Introducing an interactive Internet based forecasting system for light leaf spot of winter oilseed rape in the UK

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Abstract: Light leaf spot (*Pyrenopeziza brassicae*) is a serious disease of winter oilseed rape crops in the UK. Wind blown ascospores from crop debris of the previous season are thought to initiate infection in newly sown crops. Fungicide trial data suggests that the most effective time for the control of light leaf spot is an autumn spray. However, in autumn, the pathogen enters a hemibiotrophic phase during which infections are not readily visible and detection of the disease can be problematic. Localised spread in the spring occurs through splash-dispersed conidia.

Assessment data from regions of the UK were used to produce a model to predict the risk of light leaf spot in specific regions of the UK. The forecast is based on crop and weather factors. At the start of the season, a prediction is made for each region using the average weather conditions expected for that region. This forecast is then updated periodically to take account of deviations in actual weather away from the expected values. Three factors form the basis of the model: amount of pod disease the previous summer, autumn temperatures and the number of winter rain days above the regional average. The model, which is available to growers over the Internet, is currently in a third year of evaluation. The recent addition of active server page technology has allowed the forecast to become interactive. Growers can input three pieces of information (Cultivar choice, sowing date and autumn fungicide application information) which are taken into account by the model to produce a risk assessment that is more crop-specific.

Key words: Forecasting, light leaf spot, *Pyrenopeziza brassicae*, risk prediction, winter oilseed rape.

Introduction

Oilseed rape is the most important arable crop in the UK after cereals (> 400,000 ha *per annum*). Although losses differ greatly from season to season, it is estimated that diseases can cause up to £80M of losses per season in winter oilseed rape (Fitt *et al.*, 1997).
Light leaf spot (*Pyrenopeziza brassicae*) and stem canker (*Leptosphaeria maculans*) are the two diseases that consistently cause the greatest losses. However, there are regional differences in the severity of the two diseases and light leaf spot causes the greatest losses in the north of England and Scotland (Sutherland *et al.*, 1995). Light leaf spot is a polycyclic disease, which infects leaves, stems, flowers and pods (McCartney & Lacey, 1990). It is thought that epidemics are initiated by air-borne ascospores of *P. brassicae* which are produced in apothecia on stem and pod debris. Splash-dispersed conidia produced in acervuli on volunteer oilseed rape seedlings and vegetable brassica crops may also be involved in epidemic initiation, although conidia probably play a greater role in localised spread of the disease from initial foci. The disease spreads up plants through secondary spore dispersal and

through extension of stems with infected meristematic tissue. Evidence from experiments in which fungicides have been used to manipulate the development of epidemics suggests that light leaf spot generally decreases yields through killing leaves, and sometimes plants, in winter (Rawlinson *et al.*, 1978; Fitt *et al.*, 1998), although occasionally flowers and pods are damaged later. Fungicide timing for the control of light leaf spot has not been optimal and often crops requiring treatment have been left unsprayed at the appropriate time whilst others have been sprayed unnecessarily (Hardwick & Turner, 1994).

For both economic and environmental reasons, fungicide timing needs to be optimised so that only crops which require treatment are treated. Recommendations on spray timing depend on an understanding of the epidemiology of light leaf spot and an ability to forecast the risk of severe epidemics. Retrospective estimates of losses can be used to determine the importance of the disease in a particular season. Forecasting schemes, based on empirical relationships between measured disease incidence and earlier disease incidence or weather factors (e.g. temperature, rainfall) have been developed over a number of years at IACR - Rothamsted. The model is continually being improved by the incorporation of information on the epidemiology of light leaf spot (e.g. infection conditions, ascospore release). This paper describes work on the development of an interactive Internet-based support system which provides growers with useful information regarding light leaf spot risk.

Initial model development

The scheme for forecasting the severity of light leaf spot epidemics involves regional risk and crop risk forecasts at the beginning of the growing season in October, combined with a protocol for sampling crops to confirm the presence of light leaf spot (Fitt *et al.*, 1996; Welham *et al.*, 1998). Seasonal, regional risk indices, predicting the % crops in a region with light leaf spot in the following March, have now been issued in October 1996, 1997, 1998 and 1999. Spring disease survey data (i.e. March 1997, 1998 and 1999) were used to validate predictions made the previous autumn (i.e. October 1996, 1997 and 1998). Observed light leaf spot incidence in spring was never greater than that predicted for a region but was sometimes considerably smaller, most probably because many crops had been sprayed with fungicide.

Development of a WWW-based system

In 1998, web pages were produced and the forecast was issued as a map showing the risks in different regions of the UK. The regional forecasts were based on survey data collected in the July before they are issued in October. Regional forecasts can now be updated twice during the autumn/winter by the addition of factors dependent on autumn rainfall and winter temperature (deviations from 30-year mean values). Recently, the addition of active server pages (ASP's) has allowed the development of an interactive component into the model. The ASP's were produced using Delphi software. The pages (www.iacr.bbsrc.ac.uk/lightleafspot) now contain three information fields; cultivar (chosen from the current list of recommended cultivars), sowing date (early/late) and whether or not autumn fungicide has been applied (yes/no) (Fig. 1). Growers input information relative to their situation, press ``Submit query'' and are presented with a risk prediction for their specific area of the country under the cultural practises used on their farm (Fig. 2).

Discussion

The ultimate aim of the crop risk model is to provide growers with information about the risks of severe light leaf spot epidemics in their own crops. The recent advances highlighted in this paper have increased the potential of the model to provide the grower with valuable information prior to fungicide application decisions being made. The model is now more crop-specific than before, with cultivar resistance ratings, sowing date and early fungicide applications to be taken into account and further refining the information available to the grower. Ultimately, there is a need for crop risk indices that can be updated by using information about local weather (e.g. occurrence of infection conditions) and fungicide use throughout the season. Furthermore, predictive models need to be derived for situations where a combination of diseases occurs together.

The development of the interactive model also provides growers with a useful tool prior to sowing the crop. Because information about many commonly grown cultivars has been included in the interactive web site, a grower has the opportunity to assess the relative merits of cultivars of different resistance ratings. From this, it is easy to ascertain the potential risk from light leaf spot for a particular cultivar in a given region of the UK in a particular season.

Ultimately, there is a need to construct a decision support system for integrated management of all major diseases in winter oilseed rape in the UK. However, such a decision support system can be reliable and robust only if it is based on accurate understanding and accurate models of the epidemiology of the important diseases. The priorities now must be to obtain accurate biological data about the development of stem canker and other important disease, to construct accurate models to describe these data and then to develop a combined regional risk and crop risk forecast system.

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Figure Legends:

Fig. 1. A web-based input page allowing oilseed rape growers to enter cultivar, sowing date and fungicide application information into an interactive model to determine risk assessment of light leaf spot epidemic development.

Fig. 1

Forecast for North of England

Please enter your details to refine the forecast for your farm:

Cultivar:

Apex

Sowing date:

(•) Early: before 1st September

( ) Late: after 31st August

Autumn Fungicide Spray:

(•) No

( ) Yes

Submit Query | Reset

Fig. 2. Output page providing an oilseed rape grower with a risk assessment for light leaf spot under the particular parameters on the farm

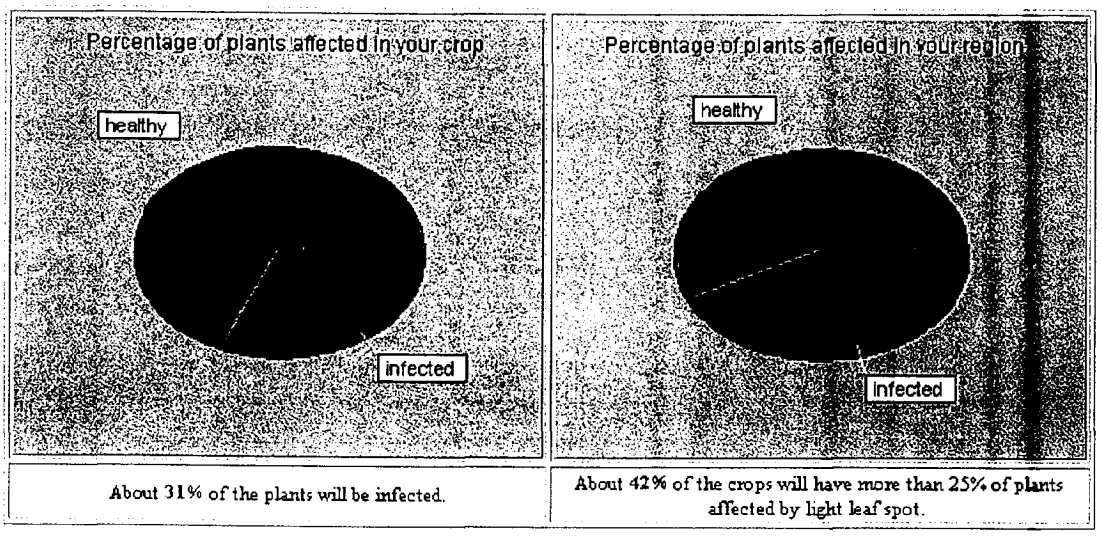
Fig. 2

Light Leaf Spot Forecast

Customized forecast for a farm in North of England

Cultivar	Apex
Resistance Rating	6
Sown	early
Autumn spray	unsprayed

The model predicts



About 31% of the plants will be infected.

About 42% of the crops will have more than 25% of plants affected by light leaf spot.