Conditions for the Development of Mature Apothecia of *Pyrenopeziza brassicae* and the Role of Ascospores in Epidemics of Light Leaf Spot on Winter Oilseed Rape

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Ascospores are produced during maturation of apothecia, the teleomorphic stage of *Pyrenopeziza brassicae* (Rawlinson *et al.*, 1978). In field experiments, apothecia were observed to develop only after senescence of plant tissues, and when resulting debris was turgid (McCartney and Lacey, 1990). Subsequent release of ascospores occurred only when apothecia-bearing debris was wet. Effects of temperature on maturation of apothecia have not previously been investigated.

Mature apothecia, releasing ascospores, have been observed on infected stem, pod and leaf debris of winter oilseed rape at various times during a season. Ascospore release has been observed in autumn from infected debris of previous winter oilseed rape crops and in spring and early summer from infected leaf debris in crops (Lacey *et al.*, 1987; McCartney and Lacey, 1990). However, the role of ascospores in initiation and progress of light leaf spot epidemics on winter oilseed rape has not been studied in detail. Wind-dispersal of ascospores (McCartney *et al.*, 1986) suggests that from a distant inoculum source, ascospores are more likely to be deposited in winter oilseed rape crops than the splash-dispersed conidia (Rawlinson *et al.*, 1978). Whether ascospores are infective and cause infections is unknown.

Maturation of apothecia was investigated on debris of artificially infected petioles. Infected petioles were collected, when senesced, 4.5 weeks after inoculation of winter oilseed rape plants (cv. Bristol) at the 5-leaf-stage (3.5 weeks old) with conidia of a Rothamsted field isolate of *P. brassicae*. To investigate the effects of temperature on maturation of apothecia, these petioles were incubated at various constant temperatures from 6 to 22°C (continuous wetness and continuous darkness). Numbers of mature apothecia per length of petiole were counted regularly during incubation to estimate the rate of development of mature apothecia. An apothecium was defined as mature when a pore became visible in the globular structure of a developing apothecium.

The infectivity of conidia was compared with the infectivity of ascospores by inoculating plants with conidia or ascospores at different spore densities per unit leaf area under the same conditions (16°C and 24 h leaf wetness duration after inoculation). Infectivity was calculated as the number of lesions produced per number of spores deposited onto a leaf. Winter oilseed rape plants (cv. Bristol) were inoculated at the 5-leaf-stage (3.5 weeks old) with conidia by spraying with an aerosol-powered sprayer suspensions of conidia onto the plants for equal lengths of time. The concentration of conidia in suspension was varied to deposit conidia at

different densities per unit leaf area. Ascospores were released from mature apothecia on debris located under the propagator covers onto the winter oilseed rape plants (cv. Bristol) at 5-leaf-stage (3.5 weeks old). The plants were exposed to ascospore release for different lengths of time to deposit ascospores at different densities per unit leaf area. During inoculation, glass microscope slides were placed at different locations within each propagator. The number of spores per unit area of a slide multiplied by the units of leaf area at the time of inoculation gave an estimate of the number of spores deposited per leaf. Two weeks after inoculation, numbers of lesions were assessed on leaves 3 and 4 of each plant.

Temperature influenced the rate of development of mature apothecia. At 17°C and 18°C, the first mature apothecia were observed after 5 days of incubation; the greatest number of mature apothecia was observed after 14 days of incubation. At 22°C, only small numbers of apothecia had started to develop, but none of them matured. Thus, an increase in temperature from the optimum temperature to temperatures above 22°C inhibited maturation of apothecia. A decrease in temperature from the optimum temperature decreased the rate of development of mature apothecia. At 6°C, the first mature apothecia appeared after 15 days of incubation; the greatest number of mature apothecia was observed after 35 days of incubation.

Ascospores were found to be more infective than conidia. In comparison, 100 lesions were observed on a leaf when 4000 to 5000 ascospores or approximately 2000000 conidia had been deposited on that leaf. When less than 50000 conidia had been deposited on a leaf, no lesions were observed in most cases, whereas when less than 500 ascospores had been deposited on a leaf, lesions were observed in all cases.

Because sexual reproduction of *P. brassicae* is likely to occur frequently in the UK (Majer *et al.*, 1998; Ball *et al.*, 1998), ascospores are likely to initiate epidemics of light leaf spot in autumn more often than conidia, and could also cause stem and pod infections in spring and early summer. Knowledge about the development of mature apothecia could thus be used to forecast the initiation of light leaf spot epidemics in autumn and progress of these epidemics in spring and summer. This study found a relationship between temperature and the development of mature apothecia under controlled conditions. Effects of other factors, like debris wetness and interrupted debris wetness, on development of mature apothecia need to be studied in detail under controlled conditions. All observed effects of various factors on the development of mature apothecia then need to be validated under natural conditions at the field, and can eventually be used to develop an accurate model to forecast light leaf spot on winter oilseed rape in the UK.

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References

Ball A.M., Siddiq A.A. and Giltrap N.J., 1990 - Assessment of benomyl resistance and mating type in field isolates of *Pyrenopeziza brassicae*, cause of light leaf spot of brassicas. - *Plant Pathology* 39, 33-37.

Lacey M.E., Rawlinson C.J. and McCartney H.A., 1987 - First record of the natural occurrence in England of the teleomorph of *Pyrenopeziza brassicae* on oilseed rape. - *Transactions British Mycological Society* 89, 135-40.

Majer D., Lewis B.G. and Mithen R., 1998 - Genetic variation among field isolates of *Pyrenopeziza brassicae*. - *Plant Pathology* 47, 22-28.

McCartney H.A. and Lacey M.E., 1990 - The production and release of ascospores of *Pyrenopeziza brassicae* on oilseed rape. - *Plant Pathology* 39, 17-32.

McCartney H.A., Lacey M.E. and Rawlinson C.J., 1986 - Dispersal of *Pyrenopeziza brassicae* spores from an oil-seed rape crop. - *Journal of Agricultural Science, Cambridge* 107, 299-305.

Rawlinson C.J., Sutton B.C. and Muthyalu G., 1978 - Taxonomy and biology of *Pyrenopeziza brassicae* sp.nov. (*Cylindrosporium concentricum*), a pathogen of winter oilseed rape (*Brassica napus* ssp. *Oleifera*). - *Transactions of the British Mycological Society* 71, 425-39.