

Commercial breeding for pest and disease resistance in cane and bush fruits

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Introduction

While breeding for agronomic traits remains a priority in any commercial breeding programme, a key objective of both the *Rubus* and *Ribes* breeding programmes at SCRI is to incorporate resistance to pest and disease.

Key pests and pathogens of raspberries in Scotland

- Raspberry root rot, *Phytophthora fragariae* var. *rubi*.
- Large raspberry aphid, *Amphorophora idaei*.
- Raspberry beetle, *Byturus tomentosus*.
- Raspberry cane midge, *Resseliella theobaldi*

Aphid resistance

- Aphid resistance largely depends on single major genes
- Currently over 90% of the *Rubus* germplasm is segregating for A_{10}^1 conferring resistance to *A. idaei*.



Large raspberry aphid (*Amphorophora idaei*)

- Plans to screen for new sources of resistance are in progress due to increasing evidence of resistance-breaking strains in the south of England.

Raspberry root rot

- *Phytophthora* is the most destructive disease of raspberries in the UK and accounts for ~20% of the tonnage lost in Scotland.
- ~25% of the commercial crossing programme is dedicated to breeding for resistance/tolerance to *Phytophthora*.
- Segregating progenies are screened in a deliberately infested plot.
- Genotypes with putative resistance are currently undergoing further evaluation for fruit quality.

Development of molecular markers linked to root rot resistance

- A population segregating for *Phytophthora* resistance was created using the cvs. Glen Moy x Latham.
- The progeny were screened for 3 years in infested field plots and then segregated into resistant, moderately resistant and susceptible bulks.
- The segregating progeny demonstrate continuous variation suggesting a strong quantitative component to resistance/tolerance.
- Using bulk segregant analysis, RAPD bands were found to be present in resistant and moderately resistant progeny but absent from the susceptible progeny.

Marker assisted selection will be a useful tool in future breeding strategies for *Phytophthora* resistance since it will identify resistant genotypes quickly relative to current practices. Field infestation plots show results only after several years and glasshouse screening shows no correlation to field results.



Field plot heavily infested with *Phytophthora*



Infected population showing segregation for resistance

Key Pests and Pathogens of *Ribes* in Europe

- Blackcurrant gall mite (*Cecidophyopsis ribis*)
- Blackcurrant Reversion Virus

Control of *C. ribis*, which besides being a pest in its own right is also the only known vector of blackcurrant reversion virus, is increasingly difficult, with the withdrawal of many chemical agents, eg. endosulphan. Resistant cultivars, produced by the introgression of resistance genes from other *Ribes* species, appear to offer the most appropriate long-term strategy for overcoming these serious pest and disease problems, particularly when used in conjunction with a suitable ICM programme.



C. ribis

Resistance sources

Resistance to gall mite is conferred by the *Ce* gene from the gooseberry, *Ribes grossularia*. Using this source, resistant material has been developed and a resistant cultivar, Ben Hope, was released from SCRI in 1997.



Ben Hope

A major source of resistance for blackcurrant reversion is the Russian species *Ribes dikuscha*, and a reversion virus-resistant cultivar, Ben Gairn, was released from SCRI in 1997. Together with Ben Hope, these cultivars have already made a significant impact on the UK blackcurrant industry.

Development of molecular markers for gall mite resistance

Traditional screening for mite-resistant seedlings involves the use of field infestation plots over a number of years. However, recent work at SCRI has concentrated on the development of molecular markers in order to facilitate the more efficient and timely selection of resistant *Ribes* hybrids.

Using populations segregating for resistance, classification into resistant and susceptible phenotypes was followed by bulk segregant analysis using AFLPs. From this analysis, 2 AFLP bands showed linkage to the *Ce* locus.

These markers have great potential utility in the marker-assisted selection of gall mite-resistant blackcurrant hybrids within the SCRI/Glaxo SmithKline *Ribes* breeding programme, and deployment strategies are under



development. However, more recent work at SCRI is concentrated on the development of SSR markers, since the latter are highly polymorphic, multi-allelic and co-dominant.

The SSRs developed so far are currently being tested on a range of *Ribes* germplasm, and linkage of these SSRs to various traits of interest, from single-gene pest/disease resistances to QTLs for fruit quality, is under investigation.

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