18b x DH544)	20 res.		
BC <sub>1</sub> (broccoli Cal18b x F <sub>1</sub> )	40 res. : 38 sus.	1 : 1	0.82
F <sub>2</sub> (Self of F <sub>1</sub> )	136 res. : 34 sus.	3 : 1	0.13
F <sub>1</sub> (DH544 x cauliflower cv. Lateman)	22 res.		
BC <sub>1</sub> (F <sub>1</sub> x cauliflower cv. Lateman)	34 res. : 43 sus.	1 : 1	0.31
F <sub>2</sub> (Self of F <sub>1</sub> )	142 res. : 48 sus.	3 : 1	0.93

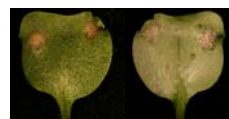
- The results indicate that resistance on all three lines is controlled by one single dominant gene
- This gene is allelic, identical or tightly linked in all three lines

## Transfer of resistance to a crop-type

- DH lines were produced from crosses between two sources of resistance and a susceptible broccoli
- DH plants have been self-pollinated
- 35 lines were tested for resistance at the cotyledon stage with one *HpB* isolate



DH line PER16, resistant



DH line PER51, intermediate phenotype

Results:

- approximately half of the DH lines were resistant
- An intermediate phenotype that shows restricted sporulation was observed in approximately one quarter of the plants



BC, plant derived from a cross between broccoli Cal16b and a resistant plant

A back-cross programme is under way to transfer the resistance to broccoli and cauliflower.

## Screening wild C-genome species

A collection of wild C-genome accessions (e.g. *Brassica cretica*, *B. incana*, *B. macrocarpa*) is being screened to identify new sources of resistance



Wild C-genome accessions inoculated with an *HpB* isolate (the 5<sup>th</sup> column includes resistant controls)



*B. incana* accession, susceptible

- Preliminary results indicate that, as with *B. oleracea*, most of the wild germplasm is highly susceptible
- Several examples of partial resistance have been observed.

## Conclusion

The resistance genes identified could be incorporated in commercial cultivars in order to control downy mildew at the seedling stage.

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