Epidemiology of blackleg disease of canola, caused by *Leptosphaeria maculans*

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Abstract

Blackleg, caused by *L. maculans*, is of major economic importance in the canola growing areas of Australia. The aim of this research was to gain information about factors affecting the epidemiology of blackleg in south-eastern Australia. The effect of temperature on a number of aspects of the life cycle of *L. maculans* was studied in a controlled environment. Germination of ascospores was greater on agar and cotyledons than on leaves, on susceptible cultivars than resistant cultivars, and at 15 and 20°C than at 5 and 10°C. Elongation of germ tubes was greater at higher than lower temperatures and generally greater on cotyledons than on leaves of the cultivars after incubation for 24 h at 10-20°C. Temperature had a greater influence than plant organ or cultivar on ascospore germination and the elongation of germ tubes.

Temperature, wetness duration, cultivar and leaf position (leaves 1-3) influenced the incubation period of *L. maculans* on canola. Ascospores infected six canola cultivars over 10-20ºC following leaf wetness duration of 16-72 h. Incubation period (from inoculation to the appearance of first lesions) was generally shorter at higher temperatures and following longer wetness periods. Incubation period decreased with increasing leaf age, regardless of the blackleg-resistance rating of the cultivars. Pseudothecia developed on naturally infested canola stubble incubated at 5-20°C under continuous wetness and a 12 h photoperiod. The time taken for pseudothecia to mature after harvest, ranged from 58.3 days at 5°C to 22.2 days at 15°C. Fewer pseudothecia developed on stubble incubated in darkness at 15°C than in light. Pseudothecia took longer to mature when wetness was interrupted than continuous. More ascospores were released at 20°C than 5-15°C, although peak sporulation occurred earlier at 5-10°C. Discharge of ascospores continued for 8 h at 5-10°C, for 10 h at 15°C, and for 12 h at 20°C.

The effect of burial of infested canola stubble in sand and field soil (in pots) on pathogen survival, pathogenicity and stubble-associated fungi was studied over 13 months in ambient conditions. The isolation frequency of *L. maculans* from stubble decreased by 63.3% after 13 months of burial, regardless of soil type. Although the frequency of isolation of *L. maculans* and *Alternaria* spp. from stubble decreased over time, that of *Stachybotrys chartarum*, *Fusarium* spp. and *Coprinus* sp. increased substantially over the sampling period. Stubble buried in field soil underwent more decay than in sand over the 13 months. Pseudothecium formation on buried stubble decreased with increasing duration of burial and ceased after 11 months in the field soil and 13 months in sand. The time required for pseudothecia to mature was 25 days for stubble retrieved after one month and 30 days when retrieved 10 months after burial, regardless of soil type. Ascospores from the stubble recovered from burial caused typical Phoma leaf spots on canola over the first 9 months of burial. Over the year, 16 genera of fungi and 12 colony types of bacteria were isolated from the field soil on peptone-rose bengal agar (PRA) and on crystal violet agar (CVA), respectively. Populations of fungi and bacteria isolated on soil-extract agar were markedly greater than those on PRA and on CVA, respectively.

Growth and sporulation of *L. maculans* on agar media and on infested canola stubble was affected by a variety of fungi obtained from stubble buried in soil or from field soil. Antagonistic activities observed included lysis, deformation, overgrowth and inhibition of *L. maculans* hyphae, and reduction of pseudothecium density on stubble to one-third or less than that on controls following inoculation with *F. equiseti*, *Gliocladium roseum*, *Trichoderma aureoviride*, *Sordaria* sp. and an unknown Coelomycete. *S. chartarum* and *Coprinus* sp. reduced the mass of canola stubble *in vitro*.

Findings will contribute to a better understanding of blackleg and to the development of more effective control measures.

Abbreviations

ANOVA	Analysis of variance
CFU	Colony forming units
CVA	Crystal violet agar
cv.	Cultivar
cvs.	Cultivars
DNA	Deoxyribonucleic acid
DV8A	Dilute vegetable juice agar
G–	Gram-negative bacteria
G+	Gram-positive bacteria
GS	Growth stage
LSD	Least significant difference
NA	Nutrient agar
NUV	Near ultra violet
PDA	Potato dextrose agar
PRA	Peptone-rose Bengal agar
RO	Reverse osmosis
SEA	Soil-extract agar
WA	Water agar

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Publications

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