

Modern techniques in the Scottish raspberry breeding programme

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The raspberry breeding programme at The James Hutton Institute is currently funded by the UK Raspberry Breeding Consortium (UKRBC) until 2014. The objectives of the programme are to produce high quality florican and primocane raspberry cultivars for the fresh and processing markets.

Classical breeding techniques of crossing and selection can take a minimum of 15 years to develop a commercial cultivar. Screening for disease, such as *Phytophthora* root rot, in an infestation plot can add another 5 years to this timescale. In an attempt to reduce this timescale, a raspberry genetic map was created and molecular markers were developed as part of our underpinning science programme. A mapping population segregating for root rot resistance was screened under both field and glasshouse conditions over a number of seasons. Two QTL associated with resistance were identified as were overlapping QTL for root vigour assessments. Markers significantly

associated with the traits were used to identify BAC clones, which were subsequently sequenced to examine gene content. A number of genes were identified including those associated with stem cell identity, cell proliferation and elongation in the root zone, control of meristematic activity and organisation, cell signalling, stress response, sugar sensing and control of gene expression as well as a range of transcription factors including those known to be associated with defence. For marker assisted breeding, the SSR marker Rub118b 110 bp allele from Latham was found in resistant germplasm but was not found in any of the susceptible germplasm tested¹.



Fresh market genotypes are selected under a protected cropping system



Glen Ericht released in 2010 for the processing market is highly tolerant to *Phytophthora* root rot. This was selected through extensive screening in an infestation plot

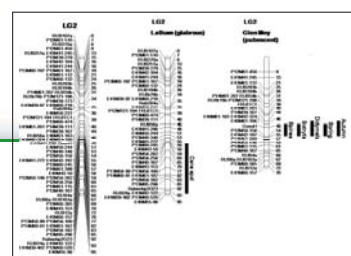


The 'Glen' series of raspberry cultivars were developed at The James Hutton Institute

Glen Fyne is a very productive cultivar with a sweet raspberry aroma

Markers currently deployed in the breeding programme:

- ***Phytophthora* root rot resistance.** Parents with the marker were identified in 2008, crosses made in 2009 and progeny screening initiated in 2010.
- **Cane botrytis (*Botrytis cinerea*) and spur blight (*Didymella applanata*) resistance.** An association was found between *Gene H*, conferring cane pubescence/hairs, and resistance to these cane diseases¹ that led to the use of a morphological marker that involves a rapid visual screen for the phenotype early in the breeding process, eliminating the need for a lab-based screen or field inoculation.



Genetic linkage map shows QTL for *Gene H* on Linkage Group 2



Gene H = pubescent canes = resistance to cane botrytis and spur blight

Other traits mapped:

- Sensory characteristics
 - Fruit size
 - Colour/anthocyanins
 - Volatiles, Brix^o

Traits currently under investigation

- Fruit softening
- Crumbly fruit
- Plant physical mechanisms associated with pest resistance
 - Cane splitting, leaf hairs

Molecular breeding is not a replacement for conventional breeding, a good germplasm base is required, crossing will continue and field screening is still required.

This new contemporary breeding approach integrates conventional breeding with molecular breeding and creates a valuable toolkit which will:

- Select important traits early in the breeding programme.
- Eliminate undesirable types before field planting.
- Reduce numbers, and therefore field costs, of early stage breeding material.
- Reduce the timescale to a commercial variety.
- Result in a more efficient, focussed breeding programme that will produce high quality cultivars suitable for low input production.

References

¹Graham, J., Hackett, C. A., Smith, K., Woodhead, M., McKenzie, K., Tierney, I., Cooke, D., Bayer, M. and Jennings, N. (2011). Towards an understanding of the nature of resistance to *Phytophthora* root rot in red raspberry. Theoretical and applied genetics (online early)

²Graham, J., Smith, K., Tierney, I., MacKenzie, K. and Hackett, C.A. (2006). Mapping gene *H* controlling cane pubescence in raspberry and its association with resistance to cane botrytis and spur blight. Theoretical and applied genetics. 112: 818-831

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