

Managing upper canopy blackleg infection (UCI) in medium and high rainfall regions

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Take home messages

- Increased canola stubble area and the increased area sown to canola will reduce the ability of growers to maintain a 500m buffer between one-year-old stubble and current crops
- Canola stubble quantity (t/ha) rather than stubble management has the largest effect on blackleg disease
- Seasonal conditions will influence whether crown canker or Upper Canopy Infection (UCI) will be more significant and potentially warrant control. It will be rare to have severe forms of both versions of blackleg in the same year
- Crown canker years occur from late sowings, resulting in plants remaining as seedlings during the winter infection period
- Upper Canopy Infection years will likely result from early sowing times resulting in plants commencing flowering in late June/early August. Early flowering will result in increased infection and will provide the fungus with more time to cause damage prior to harvest
- The decision to use a fungicide is not clear cut. You must first understand the disease risk profile of your crop
- Prior to sowing, use the BlacklegCM decision support tool to identify high risk paddocks and explore management strategies to reduce yield loss
- Fungicide application for UCI is a separate decision-making process from crown canker control. UCI fungicide application can result in very variable yield returns. You must understand the risk before applying a fungicide.

Introduction

In recent years the area sown to canola in NSW and Victoria has increased significantly. This has been driven by excellent and consistent prices for canola and favourable seasons for production (especially in 2020 and 2021). The main areas of significant expansion have been into medium and lower rainfall regions, which in the past have not been traditional canola producing districts. Whilst in medium to high rainfall areas the area sown has remained relatively stable. However, what has changed in these regions is the amount of canola stubble in the farming system and the resulting increase in disease pressure.

Increased canola density will increase blackleg inoculum (spore density)

The fungus that causes blackleg survives on old canola stubble and releases airborne spores that infect new season crops each year. The more canola stubble there is present from the previous year, the higher the disease pressure will be from blackleg. This is especially true for crops grown within 500m of the previous seasons' stubble.

If stubble remains intact it will release blackleg spores within the growing season. Spore release has been measured from old canola stubble for up to four years. However, the blackleg fungus will release fewer spores as the stubble and the fruiting bodies age, that is, one- year-old stubble produces more spores than two- year-old stubble etc. The main driver is stubble quantity from the previous season and the resulting spore release per piece of stubble (this is inoculum load). Previous work showed that approximately 99% of spores originate from the previous year's canola stubble. Canola stubble more than 1 year old produces fewer spores and has less stubble material to harbour the disease due to decomposition.

Heavy canola stubbles from 2021 will be increasing disease pressure on 2022 canola crops. High stubble loads will be the most important driver for blackleg development in medium to high rainfall regions.

Commencement of flowering will influence the development of UCI

Observations from commercial crops and research undertaken at Horsham has shown canola that commences flowering early is more prone to developing UCI compared to canola that commences flowering later in the season. It appears that canola bolting and flowering in mid to late winter is exposed to high levels of spore release and hence more prone to developing UCI, as opposed to canola that is still in the cabbage stage at this time and more prone to developing the traditional stem canker.

Your crop is unlikely to get both crown canker and UCI in the same year, therefore you need to know which form of the disease you need to manage this year.

Findings over the past few years have indicated that most years will be defined as a crown canker or UCI year, but rarely both. In most regions 2021 was a crown canker year. That is, as an agronomist or grower you will be managing for either crown canker or UCI. The risk is determined by the timing of sowing (germination).

1. **Crown canker** - severe crown canker is most likely to develop when plants are infected during the early seedling stage (cotyledon to 4th leaf). The driving factor for seedling infection is the length of time that the plant is exposed to blackleg infection while in the seedling stage. Therefore, the risk of seedling infection, which leads to crown cankers, is very variable from season to season. Once plants progress to the 4th leaf stage they are significantly less vulnerable to crown canker. That is, older plants will still get leaf lesions, but the pathogen is less likely to cause damaging crown cankers as the fungus cannot grow fast enough to get into the crown. Typically, plants sown early in the growing season (April) will develop quickly under warmer conditions and progress rapidly past the vulnerable seedling stage, whereas plants sown later (mid-May) will progress slowly and remain in the vulnerable seedling stage for an extended period.
2. **Upper Canopy Infection (UCI)** – UCI occurs when the plants become reproductive early in the growing season, typically when crops commence flowering in late June/early August. This results in cool moist conditions which are conducive for infection events but also allows enough time for the pathogen to cause tissue necrosis prior to harvest. That is, UCI flower and branch infection can occur at any time, but it only results in yield loss if it occurs early in the season. This is because the pathogen must grow from the infection point to within the vascular tissue of the plant where the necrosis occurs causing yield loss. In 2021, crops that

commenced flowering in early September in many cases did get UCI infection, but the infection did not progress to the vascular tissue and no yield losses resulted.

Upper canopy blackleg fungicide application

Blackleg Upper Canopy Infection (UCI) refers to infection of the upper stem, branches, flowers and pods and whilst we are constantly improving our understanding regarding these new symptoms, there is still a very large knowledge gap of how individual cultivars react to UCI. Furthermore, our research shows that similar symptoms of UCI can cause very severe economic impact in one season and have no economic impact in another. As such, our recommendations for managing blackleg UCI are constantly evolving.

Monitor crops for UCI development

Symptoms of UCI will begin to appear some time before the disease becomes damaging. Scout canola crops for symptoms of UCI as crops commence stem elongation. The main symptom will be leaf lesions on the upper foliage, suggesting active infections taking place and opportunities for secondary infections via pycnidiospores. Monitor crops regularly (every 7-10 days) and check for new leaf lesions and changes in lesion size. Leaf lesions on the oldest leaves at ground level are unlikely to contribute to UCI.

Should I apply a fungicide for UCI protection?

This question is a real dilemma, get it wrong and it will cost your crop a lot of money, but there is no way to predict economic return accurately yet. Current research is working on improving knowledge including determining timing of infection leading to yield loss. Research also looks at weather parameters associated with yield loss and strategies for screening for genetic resistance.

However, you can still determine if your crop is likely to be a high, moderate or low risk situation.

1. **Date to commencement of flowering.** Crops that flower earlier in the season are at a higher risk. They will flower in cooler wetter mid-late winter/early spring which is more conducive for blackleg infection.
2. **Time from the commencement of flowering to harvest.** We hypothesise that the fungus requires a certain amount of time from when it initially infects the plant to when it causes the damage (internal infection) that leads to yield loss. The longer time period from infection to harvest = increased risk of yield loss.

The date of 1st flower and the time from 1st flower to harvest are good predictors of yield loss. This knowledge can in hindsight explain why in some regions/years yield loss can occur whilst in other years yield loss may not occur. Obviously, these key dates change between regions. For example, if two crops flower on August 7th but the Barellan crop is mature on October 25th and the Cootamundra crop matures on November 25th then there is higher potential for damage to the Cootamundra crop.

1. Spring rainfall and temperature. Preliminary data suggests that given enough time, UCI will cause damage to the vascular tissue in the stems and branches resulting in yield loss to the pods. However, similar levels of disease can cause different amounts of yield loss depending on the weather during pod fill. Pods that ripen without moisture stress and during cool weather can tolerate more disease. Imagine a partially blocked xylem. On a cool day the plant can still get sufficient moisture, but on a hot day the partially blocked xylem cannot deliver enough moisture.
2. Genetic resistance. This is the missing piece of the puzzle. We do know that effective major gene resistance (Resistance Groups) will stop blackleg and if your cultivar has effective major gene resistance your crop will not get any UCI. However, it is difficult to determine if you do

have effective major gene resistance as it depends on the blackleg population on your farm. The best way to determine major gene resistance is to monitor your crop for leaf lesions. Major gene resistance is effective across all plant parts so if there are no leaf lesions it means that there could be no blackleg present or more likely that your cultivar has effective major gene resistance.

3. The other resistance is cultivar quantitative resistance, this is often indicated by the blackleg rating of your cultivar. Although it is possible for cultivars to have a high blackleg rating from major gene but low quantitative resistance. However, if your cultivar has an R rating, then it should either have effective major gene or excellent quantitative resistance. But what does adequate quantitative resistance mean for UCI control? To be honest the answer is 'we don't know'. However, we do know that cultivars with adequate quantitative resistance develop UCI symptoms, but we are suspicious that these cultivars may then have less damage to the vascular tissue than more susceptible cultivars. This could be very similar to how cultivars react at the seedling stage, that is, a MR rated cultivar and a MS cultivar both have leaf lesions, but the MS then develops more crown canker and subsequent yield loss. The reality is that we need to develop a robust blackleg rating system for UCI – we're working on it.

What are the steps to determining a UCI spray decision?

1. Leaf lesions – presence of leaf lesions indicates that blackleg is present and that your cultivar does not have effective major gene resistance. No leaf lesions = no reason to spray.
2. New leaf lesions on upper leaves as the plants are elongating – this observation is not critical but does give an indication that blackleg is active as the crop is coming into the susceptible window. However, a few wet days at early flower will still be high risk even if there were no lesions on new leaves up to that point. Remember it will take at least 14 days after rainfall to observe the lesions. More lesions = higher blackleg severity.
3. Date of 1st flower and targeted date of harvest - the earlier in the season flowering occurs is higher risk. This date will vary for different regions. Generally, shorter season regions can more safely commence flowering at an earlier date compared to longer season regions. Earlier harvest date results in less time for the fungus to invade the vascular tissue and cause yield loss. Consequently, if you're in a long growing season rainfall region and your crop flowers in early August and is harvested in December, then you are in a very high-risk situation.
4. Yield potential – yield potential is simply an economic driver. A 1% return on a 3t/ha crop is worth more money than a 1% return on a 1t/ha crop.

Fungicide application for UCI

1. Fungicide application timing. Research has shown a wide window of response times with useful results (assuming that you have a damaging level of disease) from 1st flower to 50% bloom. However, we suggest aiming for 20%-30% bloom (15-20 open flowers off the main stem) for a number of reasons. Firstly the 20%-30% bloom stage is as late as you can go and still get good penetration into the canopy. Your main aim is to protect the main stem which will have a greater impact on yield compared to individual branches. Secondly the 20%-30% bloom spray will control any initial infections that have already occurred. Thirdly the 20%-30% bloom timing will provide protection for a few weeks into the future; therefore UCI will only start occurring again after the 50% bloom stage and hopefully by then any infections will occur too late to cause significant yield loss.

2. A fungicide application at 20%-30% bloom also provides protection from early development of sclerotinia stem rot. The opportunity to manage several diseases with a single fungicide application can increase the economic justification of the operation.
3. Pod infection is unlikely to be controlled through fungicide application. Pod infection occurs when there are rainfall events during podding and the fungal spores land directly on the pods and cause disease. We have found that severe pod infection can lead to an additional 20% yield loss. Unfortunately, no fungicides are registered for application during podding due to MRL regulations. Major gene resistance will control pod infection.

How can I determine if I should have sprayed for UCI?

1. Check for external lesions.
2. Cut branches and stems to check for blackened pith, which is indicative of vascular damage and likely yield loss
3. Observe darkened branches. These branches go dark after vascular damage and are indicative of yield loss.
4. Pod infection will cause yield loss. Unfortunately there is nothing that can be done to prevent pod infection.
5. Leave unsprayed strips to check for yield returns.

Summary - management of blackleg in medium to high rainfall regions

Increased pressure from blackleg is driven by the intensity of canola production in the district, as the blackleg pathogen survives and is released from old canola stubble. Here are some important points to consider:

1. One in four-year canola rotations and 500m isolation between this year's crop and last year's stubble reduces risk significantly. Monitor crops for both UCI and crown canker so that you know if you need to retain or change practices.
2. Distance to canola stubble – crops sown adjacent to one-year-old stubble will have the highest amount of disease pressure, so maintain a 500m buffer if possible.
3. Cultivar resistance – cultivars rated R-MR or above have very low risk of developing crown cankers. MR rated varieties will develop cankers but only if grown under high disease severity, for example canola/wheat/canola in high rainfall. www.grdc.com.au/resources-and-publications/all-publications/publications/2020/blackleg-management-guide
4. Pathogen population – if you've grown the same cultivar for several years and disease severity is increasing and you then sow a cultivar from the same resistance group, you will be at a higher risk of crown cankers developing.
5. Monitor crops regularly for blackleg symptom development and progression of disease. Take regular photos of symptoms if necessary, as means of recording changes.
6. Fungicides for UCI – if your crop has blackleg lesions (mainly on upper leaves) at stem elongation and it has commenced flowering in late June/early August it is more likely to benefit from a fungicide application. Later flowering crops are unlikely to have yield losses. Cultivar resistance to UCI has been shown to be effective but we do not yet have a reliable cultivar screening system. If your cultivar has had significant yield increases from 20%-30% bloom fungicide applications in previous years, it is likely to be susceptible and benefit from fungicide application.

7. Consider the economic returns from a foliar fungicide application (price for product, yield potential, spring rainfall outlook). Use the BlacklegCM App to determine potential economic returns for fungicides for crown canker.

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Useful resources and references

- BlacklegCM App for iPad and android tablets
- www.grdc.com.au/resources-and-publications/all-publications/publications/2020/blackleg-management-guide
- Canola: the ute guide (<https://grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-27/canola-the-ute-guide>)
- Marcroft Grains Pathology website: www.marcroftgrainspathology.com.au
- www.nvt.com.au
- NSW DPI Winter Crop Variety Sowing Guide (Disease updates, variety resistance, fungicide products).

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