Potential new management strategies for blackleg control

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BACKGROUND

Recommendations to Australian canola growers for blackleg control are likely to change over the next few years as a result of the blackleg fungus overcoming deployed resistance genes. This paper indicates why these changes will occur and proposes new management recommendations.

The blackleg fungus *Leptosphaeria maculans* is the most damaging disease of canola and juncea-canola in Australia. The disease is difficult to control and many growers accept yield loss from blackleg as a normal part of canola production.

Blackleg is challenging to control commercially due to the following factors as the fungus:

1. Survives on stubble resulting in more inoculum in intensive canola production regions.
2. Spreads via windborne and rain-splashed spores resulting in inoculum being spread extensively and quickly.
3. Grows systemically within the plant resulting in limited efficacy of sprayed foliar fungicides.
4. Reproduces sexually resulting in diverse populations that can overcome resistance genes quickly.
5. Interacts with canola whereby avirulence genes in the fungus render the pathogen unable to attack canola plants with the corresponding resistance gene. These avirulence genes, and resultant virulent isolates can readily increase in frequency under selection pressure from extensively sowing of cultivars with corresponding resistance gene.

Recently acquired knowledge on the consequences of the blackleg fungus overcoming resistance includes:

1. When individual cultivars (resistance sources) are grown on a large scale and over a number of years, *L. maculans* isolates that are virulent towards that particular resistance gene dramatically increase in frequency, resulting in increased disease.
2. When a cultivar based on a different source of resistance is sown in areas where another source of resistance has been extensively sown, this cultivar is likely to have fewer blackleg symptoms as the majority of *L. maculans* isolates are virulent towards the previous source of resistance.
3. Newly deployed novel sources of resistance remain effective for a number of years before virulent *L. maculans* pathotypes increase in frequency to a level where significant disease results.
4. Resistance sources that have become ineffective can be sown again in the same area after a number of years, as *L. maculans* isolates virulent to that particular resistance source will have decreased to a low frequency.

Knowledge of the dynamic nature of fungal populations resulting in changes in frequency of virulent isolates in response to the resistance source being grown, can be used by canola growers to reduce damage caused by blackleg.

Current grower management cultural practices are to:

1. Plant canola cultivars with high levels of genetic resistance.
2. Avoid canola stubble (especially from the previous season's crop).
3. Apply seed dressing or fertiliser amended fungicide.

However, when host resistance is overcome the above practices can still be insufficient to avoid high levels of blackleg disease.

POTENTIAL NEW MANAGEMENT RECOMMENDATIONS

The Australian canola industry recognises the need to control blackleg. However, it has also been recognised that since blackleg severity varies depending on regional climate and intensity of canola production, blanket recommendations to growers from different regions will result in inappropriate management in many situations.

At the 2009 Canola Pathology Workshop at The University of Melbourne it was agreed to investigate if the blackleg risk for individual paddocks could be determined, thus enabling growers to identify risks and then change practices if required.

All known factors that influence blackleg severity are listed in Table 1, which is a prototype that could form the basis for a paddock risk assessment. After consulting such a table, growers can determine their own risk for each factor and ultimately determine the overall risk of their individual paddock. Growers can then alter individual factors to reduce risk; for example sow cultivars with a different source of resistance, apply fungicide.

The scores for each factor are based on current knowledge; however, these score are subjective and will change as more information becomes available. Prior to release to growers, the canola industry will be given the opportunity to review these factors and their scores.

Once the grower has determined the blackleg risk score for a paddock, he/she will be able to determine how management practices (factors) influence blackleg severity. The more difficult process will be for the canola industry to determine what score constitutes a low, medium or high risk situation. In the Table 1 the highest possible score is 84, it is yet to be determined what an acceptable score will be and at what score growers are advised to change practices.

Background monitoring to support the new management plan

Monitoring blackleg severity will enable growers to be informed of any changes in the current disease status of their region. Below is a summary of proposed monitoring processes:

- Determining blackleg incidence and severity of different sources of resistance in NVT sites and blackleg disease nurseries across Australia.
- Trapping fungal spores in Burkard traps and determining frequencies of different avirulence genes in populations using molecular markers.
- Collecting individual isolates from different sources of resistance and from regions where resistance may be becoming ineffective and determining their virulence by testing on plants and applying molecular markers.
- In areas with crops suspected to have ineffective resistance, sowing different sources of resistance in the following year to identify the severity of the breakdown and to give growers information on which resistance sources are still stable.

Future information to growers

1. Blackleg ratings will be published each year with reduced resistance warnings placed next to cultivars that have a lower level of blackleg resistance.
2. The GRDC-funded project (UM00034) will identify individual resistance genes in canola cultivars. These isolates will be used to identify resistance genes in each commercial cultivar.
3. Knowledge of presence of particular resistance genes in cultivars will form the basis for informing growers which cultivars should be separated from stubble of particular cultivars and which cultivar should be sown if resistance is becoming less effective.
4. Molecular markers for three avirulence genes are available. As more are characterised, growers in particular regions can be warned if pathotypes capable of attacking particular cultivars are increasing in frequency.

Table 1 Blackleg Management Risk Assessment with potential factors and weightings (scores) to be completed for each individual paddock prior to sowing canola.

Blackleg severity risk factor	**Individual factor score**									**Paddock score**
	9	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1. Annual rainfall zone (mm)	< 550	> 500	> 450	400	> 400	> 350	> 300		> 250	
2. Autumn rainfall total (mm)			< 100		60 - 100			> 100		
3. Month sown			Jun /Jul		May		April			
4. Canola intensity % farm	<20	20	15			10		5		
5. Cultivar Blackleg rating	VS	S - VS	S	MS - S	MS	MR - MS	MR	R - MR	R	
6. Jockey or Impact seed dressing				No		Yes				
7. Dist (m) to 1 year old stubble	0	100	250			500	> 500			
8. Dist (m) to 2 year old stubble					0	100	250	500	> 500	
9. Dist to 1 y old stubble of same cultivar	0	5 - 250	251 - 500			500	> 500			
10. Dist (m) to 2 y old stubble of same cultivar			0	5 - 250	251 - 500			500	> 500	
11. Years of same cultivar sown in a row			< 3		3				> 3	
									TOTAL	

This table is a prototype; the blackleg severity risk factors and their score may need to be modified prior to release to industry.

Examples of scores for different regions

Table 2 illustrates how the score will change for canola produced in different regions, for this hypothetical case we suggest a score of 40 is acceptable risk. Therefore, a grower from the southern Mallee in Victoria may determine that they can grow a cultivar with lower blackleg resistance and reduce costs by not using a fungicide and still have a low blackleg severity risk. The grower from the Wimmera may conclude that they are OK and maintain their current practices. The grower from Lower Eyre Peninsula might increase distances to one year old stubble and switch to a new cultivar to reduce their blackleg severity risk.

Table 2. Anticipated scores for three typical paddocks in different grain producing regions of southern Australia

Blackleg severity risk factor	**Lower Eyre Peninsula score**	**Wimmera (Vic) score**	**Southern Mallee (Vic) score**
1. Annual rainfall zone (mm)	*7*	*5*	*4*
2. Autumn rainfall total	*7*	*5*	*2*
3. Month sown	*5*	*5*	*4*
4. Canola intensity % farm	*6*	*4*	*2*
5. Cultivar Blackleg rating	*1*	*1*	*1*
6. Jockey or Impact seed dressing	*4*	*4*	*4*
7. Dist (m) to 1 year old stubble	*7*	*7*	*3*
8. Dist (m) to 2 year old stubble	*3*	*2*	*1*
9. Dist to 1 y old stubble of same cultivar	*7*	*4*	*3*
10. Dist (m) to 2 y old stubble of same cultivar	*5*	*2*	*1*
11. Years of same cultivar sown in a row	*5*	*5*	*5*
Total score	***57***	***44***	***30***