Sclerotinia in canola on lower Eyre Peninsula

RESEARCH

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Searching for answers

Location
Mount Hope (field trial)
Rainfall
Av. Annual: 400 mm
Av. GSR: 325 mm
2017 Total: 390 mm
2017 GSR: 274 mm
Yield
Potential: 1.70 t/ha (B)
Actual: 1.68 t/ha
Paddock History
2017: Canola
2016: Lupin
2015: Wheat
Soil Type
Red chromosol
Plot Size
2 m x 10 m x 3 reps

Key messages

- **Despite a below-average rainfall season, sclerotinia was widespread, being present in all 20 surveyed paddocks across the lower Eyre Peninsula. However, inoculum loads varied between paddocks.**
- **The major driver of infection appeared to be favourable humid conditions in the crop canopy, at least partly driven by the size of the early canola canopy.**
- **The incidence of sclerotinia ranged from 0 to 16.8% of surveyed plants infected.**
- **Severity, measured as the difference in yield between individual plants that were sclerotinia-infected and non-infected, ranged from 0 to 21%.**
- **The overall impact of sclerotinia (incidence x severity) on crop yields was therefore quite minor, ranging from 0 to 1.7% yield loss.**
- **In a fungicide trial conducted at Mt Hope in 2017, below average rainfall conditions resulted in no sclerotinia and hence no response to fungicides. Cv. Diamond averaged 1.68 t/ha.**
- **While the paddock survey indicates the potential for serious crop loss from sclerotinia should the right conditions occur on LEP, the plot trial shows that applying fungicides may provide no benefit under certain conditions.**

Why do the trial?

Sclerotinia stem rot affects canola and most pulses. It is known to affect canola crops in Australia, with significant yield loss recorded in parts of NSW and northern Victoria (Hind et al. 2003; Kirkegaard et al. 2006). Whilst it is commonly seen in South Australia, in particular, in the lower Eyre Peninsula (LEP), it has rarely been reported as causing a significant yield loss in this region. However, reports from growers and advisors suggest Sclerotinia may be becoming more common and more severe with some growers and advisors taking precautionary action in the form of fungicide applications.

The aim of this research, involving paddock surveys and field plot trials, was to generate baseline incidence and severity data to quantify the extent of the sclerotinia issue. Furthermore, it is hoped that the paddock surveys will indicate the contributing factors of sclerotinia epidemics, to answer the question of why sclerotinia incidence and severity may have increased, and also allow better prediction of outbreaks which would facilitate improved spray application decision-making. Finally, it is hoped that the field trials will quantify any economic benefits of fungicide applications.

How was it done?

Paddock monitoring and survey

Initially, six paddocks around the LEP were chosen to locate a monitoring point for detailed crop, weather and disease monitoring. Given the unusual lateness of opening rain for most of the LEP, the six sites were chosen based mostly on their early establishment following localised storms in April/ May. The details of monitoring points are shown in Table 1.

For each monitoring point, plant density and crop biomass at flowering onset, was initially recorded. A temperature and relative humidity sensor was installed between crop rows at 50 cm above ground level. Crop height, growth stage/bloom stage and the presence of fungal mycelia ('white fluffy growth'), apothecia ('mushrooms') and lesions were recorded at each weekly visit. At each visit, 20 randomly selected flowers were sampled from within 10 m of the monitoring point and were plated on a PDA growth medium to score the presence of viable sclerotinia spores on petals.

The incidence of sclerotinia was calculated by counting 500 plants within 10 m of the monitoring point, and recording the number of plants with any type of sclerotinia lesion. The severity of this infection was determined by comparing yield from a sample of healthy plants to that of infected plants.

Table 1. Details of monitoring locations on lower Eyre Peninsula.

Location	Paddock History*	Cultivar	Germinating rainfall date (mm)	Sowing density (kg/ha)	Est. density (plants/m^2)	GSR (mm)	Paddock yield (t/ha)
Coulta	WLWCWCL	45Y91	27 April (13)	2.0	20	306	2.86
Edillilie	BLWWCLW	44Y90	28 May (27)	2.0	47	333	2.00
Kapinnie	BWLWCWP	Diamond	16 May (8)	2.0	27	277	2.28
Mt Drummond	WWCWCWW	44Y90	27 May (12)	3.0	36	293	2.50
Mt Hope	WLWCWCW	44Y89	3 July (25)	2.2	22	274	1.45
Wangary	WLWWC	45Y91	24 May (10)	2.5	23	310	2.40

**Paddock history from most recent year (2016) to least recent record.*

For each of the six paddocks where a monitoring point was located and the incidence and severity of sclerotinia was calculated, a second incidence and severity calculation was then conducted in a randomly selected location within the same paddock (>100m away). Furthermore, 14 additional paddocks were surveyed and the incidence of sclerotinia calculated using the same method described above. Severity of infection was only calculated for the additional paddocks at Wanilla and Wangary, as none of the other additional paddocks had significant infection (>1% incidence).

Weather data was reviewed by considering average relative humidity (RH) throughout flowering and peak flowering for each site. It has previously been reported that >95% RH for a period of at least 48 hours is optimal for sclerotinia disease development. Thus, the total number of hours within each period which exceeded the 48 hours where average RH >95% and did not go below 80% RH, are reported, as well as the number of these periods within each season.

Plot trial

A plot trial was established at Mt Hope following opening rains. The trial comprised two varieties (Diamond and Hyola575CL) and five spray treatments (Unsprayed, Early Flowering, Mid Flowering, Late Flowering and Full Control) with a registered fungicide (Prosaro®). The full control treatment received three spray applications, at each of the other three spray timings (early, mid, late). Seed of both varieties was treated with fluquinconazole (Jockey®) and sown using a standard narrow point/press wheel seeder. A plant density of 45 plants/m^2 was targeted for both.

The trial was sown on 22 June and was located in a paddock with a history of sclerotinia, near the Mt Hope monitoring point discussed above. The site was managed for weeds, pests and nutrition as per district practice. A fungicide (Prosaro) application was made at the 3-5 leaf growth stage to assist in controlling blackleg in the vulnerable young crop, but is not expected to have influenced the later development of sclerotinia during reproductive stages.

What happened?

Paddock monitoring and survey

Crop growth and weather

Table 2 shows the details of crop growth and development. The crops were all generally germinated within the acceptable window for canola on the LEP, except for Mt Hope, where the combination of low early rainfall and water-repellent soil type resulted in staggered germination and generally delayed the growth of the crop as a whole.

Rainfall was below average at all sites during the growing season. However, there were a number of distinctly prolonged moist periods at most sites during flowering, resulting in high humidity at various times. Average RH within the crop canopy throughout the flowering ranged from 80.8-96.1% across all sites.

Figure 1 shows the minimum, mean and maximum daily RH for each monitoring site, with the peak flowering period for each site and 'infective periods' indicated on each graph.

It is clear from the weather data that the crop canopy at Edillilie remained moist for long periods throughout flowering and particularly through 'peak' flowering (>30% bloom). To a lesser degree, Coulta and Kapinnie also remained quite humid. Wangary appeared to experience two clear periods of very high RH.

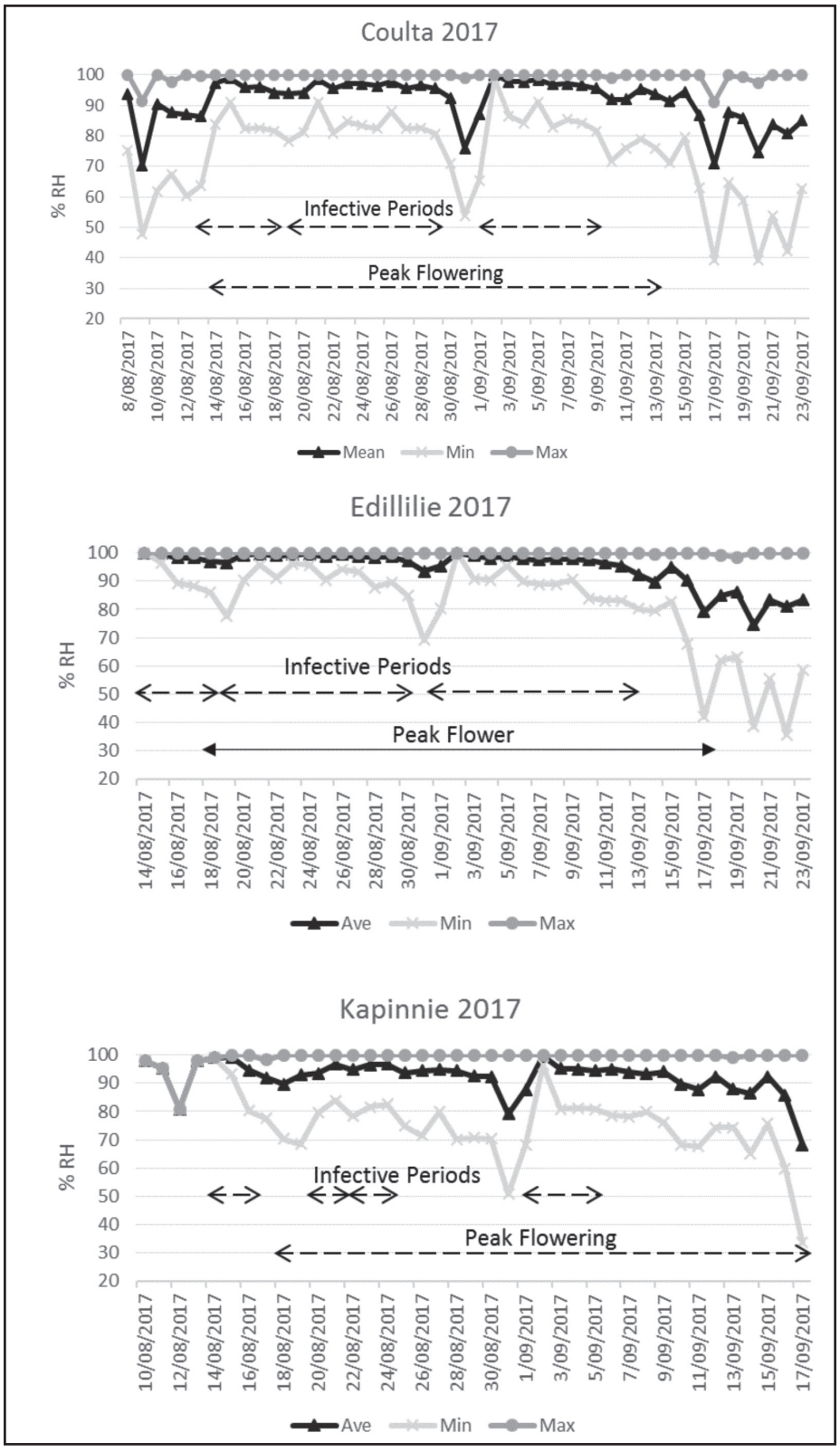
When the weather data is reviewed in terms of 'infective' periods as defined above, Kapinnie (4) experienced the greatest number of infective periods, followed by Coulta and Edillilie (3) and Wangary (2). Mt Drummond and Mt Hope did not appear to experience any periods optimal for disease development throughout flowering.

The total number of 'infective' hours experienced at each site varied considerably and did not necessarily reflect the number of periods. Edillilie experienced the greatest combined 'infective' period with a total of 753 hours, followed by Coulta (613), Kapinnie (310) and Wangary (138).

Table 2. Crop growth and development at monitoring sites on the lower Eyre Peninsula.

Site	Germination	Flowering initiation	30% bloom	50 % bloom	End flowering	Maturity*
Coulta	27 April	08 Aug	14 Aug	21 Aug	24 Sep	27 Oct
Edillilie	28 May	14 Aug	24 Aug	03 Sep	24 Sep	24 Oct
Kapinnie	16 May	10 Aug	18 Aug	21 Aug	18 Sep	29 Oct
Mt Drummond	27 May	21 Aug	28 Aug	03 Sep	03 Oct	3 Nov
Mt Hope	3 July	28 Aug	03 Sep	18 Sep	10 Oct	14 Nov
Wangary	24 May	18 Aug	24 Aug	03 Sep	03 Oct	5 Nov

**Maturity defined as physiological maturity i.e. 'windrowing stage', although not all crops were windrowed.*



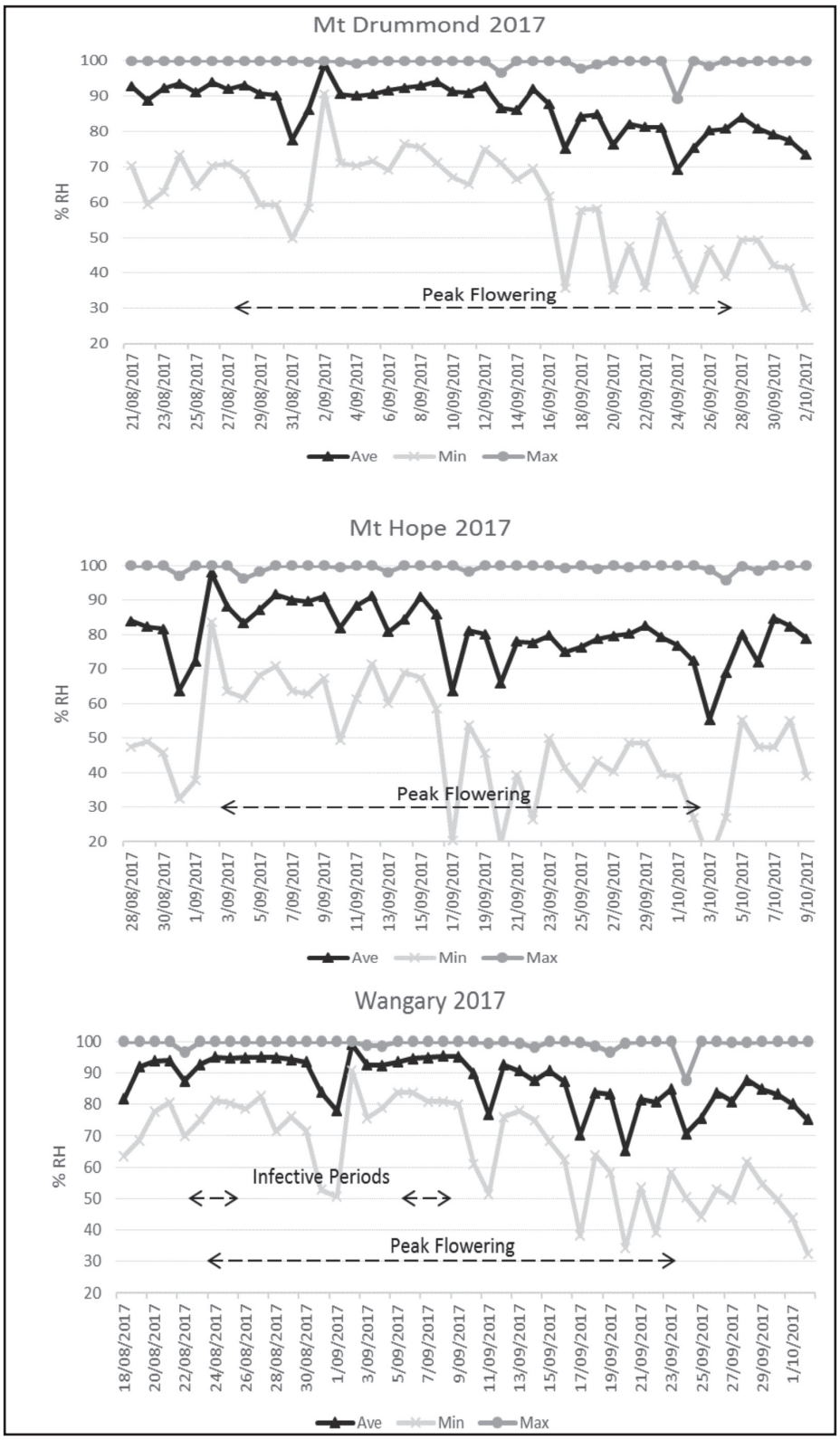


Figure 1. Relative humidity through canola flowering periods at detailed monitoring sites on the LEP in 2017.

Table 3. Petals with sclerotinia spores present as a percentage of total.

Site	Sampling Date									
	30 Jul	7 Aug	14 Aug	21 Aug	28 Aug	3 Sep	11 Sep	18 Sep	24 Sep	Ave*
Coulta	20	75	90	90	35	30	95	55	0	70
Edillilie	NA	70	40	25	55	40	45	20	0	30
Kapinnie	0	10	0	35	45	0	45	5	0	25
Mt Drummond	NA	NA	0	45	5	0	10	5	0	5
Mt Hope	NA	NA	45	55	25	5	70	10	0	20
Wangary	NA	70	70	80	95	90	100	90	5	75

**Average spore release throughout the 'peak' flowering period (30% bloom onward for 5 weeks).*

Inoculum

Sclerotinia was present at each of the six main monitoring sites, with at least one lesion present in each crop, and petal samples confirming the presence of spores in each crop. The rotational histories of these paddocks support the likelihood of inoculum build-up, with a susceptible broadleaf crop being grown roughly 2/5 years at each site, for at least the last 20 years (data not shown). Combined with a reduction in tillage and stubble burning reported by all growers (data not shown), the build-up of viable inoculum within 2-3 cm of the soil surface is expected. However, the degree to which petals were infested with spores varied between sites and throughout the season.

Table 3 shows the proportion of petals infected at each sampling date for each of the six sites.

Mt Drummond appeared to have consistently lower levels of spores released throughout the season, with only one sampling date (28 August) showing moderate levels of spores. Despite low rainfall conditions throughout the season and a significant delay in starting rainfall, there were moderate levels of petal infestation throughout the season at Mt Hope. Heavy spore release occurred relatively early at Coulta, Edillilie and Wangary, whereas Kapinnie appeared slower to start and remained quite variable throughout the season.

Spore release appeared to almost completely halt by the end of September.

Disease

Disease incidence in the six survey paddocks ranged from 0.2% at Mt Hope to 16.8% at Kapinnie. Severity ranged from 5.2% at Coulta to 20.8% at Edillilie. Combined, these estimates of incidence and severity gave a total predicted yield loss estimate of between 0.23% at Wangary to 1.72% at Kapinnie. At the second site surveyed from within each of these paddocks, yield loss was very similar, 0.16% at Edillilie to 1.36% at Kapinnie. Sclerotinia incidence was low in all other additional survey paddocks, except one at Wanilla, where incidence was 3.6% and severity 11.1%, giving an estimated yield loss of 0.4%. The incidence and severity, as well as an estimated total yield loss for the survey site is given in Table 4.

Table 4. Incidence and severity of sclerotinia in canola crops surveyed on the LEP in 2017.

Site	Variety	Sclerotinia incidence (%)	Severity (yield difference) (%)	Total estimated yield loss (%)
Coulta (Main)	45Y91	10.2	11.3	1.16
Coulta (2nd)	45Y91	12.2	5.2	0.63
Edillilie (Main)	44Y90	3.2	20.8	0.67
Edillilie (2nd)	44Y90	0.8	19.7	0.16
Kapinnie (Main)	Diamond	16.8	10.2	1.72
Kapinnie (2nd)	Diamond	13.0	10.4	1.36
Mt Drummond (Main)	44Y90	0.4	NC	<0.5
Mt Drummond (2nd)	44Y90	0.0	NC	0
Mt Hope (Main)	44Y89	0.2	NC	<0.5
Mt Hope (2nd)	44Y89	1.0	NC	<0.5
Wangary (Main)	45Y91	4.6	4.9	0.23
Wangary (2nd)	45Y91	6.6	6.2	0.41
Mt Drummond	44Y90	0.8	NC	<0.5
Kapinnie	Bonito	0.0	NC	0
Mt Hope	Diamond	0.8	NC	<0.5
Wangary	45Y91	1.8	-1.6	<0.5
Edillilie	45Y91	0.0	NC	0
Wanilla	45Y91	0.4	NC	<0.5
Wanilla	Banker	0.0	NC	0
Wanilla	44Y89	3.6	11.1	0.4
Wanilla	44Y89	0.4	NC	<0.5
Yeelanna	NA	0.0	NC	0
Karkoo	NA	0.0	NC	0
Yeelanna	45Y91	0.0	NC	0
Yallunda Flat	NA	0.4	NC	<0.5
Cummins	Quartz	0.0	NC	0

NC = not calculated (due to low incidence of sclerotinia)

Plot trial

No sclerotinia lesions were observed in any treatment, including fungicide timings or variety, of the plot trial. There were no yield differences between fungicide treatments and, whilst there was a substantial yield difference between varieties, this difference clearly does not relate to the interactions between flowering timing and sclerotinia development, but rather to yield potential differences and probably specifically to the varying phenology of the two varieties in response to the short season. Table 5 below shows the evenness of yields within each variety, for all spray timings.

What does this mean?

Paddock monitoring and survey

Sclerotinia is a widespread disease on LEP, with virtually every paddock monitored showing some signs of sclerotinia inoculum. Furthermore, there is real potential for damage given the incidence of infected plants within certain paddocks, under relatively dry, unfavourable conditions. However, despite the unexpectedly high incidence in some paddocks, yield loss was highly variable, and, at worst, only 1.7% in a reasonably high yielding crop. Application of a registered fungicide at label rate would not prove economical under this sclerotinia disease burden.

Explaining incidence and severity appears complex based on the data presented above. At Mt Drummond, the significantly lower inoculum levels, combined with no favourable periods conducive to infection quite adequately explained the lack of sclerotinia disease. Similarly, the lack of adequate conditions, despite the higher inoculum levels, appeared to limit disease at Mt Hope. Whilst all other sites had overlap of spore release, flowering and humid conditions, they varied greatly in their response. Edillilie experienced extremely wet conditions during flowering, with significant levels of inoculum, however disease expression did not occur to the extent that it did at Kapinnie, which experienced fewer favourable humid hours, similar spore release and yet far greater disease incidence and severity. Similarly, Coulta and Wangary appeared to be less suitable for sclerotinia than at Edillilie, yet both experienced equal or greater disease burden. From the data collected to date, incidence appears to be somewhat explained by inoculum load (petal testing). The exception to this was at Kapinnie, where a lower inoculum load still resulted in high infection rate and relatively high disease severity, however this may have been due to other factors, such as cultivar. Severity appears to be somewhat related to the total number of infective hours i.e. once an infection occurs, greater periods of high humidity may control the degree to which the infection progresses and, hence, how much yield is lost in that plant.

This work will continue in 2018 and it is expected that further data points from a range of seasons/ inoculum levels/crops will give a clearer picture of the nature of sclerotinia on LEP and hopefully lead to greater predictability and more certain decision-making around fungicide application.

Table 5. Yields and oil content of fungicide x variety treatments at Mt Hope in 2017.

Variety	Spray timing	Yield (t/ha)	Oil (%)
Diamond	Unsprayed	1.62	44.5
	Full (all timings)	1.69	45.3
	Early (10% bloom)	1.67	44.0
	Mid (30% bloom)	1.66	44.8
	Late (50% bloom)	1.76	44.8
Hyola 575 CL	Unsprayed	1.01	43.9
	Full (all timings)	1.01	43.2
	Early (10% bloom)	0.94	43.6
	Mid (30% bloom)	0.98	43.8
	Late (50% bloom)	0.98	43.8

Plot trial

The plot trial clearly illustrates two key points. Firstly, for sclerotinia to develop, there must be coincidence between spore release, prolonged wet conditions and the presence of senescing (dying/falling) flowers. The petals collected from the grower's crop surrounding the plot trial as part of the paddock survey showed that sclerotinia spores were present in this paddock and a small number of infected plants were found in the grower's crop. However, this crop was dry sown and germinated earlier than the plot trial and, thus, there were flowers senescing earlier in the season. It is likely that some of these petals contained spores and were able to lodge against the canola stems during a period humid enough earlier in the season for minor sclerotinia lesions to develop. However, in the plot trial, where spore release likely occurred when plots were still at vegetative or bolting stages, it is likely that any spores released did not contact suitable senescing material to begin the infection process. It is also possible that spore release did occur as late as flowering stages in the plot trial but that the dry conditions at this time did not allow for further infection of stems.

Secondly, the complete lack of response to fungicide is notable. Although it should be expected that no fungicide application would have an effect on sclerotinia given the conditions were not suitable for it to develop, it might have been expected that there would be some associated benefit from the control of other diseases, including upper canopy infection (UCI) blackleg, given this certainly was present in the trial and blackleg appears to be less dependent on extended wet conditions. However, in this trial, despite the presence of UCI blackleg disease and sclerotinia inoculum, there was absolutely no gain from spraying a fungicide. 2017 was an atypical season and more data needs to be collected before management conclusions can be made from this research.

Acknowledgments

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