RISK MANAGEMENT OF AERIAL BLACKLEG (UPPER CANOPY INFECTION) IN CANOLA

Genevieve Clarke (BCG) and Steve Marcroft (Marcroft Grains Pathology)

TAKE HOME MESSAGES

- Early flowering resulted in upper canopy infection symptoms; later sown plots escaped the disease.
- Variety selection (Resistance Group) had a significant effect on disease severity.
- Fungicide application on early sown treatments reduced upper canopy infection severity.
- Yield loss to upper canopy infection is very variable, therefore yield responses to fungicide application is also variable, typically ranging from 0 to 20%.

BACKGROUND

In recent years the prevalence of upper canopy infection (UCI) of blackleg in canola has increased. It is thought this has been influenced by changing farming practices with earlier and longer flowering periods which align with typical spore release time of the blackleg fungus (*Leptosphaeria maculans)* (Figure 1). Yield loss potential from blackleg upper canopy infection (UCI) typically ranges from 0 to 20% but can be higher especially if pods also become infected (Marcroft and Sprague, 2018).

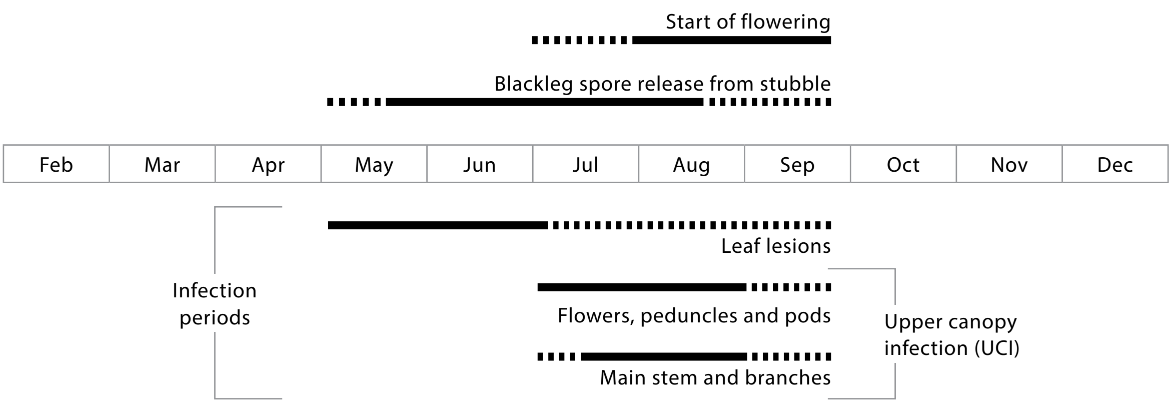

Figure 1. Blackleg infection periods on different parts of canola plants relative to spore release timings and start of flowering windows in medium and high rainfall zones. Solid lines indicate the main infection periods and dotted lines indicate reduced infection risk. Start of flowering solid line indicates the optimal period where yield is maximised and disease risk is reduced. Source (Brill et al. 2019).

What is blackleg upper canopy infection?

Blackleg can infect all areas of a canola plant however UCI is defined as infection in flowers, peduncles, pods, stems and branches.

When looking for symptoms in the paddock, search for browning of flowers and peduncles, necrotic lesions with a dark outline on stems, branches and pods as well as complete browning of branches that, when cut open, appear grey in colour internally.

Figure 2. Images displaying UCI symptoms. Browning off of infected flowers (left) and browning of branches and pods showing grey internal tissues (right). Source: Steve Marcroft (Marcroft Grains Pathology)

Nearly all research into UCI has been undertaken in the higher rainfall zones as blackleg is more severe in regions with intensive canola production and consistent moisture. Blackleg however can still cause yield losses in other regions in some seasons. In 2019 some growers in the mallee region did apply fungicides but most did not report a yield response to the fungicide.

AIM

To observe whether UCI is present in the southern Mallee environment and how management strategies such as variety selection, sowing time and fungicide applications effect UCI presence and damage in this environment.

PADDOCK DETAILS

Location:	Curyo
Crop year rainfall (Nov-Oct):	342mm
GSR (Apr-Oct):	204mm
Soil type:	Sandy clay loam
Paddock history:	Fallow

TRIAL DETAILS

Crop type/s:	Refer to table 1.
Treatments:	Refer to table 1.
Target plant density:	50 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	Refer to table 1.
Replicates:	Four
Harvest date:	TOS1 10 November, TOS2 20 November
Trial average yield:	2t/ha

TRIAL INPUTS

Fertiliser:	Granulock® Supreme Z @ 60kg/ha at sowing and urea @ 80kg/ha on 9 June
Herbicide/Insecticide:	Trial managed as per best practice
Fungicide:	See table 1.
Seed treatment:	Jockey® @ 2L/100kg + Gaucho® @ 400ml/100kg

METHOD

A replicated field trial was established at Curyo in a split plot design. Assessments included flowering dates, NDVI, disease scores (on a scale from 1-9) by visual assessment of percentage of plot showing UCI symptoms and yield and quality analysis.

Table 1. Trial treatment outline. Untreated control received no fungicide, full control received fungicide at each application timing including an additional application at 4-6L.

Variety	Time of sowing (TOS)	Fungicide Application timing	Application rate
ATR Bonito ATR Stingray Hyola 350TT	TOS1 31 March TOS2 5 May	Untreated 30% bloom End of flowering (EOF) Full control	Aviator® Xpro® @550ml/ha

RESULTS AND INTERPRETATION

Flowering timing

The trial established well with moist conditions at both sowing times. Early sown treatments progressed quickly with warm soil temperatures and first flowers appearing on Hyola 350TT treatments in late May.

The definition of the start of flowering, established to assess whether crops are beginning to flower in their optimal start of flowering window, is when 50% of plants have one fully open flower (Brill et al. 2019). In this trial, early sown treatments began to flower earlier than the optimal window, making them prone to frost damage, while later sown treatments began to flower just outside the end of the optimal start of flowering window, exposing them to a higher risk of heat damage (Figure 3).

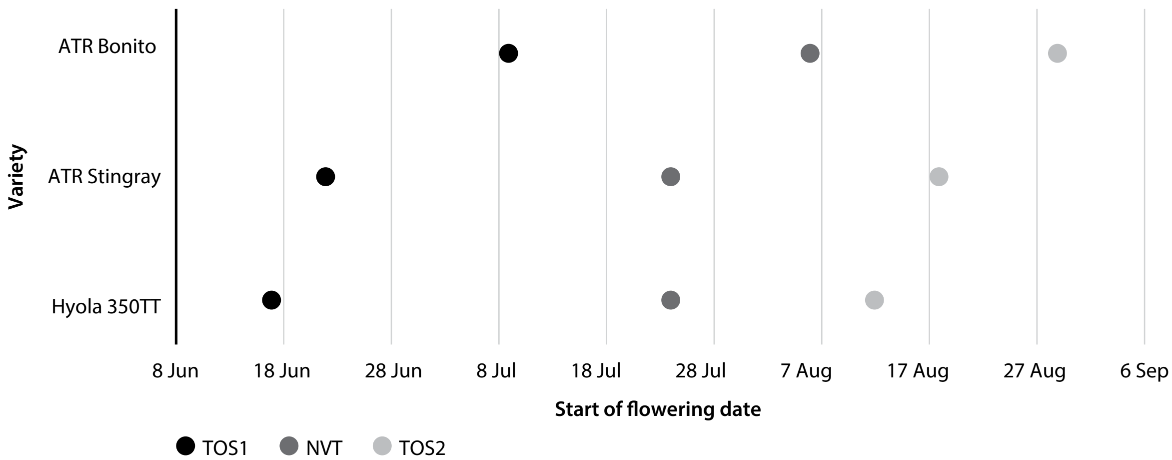

Figure 3. Start of flowering of full control treatments for each variety. Optimal start of flowering (OSF) window for Birchip 26 July with 33 day range. NVT comparison treatments sown 22 April at the site have been included to demonstrate sowing date and flowering interactions further.

Disease presence

By late spring UCI presence was significantly higher in earlier sown treatments (P=0.004). Comparing varieties, Hyola 350TT showed little to no UCI across both sowing times, while ATR Bonito and ATR Stingray had significantly higher infection levels from visual inspection (Figure 4).

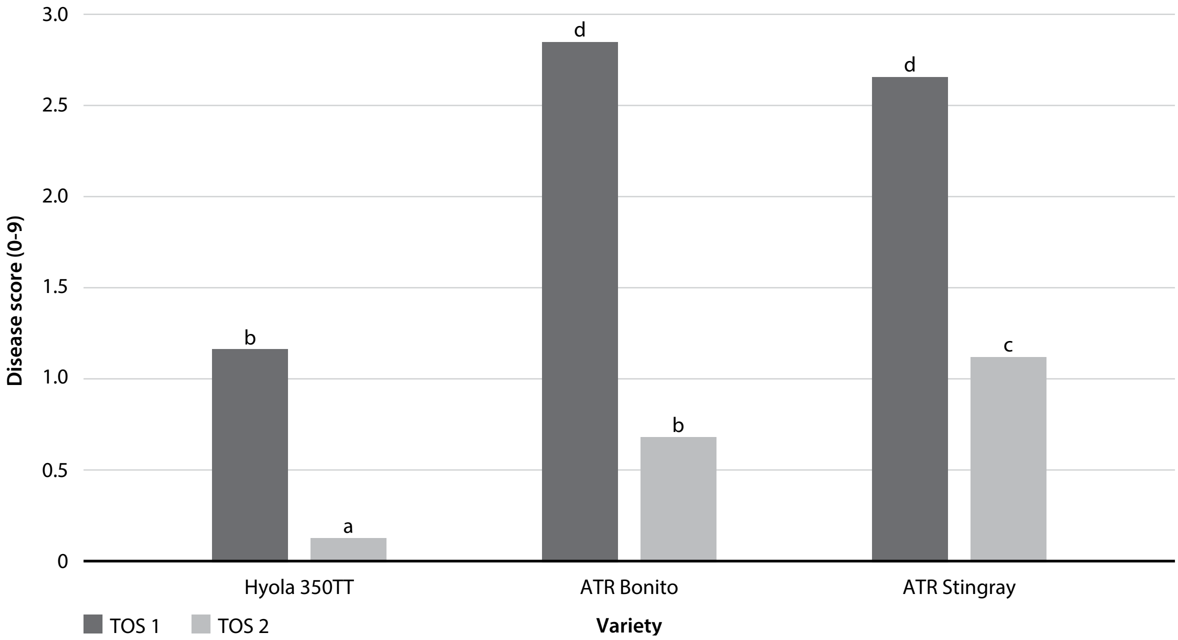

Figure 4. Mean disease scores (0-9 scale where 0=no UCI symptoms present, 9= UCI symptoms on 100% of plants) taken by visual inspection 12 October of TOS1 and TOS2 treatments by variety. Letters indicate significant difference. Stats: TOS x Var (P=0.003, LSD= 0.6, CV= 42.8%). *Note high CV% indicates variability in the data. Interpret with caution.

In earlier sown treatments, where disease presence was greater, a significant interaction between variety and fungicide application timing was found to effect UCI levels (table 2). Overall, Hyola 350TT showed the least level of infection with only untreated treatments significantly higher than all treatments with fungicide applied. This is believed to be due to effective major gene resistance in Hyola 350TT that is not present in the other varieties trialed. In ATR Bonito and ATR Stingray disease levels were higher and the end of flowering spray timing was too late for effective control, scoring similarly to untreated controls.

ATR Stingray, which flowered earlier than ATR Bonito generally showed more UCI symptoms.

Table 2. Mean disease scores (0-9 scale where 0 = no UCI symptoms present and 9= UCI symptoms on 100% of plants) taken on September 17 of TOS1 treatments. Letters indicate significant difference. *Note high CV% indicates variability in the data. Interpret with caution.

Variety	Fungicide application timing	Disease score (0-9)
Hyola 350TT	30% bloom	0.8^{a}
Hyola 350TT	Full control	1.0^{a}
ATR Bonito	Full control	1.3^{a}
Hyola 350TT	EOF	1.3^{a}
Hyola 350TT	Untreated	2.5^{b}
ATR Bonito	30% bloom	2.5^{b}
ATR Bonito	Untreated	3.3^{bc}
ATR Stingray	Full control	3.3^{bc}
ATR Bonito	EOF	3.8^{c}
ATR Stingray	30% bloom	4.3^{cd}
ATR Stingray	EOF	4.3^{cd}
ATR Stingray	Untreated	5.0^{d}

Sig. diff.	
Variety	**<0.001**
Fungicide	**<0.001**
Variety x Fungicide	**0.049**
LSD (P=0.05)	
Variety	**0.5**
Fungicide	**0.6**
Variety x Fungicide	**1.0**
CV%	**25.6**

Yield

Unfortunately, this trial experienced significant and uneven damage from mice and birds which meant the yields achieved could not be included in the analysis.

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

This research found UCI is present in the southern Mallee environment, particularly in early sown treatments. With the good early rains received this season, variety selection to match phenology for flowering timing and selecting for major gene resistance would have allowed growers to capitalise on the early rains without necessarily increasing the risk of UCI later in the season.

Where fungicide was applied it was evident that UCI severity was reduced in early sown treatments. When sown later, fungicide application was not warranted due to lack of disease pressure. It is expected that fungicide application would likely have had a yield response on early sown treatments however, this was too difficult to measure considering the damage caused by mice and birds. Further research into application timing will help to shape the impact fungicide application has on final yields in the southern Mallee environment.

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Will I get an economic return from fungicide application for blackleg UCI?

There is currently no accurate method to predict whether a fungicide application will provide economic returns for the control of blackleg UCI. It was hoped this trial would provide yield data towards this. However, significant investment has been made into research to help provide clarity around the issue. From past research, fungicide applications for UCI can return very variable yield results. At this stage, the best guide for whether to apply a fungicide is to understand the risk of infection.

What factors increase the risk of blackleg upper canopy infection and yield loss?

- **Crop rotation** and location of the crop in relation to canola stubble. Blackleg is stubble born and can be released multiple years after a canola crop was grown if retained. It is recommended that a one in four year rotation and 500m isolation from last year's canola will reduce this risk.
- **Early flowering** in late winter/early spring will expose plants to cooler and wetter conditions, conducive for infection in the upper canopy. Managing sowing date and variety (maturity group) to target optimal start of flowering windows will help to manage this (table 3).

Table 3. Recommended sowing timing (grey cells) for canola of three maturities in Mallee and Wimmera regions to target optimal start of flowering windows. Source (Brill et al. 2019).

Region	Phenology	April				May
		Week 1	Week 2	Week 3	Week 4	Week 1
Mallee (Swan Hill)	Slow	(grey)	(grey)			
	Mid		(grey)	(grey)		
	Fast			(grey)	(grey)	
Wimmera (Horsham)	Slow	(grey)	(grey)	(grey)		
	Mid		(grey)	(grey)	(grey)	
	Fast			(grey)	(grey)	(grey)

- **Variety selection**. Some varieties have effective major gene resistance to blackleg UCI and will not require a fungicide in instances where other varieties that lack this resistance will. However, the difficulty in this is that it depends on the blackleg population on your farm. The best way to determine this is to monitor leaf lesions. If, in conducive conditions, no leaf lesions develop it is likely to have effective major gene resistance (or blackleg is not present).
- **Time from start of flowering to harvest**. It is hypothesised that a longer time between commencement of flowering and harvest will allow time from initial surface infection to infection of vascular tissue. Therefore, the longer amount of time between flowering and harvest, the higher the potential for yield loss.
- **Seasonal conditions**. Cool and moist conditions are conducive to spore release that can cause infection. The same level of infection can cause different amounts of yield loss in different seasons. Where conditions are hotter and drier, following infection during pod fill, this may have more of an impact on yield loss. Moist and mild conditions during pod fill will help the plant cope with disease more efficiently and may result in less yield damage from the same amount of visual symptoms on plants.

Monitoring for infection symptoms

It will take two weeks following rainfall for lesions to develop. Monitoring should be commenced after this period for symptoms.

When monitoring; check for external lesions, cut branches to check for blackened pith (this indicates vascular damage which is likely to cause yield loss) and observe for darkened branches.

Pod infection will cause yield loss but at the time this can be observed it is too late for fungicide application.

Current best practice recommendation for spray timing of sclerotinia (30% bloom) is likely a good time to target fungicide application for the control of UCI as the canopy is still open enough for good coverage. Monitoring for symptoms leading up to this stage will help to indicate whether this spray timing should be targeted in your crop.

What are the steps to determining a UCI spray decision?

- **Leaf lesions** – the presence of leaf lesions indicates that blackleg is present and that a variety does not have effective major gene resistance. No leaf lesions indicates there is no reason to spray.
- **New leaf lesions on upper leaves as the plants are elongatin**g – this gives an indication that blackleg is active as the crop is coming into the susceptible window. However, a number of wet days at early flower will still be high risk even if there were no lesions on new leaves up to that point.
- **Date of 1st flower and date of harvest** – the earlier in the season flowering occurs the higher risk of UCI. This date will vary for different regions. Earlier harvest date results in less time for the fungus to invade the vascular tissue and cause yield loss.
- **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. Calculating the cost of application against potential yield and market grain price will aid in whether a potential return can be gained from fungicide application.

Leaving unsprayed strips in the paddock will allow you to check for yield response at harvest to help future decision making.

REFERENCES

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ACKNOWLEDGEMENTS

This trial was funded by BCG members through their membership subscription.

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