WEB-BLIGHT – IMPLEMENTATION OF A WEB-BASED INTERNATIONAL INFORMATION AND DECISION SUPPORT SYSTEM FOR POTATO LATE BLIGHT

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ABSTRACT

Potato late blight caused by Phytophthora infestans (Mont.) de Bary is one of the most serious diseases in potato production in many EU countries. To meet the political demands of a minimisation of pesticide use, an intensified use of decision support and IPM strategies is required. The Internet based ‘Web-Blight’ service was initiated to provide an online warning and prognosis system for potato late blight in the Nordic and Baltic countries. In order to obtain comparable results, methods were harmonised and a set of interacting PC and Internet applications were developed to be used by the project partners. The present paper describes the technical implementation of the system and results of the first year of online service. In the future, the collaboration with the present partners will be expanded and new countries are expected to join in.

INTRODUCTION

In recent years, new and more aggressive populations of Phytophthora infestans were observed in Europe, posing an increasing threat to potato production in many EU countries (Fry and Goodwin, 1997; Andersson et al., 1998; Flier and Turkensteen, 1999; Hermansen et al., 2000). In 2000, up to 20 fungicide applications were used to control the disease in some parts of central Europe (Schepers, 2001). At the same time, political action plans at national and EU-level demands the farmers to minimise the use of pesticides. Therefore, to fulfil the political goals of reducing fungicide input and at the same time keep high yield and quality, the farmers need decision support. A number of decision support systems for the chemical control of potato late blight are now in operational use (Bouma and Hansen, 1999). In 1996, the Danish Institute of Agricultural Sciences (DIAS) developed the first version of Pl@nteInfo, an Internet based information and decision support system for agriculture (Jensen et al., 2000). One of the components in this system was a late blight monitoring system (Hansen et al., 2001). To widen the scope of this successful application, the ‘Web-Blight’ service was initiated in 2000 as an international warning and prognosis service for potato late blight (http://www.web-blight.net). Its objectives are (a) to manage and operate networks for Internet based potato late blight decision support and (b) to improve existing and new Internet based late blight decision support systems and to speed up this process.

To reach the goals, international collaboration should be intensified in general and network collaboration groups should collect and analyse similar data from many countries in Europe. In the current version, Web-Blight includes applications for (a) late blight monitoring, (b) evaluation of disease resistance in potato cultivars using data from observation trials under natural conditions and (c) evaluation of results from field trials to validate late blight decision support systems.
This paper reports the technical implementation of the Web-Blight. It demonstrates the data flow from trial results to web output and discusses possible future developments.

MATERIALS AND METHODS

According to the agreed standards, a package of PC programmes was developed to manage and facilitate data assessment and entry. The programme names all start with ‘Pi-’ for *Phytophthora infestans* followed by an abbreviation indicating the purpose. In the following, the administration programme and the three data assessment and transfer programmes are described. Finally, details on the Internet applications receiving the data are given (Fig. 1).

![Diagram of data flow in the Web-Blight system](image)

**FIGURE 1.** Data flow in the Web-Blight system.

**Administration**

*Pi-CountryAdministrator*

In each country, a country administrator (CA) is assigned. By means of the Pi-CountryAdministrator programme, the CA can define regions, variety lists, locations of local weather stations within the country. The CA also appoints the so-called country reporters (CR). For each CR, a configuration file is created with (a) the full name, initials, e-mail and country code of the reporter and (b) up to three FTP/WWW site combinations as output targets. Since this file is mandatory for a full functionality of the data assessment and transfer programmes, it is sent to the CR by e-mail. Simultaneously, the file with the region and the variety list is uploaded to the defined FTP site(s).
Data assessment and transfer

As full-fledged Windows applications, these programmes provide graphical components with point-and-click functionality to minimise input errors (Fig. 2). Each programme has the facility to establish a connection to an FTP site defined in the configuration file. Thus the CR can readily download the variety list and/or region list or upload collected data. After a successful upload, Internet applications on the assigned WWW site are started for further processing of the new data.

**Pi-Monitoring**

Observations of potato late blight infestations in fields, home gardens, dumps etc. are entered into this programme and transferred to the web-blight server via FTP. Field data are field name, variety name, field type, region and geographical position, crop emergence date, quality of seed material, field history, and grower name and telephone number. Observation data are date of observation, disease severity and corresponding crop growth stage.

**Pi-ObsTrial**

Disease data from observation trials under natural conditions are entered in the Pi-ObsTrial programme and transferred to the Web-Blight. Background data are identification of the responsible institution, trial site information and trial information. Observation data are disease assessments and growth stage for each variety and replicate. Assessments are recommended at least once a week during the season.
Pi-DSSTrial

The Pi-DSSTrial programme is based on a field trial guideline and report form developed in the frame of EU.NET.ICP (Kleinhenz and Jörg, 1999). The objective is to report, analyse and compare different control strategies and decision support systems for the chemical control of potato late blight. Beside all background information for the responsible institution, trial site and the trial, results reported for each treatment are: Disease development, yield, starch content and level of tuber blight, and the amount and type of fungicides used for each treatment.

Internet applications

Almost all web pages in Web-Blight are generated dynamically. When a web page is requested, a so-called presentation programme is activated with a sequence of parameters. The parameters define the type of data that are retrieved from a database. A temporary file on the server with the HTML code is generated and sent back to the browser. The server also provides a number of administration programmes for database updating and maintenance. First, these programmes perform a validation of the incoming data. After a successful validation the database is updated thus securing its integrity. The software package SAS is used for data storage, presentation and administration programmes, real-time generation of graphics and Internet communication between user and server.

The binary code of each data assessment and transfer programme contains a URL to its specific administration programme. To upload new data, an Internet connection is established and the files are transferred via FTP. If the transfer is successful, a browser is opened and the administration programme is initiated. It converts the uploaded ASCII files into a temporary database. A preliminary web output is sent back to the browser, giving the CR the opportunity to check the uploaded data before making it public. In case of disapproval, the CR just terminates the connection at this point and the temporary database is deleted. If the results are approved, the new data are transferred to the permanent database. The browser is then redirected to the respective presentation programme on the Web-Blight Internet site.

In order to meet the necessary requirements of an international web site, the pages can be translated into all languages of the participating countries in real-time.

RESULTS AND DISCUSSION

In 2000, Pi-Monitoring has been applied in five countries for the first time. Due to the higher complexity of Pi-ObsTrial and Pi-DSSTrial, prototypes were developed that are expected to be available for the growing season 2001. For the time being (January 2001) the online services of Web-Blight comprise monitoring information and a demo version of the web output of observation trial results.

The monitoring information is initially presented on country maps: The map of the selected country is shown and a small square shows the position of the observation. Clicking on one of the squares, links to a table with further information of the field. Additionally, a link provides a tabular representation of the results. This table lists all the observations made in a country and the table rows can be sorted after each column (for more details see Hansen et al., 2001).

The resistance information is given in tabular format first (Fig 3.) The user can choose between the different institutions, trial sites and trials from dropdown fields. A fourth field
enables the user to select a reference variety from the list of varieties evaluated in the trial. In the subsequent table, the results are given: The delay of first symptoms (in relation to the reference variety), the final disease rating, the apparent infection rate (slope of the disease curve) and the relative area under the disease progress curve. The result table can be sorted after each variable. A check box is shown for each variety name, and the reference variety is checked by default. On loading of the primary page, a second browser window is opened simultaneously and a graphical presentation of the disease progress curve is given. With the checkboxes, the user can define up to four varieties to be shown in the graph. When the primary page is left, the second browser window is automatically closed.

FIGURE 3. Example of output pages generated by a presentation programme. Here results from trials evaluating crop resistance against potato late blight are shown.

A similar approach was chosen to present the results of the validation trials. On the primary page the user selects a reference treatment instead of a variety. Additionally, a response variable (yield, starch content, tuber infection or disease progress) can be chosen. Again, a second browser window is opened and either a line graph for the disease progress or a bar chart for the data measured at harvest is shown. If the data are complete for all treatments and replicates, it is furthermore possible to calculate an analysis of variance.

It is not surprising that the page requests from June to November 2000 on the Web-Blight monitoring pages were relatively few: in total 10943 requests from 5 participating countries (Denmark, Norway, Sweden, Finland and Lithuania). Due to only limited promotion, the year 2000 was considered a test run of the prototype. Thus the main objective was to get feedback from the project partners; some effort has been done to remove their accesses from the counting. Moreover, the system doubled information for Denmark already presented in Pl@nteInfo. For 2001, the monitoring in Web-Blight will be linked into the Pl@nteInfo system and thus replace the existing application. Nevertheless an apparent rise from June (718) to July
(3676) was noticeable, especially in Norway where the number of requests increased from 179 in June to 2268 in July. As the response from the project partners were predominantly positive and new partners will join in, a significantly higher traffic on Web-Blight in 2001 is expected.

Further developments will include discussion groups and mailing lists to ease the communication (a) horizontally between the project partners as well as (b) vertically between the country administrator and the reporters. As results from observation and validation trials come in, new approaches to estimate the date of primary attacks and the epidemiological progress will be developed. These models will form the core of the prognosis part of the Web-Blight project, making it a comprehensive tool for integrated potato late blight management.

Collaborative Internet applications like the Web-Blight applications probably will be used in future warning systems for pests and diseases. We cannot afford to duplicate work, and network collaboration and harmonisation of methods facilitate that conclusions and quantitative knowledge are obtained faster and more reliable

REFERENCES


