Interactive forecasting of light leaf spot (*Pyrenopeziza brassicae*) risk for winter oilseed rape on the Internet

Neal Evans*[1], Julie M. Steed[1], Sue J. Welham[1], John F. Antoniw[1], Andreas Baierl[1], Judith A. Turner[2], Peter Gladders[3] and Bruce D.L. Fitt[1]

[1]Rothamsted Research, Harpenden, Herts., AL5 2JQ, U.K. E-mail: neal.evans@bbsrc.ac.uk
[2]Central Science Laboratory, Sand Hutton, York, YO41 1LZ, U.K. E-mail: j.turner@csl.gov.uk
[3]ADAS Boxworth, Cambridge, CB3 8NN, U.K. E-mail: Peter.Gladders@adas.co.uk

ABSTRACT

Disease survey and weather data from different regions of the UK were used to produce a model that predicts the risk of severe light leaf spot for winter oilseed rape crops in that region. At the start of the season (in October), a prediction is made for each region, using the deviation of summer temperature from the 30 year mean and the incidence of light leaf spot on the pods of the previous crop immediately before harvest (previous July). The forecast is then updated periodically to take account of observed deviations from the average winter rainfall. Recently, the Internet version of the model that is hosted on the web-site at www3.res.bbsrc.ac.uk/leafspot/ has been updated to make it more crop-specific. Oilseed rape growers input two pieces of information specific for their crop; cultivar and sowing date. A crop-specific prediction of risk from light leaf spot, with or without the effect of an autumn fungicide application targeted at light leaf spot, is then delivered to the grower. The interactive light leaf spot model is currently being incorporated into a two-way interactive oilseed rape pest and disease Decision Support System (DSS) for winter oilseed rape (PASSWORD).

Key words: Forecast, interactive, Internet, light leaf spot, *Pyrenopeziza brassicae*.

INTRODUCTION

Diseases can cause up to £80M of losses per season in winter oilseed rape, athough losses differ greatly from season to season (Fitt *et al.,* 1997; http://www.csl.gov.uk/prodserv/cons/crop/survey/osrintro.cfm). 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 in Scotland (Sutherland *et al.,* 1995).

Fungicide timing for the control of light leaf spot has not been optimal (Hardwick & Turner, 1994). Fungicide timing needs to be optimised so that only crops which require treatment are treated. A forecasting scheme, based on empirical relationships between disease incidence and weather factors (e.g. temperature, rainfall) has been developed over a number of years by Rothamsted Research, ADAS and CSL. This paper describes the recent development of an Internet-based version of this system which provides information to help growers to identify seasonal risk and to optimise fungicide use for control of light leaf spot on winter oilseed rape.

MATERIALS AND METHODS

Development of initial regional model

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*., 1998; Welham *et al*., 1999). Seasonal, regional risk indices, predicting the % crops in a region with damaging light leaf spot in the following March, have now been issued in October since 1996. Spring disease survey data were used to validate predictions made the previous autumn (i.e. October 1996, 1997, 1998 and 1999). 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 at risk had been sprayed with fungicide.

Development of an interactive, Internet-based model

The light leaf spot web pages were first produced in 1998. During this first year, the forecast was issued as a map showing the light leaf spot risk for different regions of the UK. Recently, the use of active server page (ASP) technology has allowed the development of an interactive crop-specific model. The ASP's were produced using Delphi software (Borland Software Corp., California, USA)

and the pages are hosted on a Microsoft interactive internet server. The pages (www3.iacr.bbsrc.ac.uk/leafspot) now contain two input fields; cultivar (chosen from the current list of recommended cultivars) and sowing date. Growers input information about their specific cropping situation, press “Submit query” and are presented with two risk predictions for their specific area of the country under the cultural practices used on their farm. The first risk prediction provides information for an unsprayed crop, whilst the second risk prediction takes into account the effect of an autumn-applied fungicide spray targeted against light leaf spot. A recent addition to the website is a registration/comments form. Growers or their advisors are encouraged to register their email address or mobile telephone number and will be alerted to forecast model updates either by email to their computer or an SMS text message to their mobile phone.

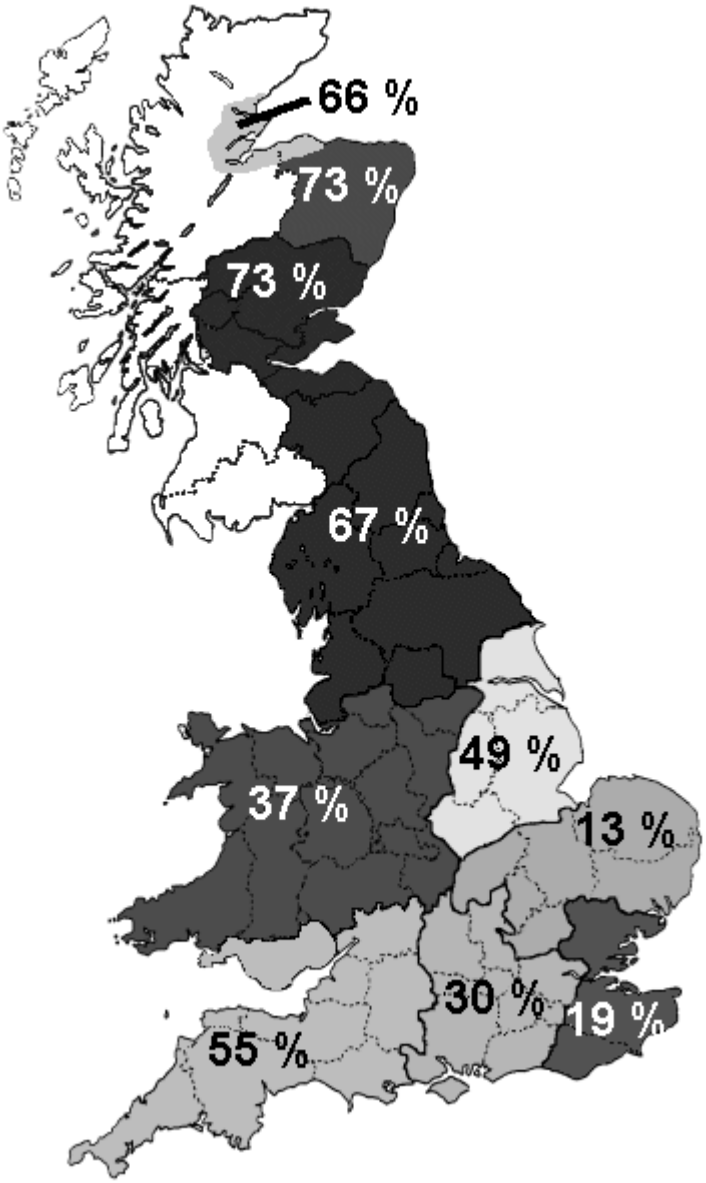

Fig 1. Map indicating the UK regional risk for the percentage of winter oilseed rape crops predicted to have >25% infection with light leaf spot (*Pyrenopeziza brassicae*) issued in October 2002 for spring 2003 (assuming the use a cultivar with a resistance rating 5).

DISCUSSION

The recent advances provided by the interactive crop-specific model have increased the potential of the model to provide growers and advisors with valuable information about disease risk before fungicide application decisions are made. The additional crop-specific information provides a further refinement to the original regional forecast. 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 produced for situations where a combination of diseases occurs together.

The interactive model also provides growers with a useful tool which can be used before sowing the crop. Because resistance information on commonly grown cultivars has been included in the interactive web site, the grower has the opportunity to assess the relative merits of using cultivars with different resistance ratings on a farm in a specific region. From this, it is possible to ascertain the potential risk from light leaf spot for a particular cultivar in a given region of the UK in a particular season and to evaluate the benefits of growing a more resistant cultivar.

The addition of a registration/comments form allows the forecast to become two-way interactive for the first time. Growers or advisers who register can choose whether they would like automatic notification of forecast updates, either by email or by SMS text message to their mobile telephone. It is envisaged that the further development of mobile telecommunications technology will allow real-time interaction with the forecast website, for example, to take into account a recent disease assessment or to incorporate on-farm meteorological data. A study in Finland utilised SMS text messaging not only to alert growers to developing outbreaks of common agricultural pests, but allowed the development of a dynamic real-time database of actual pest levels at the field level through farmer response SMS text messages sent to the study centre (Markkula *et al*., 2000).

The PASSWORD project (Pest and Disease mAnagement System Supporting Winter Oilseed Rape Decisions; http://password.csl.gov.uk) aims to develop a decision support system for integrated management for stem canker, light leaf spot and the major pests of 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 pest module of PASSWORD (DORIS: developed at the Central Science Laboratory, York) is already being tested under field conditions. Forecasting models are now being developed for stem canker, the other important disease of winter oilseed rape in the UK. This will facilitate the development of a combined regional risk and crop risk forecast system for both light leaf spot and stem canker on winter oilseed rape.

ACKNOWLEDGEMENTS

This work was funded by the UK Department for Environment, Food and Rural Affairs, Arable LINK, the Biotechnology and Biological Sciences Research Council and the Home-Grown Cereals Authority.

REFERENCES

Fitt, B. D. L., K..J. Doughty, T. Gilles, P. Gladders, J.M. Steed, H. Su, and K.G. Sutherland, 1998: Methods for assessment of light leaf spot (*Pyrenopeziza brassicae*) on winter oilseed rape (*Brassica napus*) in the UK. Ann. App. Biol., 133, 329-341.

Fitt, B.D.L., P. Gladders, J.A. Turner, K.G. Sutherland, S.J. Welham and J.M.L. Davies, 1997: Prospects for developing a forecasting scheme to optimise use of fungicides for disease control on winter oilseed rape in the UK. Aspects of Applied Biology 48, 135-142.

Hardwick, N.V. and J.A. Turner, 1994: Fungicide use on winter oilseed rape in England and Wales, 1986-1993. 4th International Conference on Plant Diseases, Bordeaux. ANPP, 1163-1170.

Markkula, I., A. Hannukkala, A. Lehtinen, I. Mattila, H. Ojanen, S. Raiskio, P. Reijonen and K. Tiilikkala, 2000: Pest warnings and forecasts sent as SMS messages from models into "farmer's pocket". The BCPC Conference Proceedings: Pests and diseases, Volume 1, 285-290.

Sutherland, K.G., S.J. Wale, C.E. Sansford, 1995: Effect of different epidemics of *Pyrenopeziza brassicae* on yield loss in winter oilseed rape. Proceedings 9th International Rapeseed Congress, Cambridge, 1004-1006.

Welham, S. J. B.D.L. Fitt, B. D. L. J.A. Turner, P. Gladders, K. Sutherland, 1999: Relationships between regional weather and incidence of light leaf spot (*Pyrenopeziza brassicae*) on winter oilseed rape in England and Wales. Aspects of Applied Biology, 56, 51-59.