

Survival and dissemination of *Leptosphaeria maculans* in south-eastern Australia

Stephen Marcroft^{1,4}, Susan Sprague¹, Phillip Salisbury^{1,2} and Barbara Howlett³

¹Department of Primary Industries (Victorian Institute for Dryland Agriculture), Private Bag 260, Horsham Victoria 3401 Australia, steve.marcroft@nre.vic.gov.au, susan.sprague@CSIRO.au

²Institute for Land and Food Resources, The University of Melbourne, Melbourne Victoria 3010 Australia, psalisbury@optushome.com.au

³School of Botany, The University of Melbourne, Melbourne Victoria 3010, Australia, bhowlett@unimelb.edu.au

⁴Joint Centre for Crop Innovation, Private Bag 260, Horsham, Vic. 3401, Australia

ABSTRACT

The recent increase in area sown to canola in Australia has resulted in large acreages of canola stubble and thereby increased disease pressure to a point where yield loss in canola can be considerable. Fields containing two to 42 month old stubble were evaluated for the number of ascospores discharged in three diverse rainfall environments in Victoria. Ascospores were discharged from stubble of all ages and environments, however, >97% of ascospores produced by the fungus were from the previous season's canola stubble, with few from older stubble fields. The critical factor was the physical amount of stubble persisting. In all environments stubble broke down quickly with only small amounts left after two years. This was supported by results from New South Wales which found that short rotations (canola / wheat / canola) had the same level of blackleg infection compared to long rotations (four year break between canola crops). The distance between current canola crops and stubble from the previous season was measured and found to be critical to infection severity. The overall finding of this research suggests that crop rotation is not as important in reducing disease levels as previously thought and that crop isolation from stubble of the previous season is the critical factor. Canola crops should be sown at least 100m from canola stubble from the previous season with 500m being preferable.

Keywords

Blackleg, Canola, *Brassica napus*, Ascospore, Stubble,

INTRODUCTION

Brassica napus (canola) is an important crop in Australia. The area under cultivation increased from 100 000 ha in 1990 to 1.8 million ha in 1999, with 1.1 million ha in 2002. Blackleg (*Leptosphaeria maculans*) is the most important disease of canola in Australia with widespread epidemics destroying the industry in the early 1970's. Resistant cultivars now form the basis of the re-established canola industry, however, due to the large area sown to canola, inoculum levels of *L. maculans* have increased resulting in high disease pressure.

The primary source of inoculum of *L. maculans* is airborne ascospores. Mature pseudothecia (sexual fruiting bodies) on infected canola stubble discharge ascospores during extended moist periods, which normally occur after the opening rains and thereon throughout the growing season. Ascospore infection leads to leaf lesions, the fungus then grows systemically from the lesion down the vascular vessels to the stem crown where it kills cells of the stem cortex, resulting in a blackened canker at the base of the stem. In Australia there have been few, if any, published reports on the phenology of ascospore discharge (timing of ascospore release and stubble longevity) after the 1970s.

MATERIALS AND METHODS

Rate of stubble decomposition

During 2000 and 2001, 74 fields which had a previous canola crop in 1996, 97, 98 or 99 were surveyed in Wonwondah, Victoria (450mm annual rainfall) for the presence of canola stubble.

The survey was also completed in 12 fields at Birchip, Victoria (350mm annual rainfall), and 24 fields at Lake Bolac, Victoria (600mm annual rainfall) to determine environmental effects on stubble decomposition. A "W" transect was walked in each field and forty 0.1m² quadrats were used to collect stubble. The stubble was washed, oven dried and then weighed.

Ascospore discharge

A Burkard ascospore liberator was used to determine the number of ascospores discharged from the stubble collected. The stubble was cut into 6cm pieces (to enable it to fit into the liberator), pre-conditioned at 100% humidity for 24 hours, immersed in water to trigger ascospore discharge and placed into the liberator. The liberator traps the ascospores by sucking them onto microscope slides (coated with vaseline) as they are discharged from the sexual fruiting bodies of the fungus. These ascospores were then counted using a compound microscope.

Blackleg severity in commercial fields

The relationship between distance to stubble and blackleg severity was measured in 60 commercial crops at Wonwondah. To determine the effect of rotation on blackleg severity 12 fields at Junee, NSW (525 mm annual rainfall) of either long crop rotation (no canola grown for the previous three years) or short rotation (canola / wheat / canola) were sampled. A "W" transect was used to collect 100 plants from each field, the roots were then cut off with secateurs and the stem visually assessed for the per cent stem cross section internal-infection (CSII).

RESULTS & DISCUSSION

Rate of stubble decomposition

In all three environments, stubble aged six months accounted for the majority of stubble present. Fields containing 18 month old stubble contained 13% of the amount of stubble found in six month old stubble fields while fields containing 30 and 42 month old stubble had only 3% of the stubble found in six month old stubble fields. The weight of stubble between individual fields of the same age varied considerably especially for six month old stubble (300 to 2580 kg/ha).

Six months after harvest, fields in the low rainfall environment contained significantly more stubble than fields in the medium and high rainfall environments, which both had similar amounts of stubble at this time. Smaller differences were found in fields of older stubble of all ages between the three environments.

Ascospore discharge

Ascospores were discharged from pseudothecia on canola stubble of all ages and from all three environments. Ascospore discharge per piece of stubble was multiplied by the physical amount of stubble (kg / ha) within each field to determine ascospore discharge per hectare. From this calculation more than 97% of all ascospores discharged from all environments were found to originate from six month old stubble (Table 1).

Blackleg severity in commercial fields

The CSII was similar for fields sown in short rotation (canola / wheat / canola) compared to fields sown into long rotations (no canola for the previous 3 years). Rotation length therefore, was not important to disease severity which supports the previous finding that ascospore discharge is almost exclusively from six month old stubble.

Disease severity was however correlated to distance from six month old stubble. There was a general decline in blackleg severity over 500 m from six month old stubble but no significant reduction in disease severity between 500 and 1000 m (Fig. 1).

These results suggest that to decrease blackleg severity in canola crops in Australia, growers should space their crops across the farm avoiding the previous year's canola stubble rather than being concerned within field rotation.

Table 1. Average and range of *Leptosphaeria maculans* ascospores discharged per hectare from canola stubble of different ages (6, 18, 30 and 42 months old) at different environments (low, medium and high annual rainfall) during 2000 and 2001. Values with the same suffix vertically (a, b or c) are not significantly different ($P=0.05$). n.a., not available; stubble was not collected from these fields.

Stubble age (months)	Ascospores discharged Per hectare (average)	Range of numbers of ascospores discharged per hectare
Low rainfall environment		
6	261,208,000a	346,000 – 777,449,000
18	1,933,000ab	1,127,000 – 3,403,000
30	549,000b	35,000 – 996,000
42	122,000b	20,000 – 320,000
Medium rainfall environment		
6	116,074,000a	452,000 – 407,451,000
18	3,498,000b	34,000 – 14,298,000
30	2,507,000b	29,000 – 5,626,000
42	27,000c	11,000 – 50,000
High rainfall environment		
6	507,392,000a	90,703,000 – 890,322,000
18	1,463,000b	6,1001,000 – 10,000
30	12,000c	20,000 – 8,000
42	n.a.	n.a.

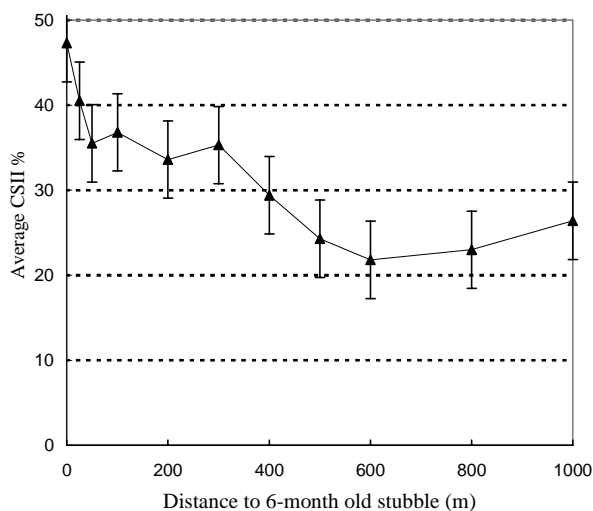


Fig. 1. Influence of the distance from six month old canola stubble on blackleg severity of canola within the same crop. Disease severity was measured as average stem cross section internal-infection - CSII at Wonwondah, Vic during 2001. Vertical bars represent the l.s.d. ($P < 0.05$).

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