Factors affecting sclerotinia stem rot infections in canola

Sarita Jane Bennett*, Kyran Brooks, Michael Ashworth, Matthew Denton-Giles and Pippa Michael,
Centre for Crop and Disease Management, School of Molecular and Life Sciences, Curtin University, WA 6010
* Presenting author
+ Now at: Australian Herbicide Resistance Initiative, University of Western Australia, Crawley, WA 6009

Key messages

1. When conditions are ideal for canola, over half of the Sclerotinia sclerotiorum lesions can be removed from the stubble following Harvest Weed Seed Control (HWSC) guidelines.
2. The numbers of sclerotes left in the soil following a badly infected sclerotinia stem rot crop is highly variable, but can be significant in patches. Rotation of canola with non-host crops is therefore recommended.
3. Even in a dry and late start to the season sclerotinia stem rot infection was recorded in up to 10% of plants, however the severity of infection and subsequent yield loss was less.
4. It is estimated that, if a better understanding of factors affecting sclerotinia stem rot infection of canola led to improved management of the disease and an increase in yield, by as little as 1%, then the benefits to WA grain growers will be close to $1.5 million per annum.

Aims

To improve our understanding of the factors that contribute to sclerotinia stem rot outbreaks in canola crops under different agro-ecological conditions and alternative management of the crop.

To separate the confounding effect of pollination type and location on sclerotinia infection identified in 2016, trials in 2017 were sown at seven locations and included both an open-pollinated and hybrid variety, with the aim to investigate factors influencing sclerotinia infection and sclerotia formation.

To understand the spatial distribution and numbers of sclerotia left in the soil following crop infection.

Method

2016 Field survey of canola paddocks

In 2016 a survey was taken of canola paddocks from Geraldton to Ravensthorpe and ten Sclerotinia sclerotiorum infected stems collected from each paddock at the seed development growth stage. Location, pollinated-type and rotation information was collected. Stems were assessed for a number of factors related to lesion location on the stem and sclerote formation.

2017 Spatial soil survey of paddocks with bad sclerotinia infection in 2016

In March 2017, a spatial assessment was undertaken of six paddocks that had sclerotinia stem rot infected canola grown in 2016 (2 paddocks each at York, Moora and Mingenew). All sites apart from one site at York were reported to be badly infected. Soil and surface vegetative material was sampled from a 25cm² quadrat, to a depth of 5cm, every 20m along two transects of 40m in each paddock. Soil samples were sieved, and vegetative material broken to remove sclerotes from each sample. Number of sclerotes/m² were extrapolated from the number counted per 25cm² quadrat and a spatial distribution map produced for each site transects. Collected sclerotes were checked for viability by growing on nutrient-rich agar plates following sterilization. Sclerotes were determined to be viable once Sclerotinia sclerotiorum mycelium had grown around the sclerote and new sclerotes were in formation.

2017 field trials

Field trials were sown in 2017 at seven locations in the WA wheatbelt; Greenough, Dandaragan, York, Corrigin, Williams, Kojonup and Katanning to assess sclerotinia stem rot infection in canola in open-pollinated (OP) and hybrid canola. Trials were sown with six plots (10 m x 6 rows), as three blocks, of two varieties: ATR Bonito (OP) and Hyola 559 TT (hybrid) that were either sprayed for sclerotinia stem rot management with Prosaro at 20% flowering or untreated. Greenough, Dandaragan and Corrigin were dry sown, the remaining sites were sown at the break of season. Due to the dry and late start to the season each plot was recorded for plant emergence as well as infection rate. At the end of the season five infected stems were collected from each site. Where five infected stems were not present, uninfected stems
were collected. Stems were assessed for a number of factors related to lesion location on the stem and sclerote formation.

Results

2016 Field survey of canola paddocks

Canola stems were collected from 82 paddocks across the WA wheatbelt. Of the paddocks samples hybrid varieties dominated in the north and open-pollinated varieties in the south, with a total of 55 paddocks of hybrid varieties and 27 paddocks of OP varieties sampled (see table 1). An unbalanced ANOVA showed that there was a significant difference in the number of sclerotes recorded in relation to pollination type (df = 1, F = 45.94, P<0.001), with lesion length (F = 269.84, P<0.001) and stem diameter at lowest point of lesion (F = 335.24, P<0.001) significant covariates (Brooks et al. 2018a).

Table 1: Location of sclerotinia stem rot infected canola paddocks sampled in 2016 survey

<table>
<thead>
<tr>
<th>Pollination type/ port zone</th>
<th>Albany</th>
<th>Esperance</th>
<th>Geraldton</th>
<th>Kwinana West</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid</td>
<td>13</td>
<td>4</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Open-pollinated</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

Walsh et al. (2013) have developed methods of Harvest Weed Seed Control (HWSC) to control herbicide resistant weeds. Using the same harvest cutting height it was determined that although infected hybrid canola plants contained more sclerotes on average (13 ± 0.4), compared to infected OP plants (4 ± 0.3), the height of the lesion on the stem was higher, so that 69% of the sclerotes can be intercepted compared to 56% of sclerotes in infected OP plants. Brooks et al. (2018b) have shown that sclerotes intercepted using HWSC and burnt in narrow windows can be destroyed.

It is important to note that 2016 was a wet year with an early break of season (Fig. 1). Results presented may therefore not be indicative of a dryer season

2017 Spatial soil survey of paddocks with significant sclerotinia infection in 2016

Numbers of sclerotes collected from the two transects at each site were very variable. Around half of soil samples contained no sclerotes (48%), and 85% contained 20 or less sclerotes per sq.m (Fig. 1). All sites that had significant infections of sclerotinia stem rot in 2016 contained at least one soil sample (25cm²) with more than 20 sclerotes and up to 44 sclerotes. Only Site 1 from York that had a lower infection level in 2016 did not contain any samples with more than 3 sclerotes in them. These results suggest that the number of sclerotes left in the paddock following sclerotinia stem rot infection are significant but patchy. All sclerotes were found to be viable. However, further research work is required to determine the number of sclerotes that may produce apothecia in subsequent years, and the rate of decline in their viability over time.
Fig. 1. Numbers of sclerotes of *Sclerotinia sclerotiorum* collected from 25cm² quadrats soil samples along transects in six paddocks with sclerotinia stem rot infected crops in 2016. Legend shows sites; 1 and 2 = York, 3 and 4 = Moora, 5 and 6 = Mingenew.

2017 field trials

The season in 2017 was dry with a very late break, after substantial late summer rain. Field trials were therefore planted later than ideal resulting in a patchy germination in some locations. An ANOVA of season by variety by fungicide treatment on final yield showed a significant difference between locations (df = 6, F = 51.14, P<0.001) and variety (df = 1, F = 15.95, P<0.001), with no significant difference between ± fungicide treatment. Plant density was run as a covariate, but was not significant. Yields were highest at Kojonup (GSR = 368 mm), Corrigin (GSR = 229 mm) and Williams (GSR = 419 mm), and were lowest at Greenough (GSR = 258 mm), Dandaragan (GSR = 334 mm) and York (GSR = 259), with Hyola 559 recording a higher yield at all sites except Williams. Sclerotinia stem rot infection was recorded was Dandaragan, Greenough, Kojonup and Williams only (Fig. 12). Infection rates were low and variable with a maximum infection level of 10% of plants recorded in any plot. The position of the lesion was also more variable than in 2016 with lesions occurring at the base of the plants, and also at Dandaragan in particular, in the plant canopy. Sclerote numbers per lesion were even more variable, ranging from 0 to 20 per lesion.

![Sclerotinia stem rot infection rates on fungicide treated and untreated canola trials in 2017](image)

**Conclusion**

Sclerotinia stem rot infection levels, subsequent lesions and sclerotes produced vary significantly between seasons. The wet start to the season in 2016 led to significant infection levels, but also resulted in lesions, that in more than 55% of the plants surveyed, could be removed using HWSC methods. In 2017, with a dry start to the season, although sclerotinia stem rot was still recorded at some sites, the number of sclerotes within the lesions was lower. The number of sclerotes remaining in the soil following a significant sclerotinia stem rot infection in the crop is highly variable, but some patches in all paddocks surveyed were found to have significant numbers, and the paddock will need to be rotated to reduce the risk of a sclerotinia stem rot infected canola crop in that paddock in subsequent years.

Canola production in WA is worth about $1.2 billion per annum to the agricultural industry ([www.agric.wa.gov.au](http://www.agric.wa.gov.au), 2017), with a five-year average grain price of $512/ha and a four-year average yield in WA of 1.17t/ha. The production area in WA is around 1.24 Mha (4-yr average). Murray and Brennan (2012) estimate that there is a potential loss of $40M/yr due to sclerotinia stem rot infection in canola and subsequent yield loss. They also estimate that, in WA, sclerotinia stem rot infection occurs in 99% of years, and that 40% of the area sown to canola with have *Sclerotinia sclerotiorum* present, with a 10% yield loss on average. We estimate that if the outcome of this research is an increase in yield of 1%/yr resulting from improved management of factors affecting sclerotinia stem rot infection the economic benefits to the industry will have close to $1.49M/yr economic benefit to WA canola growers.

**Key words**

Canola, sclerotinia stem rot, *Sclerotinia sclerotiorum*, sclerotes, HWSC
References

Acknowledgments
The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and GRDC investment, the author would like to thank them for their continued support.
Thanks also to all the agronomists and growers that have given up their time and allowed the project team onto their land. Thank you to Kalyx and Living Farm for trial management and to Amir Abadi for assistance with the economic assessment of the impact of this research.

GRDC Project Number: CUR00023