STRATEGIES FOR DURABLE BLACKLEG RESISTANCE IN AUSTRALIA

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The blackleg fungus (*Leptosphaeria maculans*) is the major pathogen of canola (*Brassica napus)* worldwide. In the early 1990s an accession of *Brassica sylvestris* was identified as being highly resistant to the blackleg fungus. This major gene resistance was successfully incorporated into canola, resulting in a virtual immune response to blackleg. Pacific Seeds released cultivars with *sylvestris* resistance, substantially reducing yield losses due to blackleg. However, within only the third year of commercial cropping the blackleg fungus has overcome this resistance in several regions. During the 2003 season yield losses were up to 90 %. Cultivars relying predominantly on *sylvestris* resistance are being withdrawn from the market.

In reponse, the Australian Grains Research and Development Corporation has funded a project to determine how to deploy resistance genes in a manner that does not lead to resistance breakdown. The research is split into four components.

(i) Field Survey to Map the Spread of Resistance Breakdown

The results from a 2003 blackleg survey have shown that resistance breakdown occurred in areas where:
a) sylvestris resistance was grown for at least three years
b) canola production is extensive
c) the region had a history of high blackleg severity (in conventional quantitative cultivars).

Surveys will be undertaken for three years to identify regions where resistance breakdown has occurred. The circumstances common to sites where the fungus has overcome blackleg resistance will be determined. Sites will be assessed for rainfall, temperature and intensity of canola production.

(ii) Genetic Fitness of Strains

Major gene resistance is assumed to be based on a gene for gene interaction with the pathogen, whereby alteration of a single gene in the pathogen is required for resistance to be overcome. Since the blackleg fungus outcrosses and recombines readily under Australian conditions and produces millions of wind-dispersed spores, its ability to respond to selection pressure (such as new resistance genes) is high. Therefore, if major genes for resistance are to be used, the best strategy may be to keep rotating cultivars with different major genes as well as quantitative resistance, so that the frequency of strains able to attack one particular major resistance gene will not increase.

Experiments will determine the specificity of different isolates against a series of resistance sources. If isolates are specific to a particular resistance gene, then rotating different resistance genes by rotation of canola varieties may protect resistance genes from breaking down. Such specificity has been noted by Helen Hayden, who showed that of 150 blackleg isolates collected from stubble of cv. Dunkeld at Wonwondah, Vic, 20 attacked both *sylvestris* and *Brassica juncea* cv. Stoke, 19 attacked Surpass only, and 11 attacked *B. juncea* only and the rest (100) attacked neither cultivar.

(iii) Strategies to Improve Durability

This experiment will involve rotating different sources of blackleg resistance in the field over four years to determine if rotation is a feasible method of minimising the ability of virulent blackleg isolates to increase in frequency. If successful, a system of resistance rotation could be utilised by growers. The system would be modelled on the system of rotating herbicide groups to avoid herbicide resistance. Farmers would be encouraged to rotate different resistance sources and keep crops 500m away from stubble of the same resistance.

(iv) Isolation Distance Required to Protect Resistance Genes

Previous studies on polygenic resistant cultivars indicate that an isolation distance of 500m between the current crop and last year's canola stubble is sufficient to avoid the highest densities of blackleg inoculum. However, the isolation distance required where a resistance breakdown has occurred may be different to the isolation distance required for protecting effective quantitative resistance. If isolation distances required are relatively short (500 - 1000m) individual farmers or groups of farmers could successfully manage resistance rotation on their own properties.