Factors affecting sclerotinia stem rot infections in canola

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Key messages

1. In high infection years, 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 an increase in yield, by as little as 1%, through improved management of Sclerotinia stem rot infection in canola would result in benefits to WA grain growers of 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 a 2016 survey, through field trials in 2017 including both an open-pollinated and hybrid variety.

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 undertaken of canola paddocks from Geraldton to Ravensthorpe and ten *Sclerotinia sclerotiorum* infected stems collected from each paddock at the seed development growth stage. Location, pollination-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 high levels of 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 highly infected. Soil and surface vegetative material was sampled from a $25cm^2$ 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/m^2 were calculated from the number counted per $25cm^2$ quadrat and a spatial distribution map produced for each site transects. Collected sclerotes were assessed 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 formed.

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 with Prosaro at 20% flowering or untreated. Greenough, Dandaragan and Corrigin were dry sown, the remaining sites were sown at the break of season. Plant emergence as well as infection rate were recorded for each plot. At the end of the season, five infected stems were collected from each plot. 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 sampled 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 ($F = 45.94$, $P=<0.001$), 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 by Port Zone

Pollination type/ port zone	Albany	Esperance	Geraldton	Kwinana West
Hybrid	13	4	17	21
Open-pollinated	9	9	0	9

Walsh et al. (2013) have developed methods of Harvest Weed Seed Control (HWSC) to control herbicide resistant weeds. Using the same recommended harvest cutting height of 15cm, 69% of the sclerotes from infected hybrid plants were intercepted compared to 56% of sclerotes in infected OP plants, due to higher stem lesions in infected hybrid plants. However, infected hybrid canola plants contained more sclerotes on average (13 ± 0.4), compared to infected OP plants (4 ± 0.3). 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. Results presented may therefore not be indicative of a dryer season.

2017 Spatial soil survey of paddocks with high levels of sclerotinia infection in 2016

Numbers of sclerotes collected from the two transects at each site were 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 ($25cm^2$) 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. 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 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.

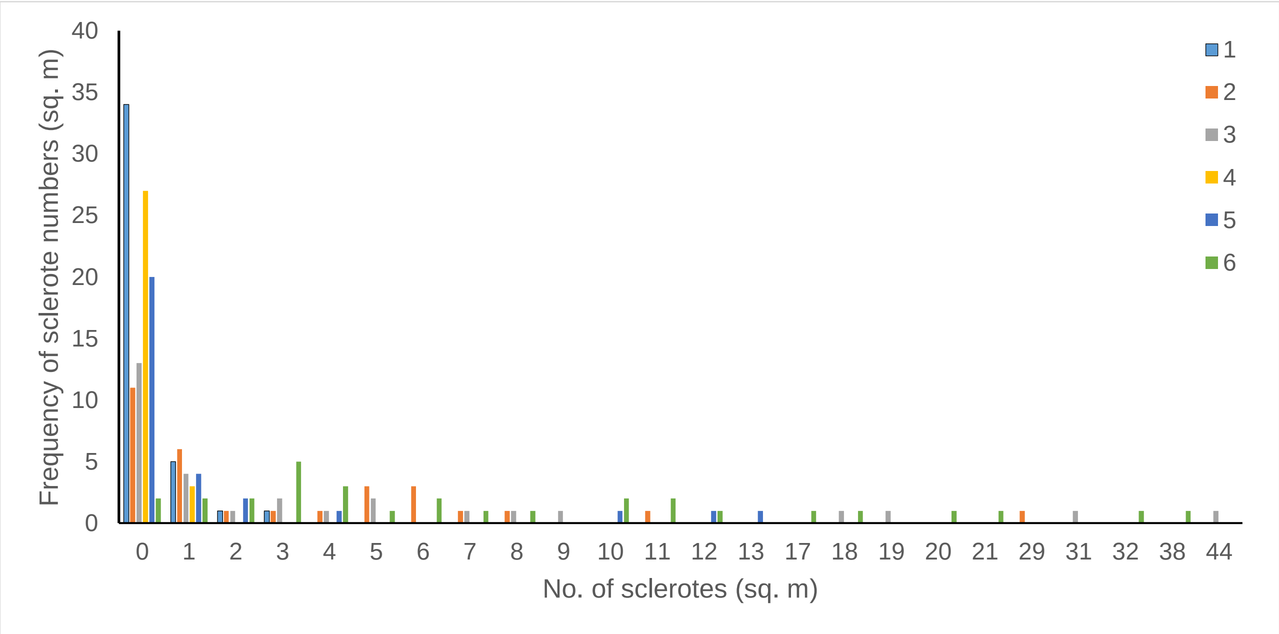

Fig. 1. Numbers of sclerotes of *Sclerotinia sclerotiorum* collected from $25cm^2$ quadrat soil samples along transects in six paddocks with Sclerotinia stem rot infected crops in 2016. Legend shows sites; 1 and 2 = York, 3 and 4 = Moora, 5 and 6 = Mingenew.

2017 field trials

The 2017 season 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 in 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 only recorded at Dandaragan, Greenough, Kojonup and Williams (Fig. 2). 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.

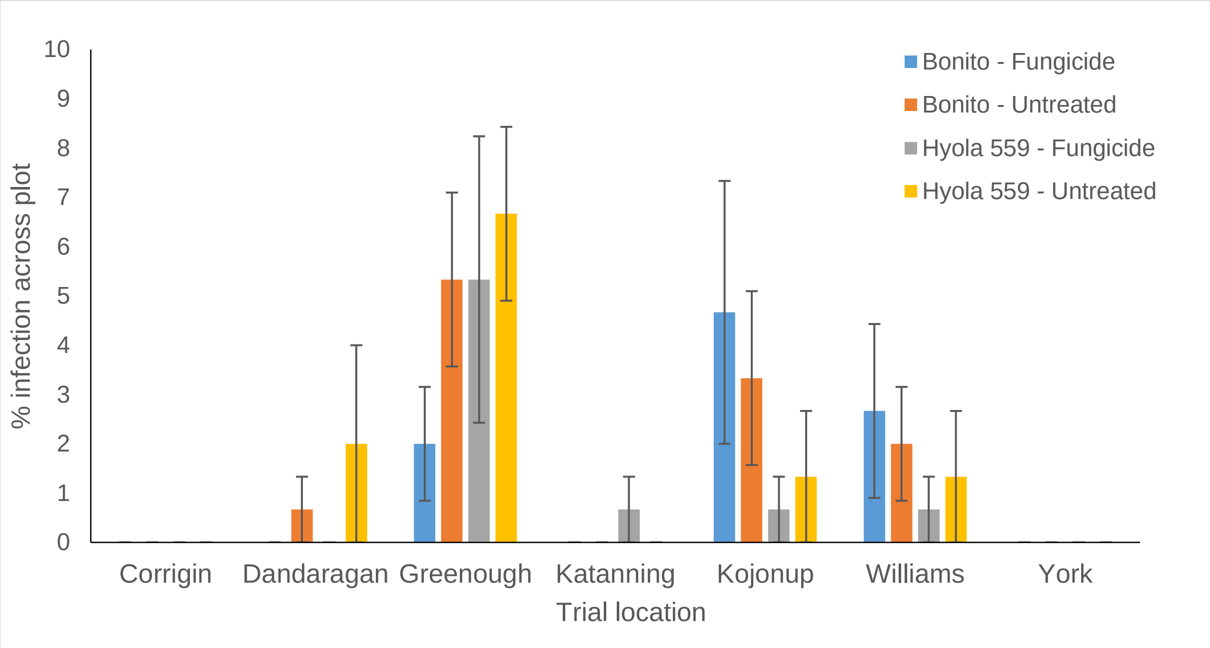

Fig. 2. Sclerotinia stem rot infection rates on fungicide treated and untreated canola trials in 2017

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 tall and dense canopies, so that Sclerotinia stem rot lesions were higher than 15cm from the ground. Sclerotes within 55% of the infected plants surveyed could therefore be removed using HWSC methods. The number of sclerotes remaining in the soil following significant Sclerotinia stem rot infection in a crop is highly variable, but some patches in all paddocks surveyed were found to have significant numbers. The dry start to the season in 2017 resulted in no or lower infection levels at trial sites, and a reduced number of sclerotes within the lesions sampled compared to sampled infected plants in 2016.

Canola production in WA is worth about $1.2 billion per annum to the agricultural industry (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 has *Sclerotinia sclerotiorum* present, with a 10% yield loss on average. The outcome of this research suggests that infection levels in subsequent years can be reduced by following HWSC methods and burning windrows. However, this is only recommended in highly infected crops as it does not meet conservation agriculture principles. It is estimated that if canola yields can be increased following HWSC methods by 1%/yr the economic benefits to the industry will be close to $1.49M/yr.

Key words

Canola, Sclerotinia stem rot, *Sclerotinia sclerotiorm*, sclerotes, HWSC

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