HL0169:

Molecular breeding for root rot resistant raspberries suitable for low input growing systems

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High quality raspberry but with no resistance to root rot

Root damage

The use of genetic based durable pest and disease resistance is a major part of the breeding objectives of most breeding programmes world-wide. High quality raspberry cultivars, adapted to the challenges faced by their environment, are essential for the future expansion of the UK raspberry industry, where increasingly the desire is for fruit grown in low input/ICM production systems.

The main obstacle in shifting production to low input systems is a lack of high quality cultivars resistant to some of the most damaging pathogens, notably to raspberry root rot caused by *Phytophtora fragariae* var. *rubi*. In this case there is a complete lack of commercially acceptable resistant cultivars. Raspberry root rot has had a devastating effect on many growers, rendering their plantations uneconomic and ultimately unsuitable for raspberry production.

The existing control measures for root rot involve the use of significant quantities of fungicide at very high cost. No suitable high quality cultivars are available with genetic based resistance to raspberry root rot, and until these can be developed reliance on fungicide will continue.

Breeding in raspberry, is a long process, the speed and precision of which can be improved by the utilization of genetic linkage maps where the plant's chromosomes are represented as linkage groups with signposts, in the form of molecular markers, placed along the chromosome.
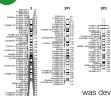Phenotypic traits can then be associated with molecular markers to develop marker assisted breeding.

Breeding programme by conventional means

Background

All traits in plants are controlled by genes, and the combination of alleles or versions of the genes in the plant is known as the genotype. Red raspberry is diploid and therefore can have two different alleles of each gene. In order to develop marker assisted breeding, the identification of regions on the chromosome with alleles for resistance to root rot need to be achieved.

Resistance to raspberry root rot exists in North American germplasm and thus, through plant breeding, can be transferred into European germplasm. Latham an old cultivar close to species material can be used as a donor of root rot resistance.

Currently selection for resistant progeny in a crossing programme requires years of field trials after each cross and when coupled with the difficulty in combining resistance with quality traits, the lack of resistant high quality cultivars is understandable through conventional breeding.
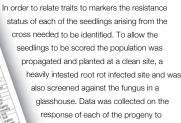
Project aim

The aim of this project was to identify map regions, where alleles associated with resistance were located, and from this, information to develop marker-assisted selection for raspberry root rot.

A population segregating for root rot resistance was developed utilising a cross between Glen Moy, a susceptible European raspberry, and Latham, the resistant parent from North America. A genetic linkage map was also constructed from this population allowing the genotype and phenotype to be directly associated.

In order to relate traits to markers the resistance status of each of the seedlings arising from the cross needed to be identified. To allow the seedlings to be scored the population was propagated and planted at a clean site, a heavily infested root rot infected site and was also screened against the fungus in a glasshouse. Data was collected on the response of each of the progeny to infection both in the field and in the glasshouse trials and this information was combined with linkage map information to identify regions responsible for root rot resistance.

Distribution of disease scores in glasshouse trials

Segregating population

Latham and Glen Moy roots after root rot infection

Results

GH and Field results

Two map regions one on each of two of the seven raspberry linkage groups (chromosomes) were identified as being significantly associated with root rot resistance and markers have been identified in each of these regions for marker assisted selection. Interestingly root parameters map to the same region on one of the linkage groups and close to the second region as those identified for resistance.

Close correlation was identified between root parameters such as root density and root diameter from the mother plant, with the plants ability to resist root rot. The more root the plant has the more it resists root rot infection.

Outputs

This work has identified germplasm with resistance to root rot, developed molecular markers for screening promising selections for resistance to root rot and produced an enhanced map of potential gene sequences for raspberry breeding which will also be of great value in another Link project relating quality traits to markers. Markers are available for raspberry breeding programmes in the UK.