

Image Based Rapeseed-Mustard Disease Expert System : An Effective Extension Tool

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ABSTRACT

Rapeseed-Mustard is an important oilseed crops and contributes around 23.2 per cent of the total oilseed production in India. The production of Rapeseed-Mustard is widely effected by rapeseed-mustard diseases. Alternaria blight [Alternaria brassicae (Berk.) Sacc.], white rust [Albugo candida (Pers.) Kuntze] and White rot [Sclerotinia sclerotiorum (Lib.) de Bary] downy mildew complex, powdery mildew, white rot of rapeseed-mustard are the diseases that are quoted frequently in the states where the crops are grown in India. The identification of disease is the difficult task. If the diseases identified timely, the control measures can be applied effectively. Now a day the use of digital technology can produce high quality digital images including photos and clips of healthy and infected plants easily that can play very important role in disease identification. Digital images can be seen and shared easily among the experts. Image can be examined on camera screen literally the second they are captured and downloaded to a computer for closer inspection within minutes. In present study a computerised expert tool image based Rapeseed-Mustard disease expert system was developed to help extension personals, researchers and farmers in identification and management of these diseases. The expert system uses a hierarchical classification and a mix of the text description, photographs and artistic pictures. The system involves two main sub-tasks, namely, diagnosis and management. The system designed and developed using Visual Basic as front-end and Microsoft Access-2000 as back-end software.

Keywords: *Rapeseed-Mustard; Disease diagnostic; Inference engine; Knowledge base; User interface; Digital image; Photos; Alternaria blight; Sclerotinia; Downy mildew; Powdery mildew; White rust*

Rapeseed-Mustard is an important oilseed crops of India. The major growing states are Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and West Bengal together contributing 86.9 per cent to the total national production.

Rapeseed-Mustard production is widely effected by rapeseed-mustard diseases like Alternaria blight [Alternaria brassicae (Berk.) Sacc.], white rust [Albugo candida (Pers.) Kuntze] and White rot [Sclerotinia sclerotiorum (Lib.) de Bary] downy mildew complex, powdery mildew and white rot. It is estimated that, on average harvest seed yield losses due to Alternaria blight range from 5-15% and can reach 47% (Kolte, et al. 1987). White rust in B. juncea can result in yield losses of up to 47% (Kolte, 1985), Rot of mustard has become important in recent times in India and elsewhere with high disease incidence and causes upto 40 % yield losses leading to discouragement of growers of the crop (Chattopadhyay et al. 2003).

Plant protection involves the correct and timely identification and control of diseases. The identification of diseases is the difficult task and often requires consultation with specialist. An accurate and rapid diagnosis can avoid costly mistakes by timely applications of appropriate management practices.

In the past a few years, advances in information technology (IT) have created a new vistas for business, scientific research, and social interaction. IT transformed the way we learn, teach, communicate, and even play (PITAC, 1999). This expanding infrastructure has triggered deep changes in automated systems and information delivery. Digital electronic devices such as digital/video camera can provide high quality media. Visual symptoms of pests and plant diseases can be captured by electronic devices for quick diagnosis (Holmes, et al., 2000; Xin, et al., 2001). The high quality digital images including photos and clips of healthy and infected plants captured using modern digital

technology can play very important role in disease identification. Digital images can be seen and shared easily among the experts. Image can be examined on camera screen literally the second they are captured and downloaded to a computer for closer inspection within minutes (Mark D. Ricker, 2004). In present study a computerised expert tool Image based Rapeseed-Mustard Disease Identification and Management (R-MDI&M) Software was developed to help extension personals, researchers and farmers for identification and management of these diseases. The expert system uses a hierarchical classification and a mix of the text description, photographs and artistic pictures (J.L. Gonzalez-Andujar, et al 2006). The system is supported by a database containing information about 8 diseases of rapeseed-mustard and 40 colour images of various symptoms.

The system involves two main sub-tasks, namely, diagnosis and management. Diagnose sub-task finds out the disease and their cause on the bases of photos and clips of diseases symptoms appears on plant. Management sub-task provides a management plan for the diseases. The Objective of our research is to collect information on various aspects of rapeseed-mustard diseases; preparation of knowledge base; development of an initial version of 'R-MDI&M' software and updating with new features to derive the final version. The user-friendly software designed and developed using Visual Basic as front-end and Microsoft Access-2000 as back-end. The expert system is under evaluation following the conventional expert system evaluation methodologies. Results of the validation indicated that non-expert users were able to make identification using this expert tool.

METHODOLOGY

A panel of human experts in the field of rapeseed-mustard diseases and published materials were consulted to collect the Knowledge about the rapeseed-mustard diseases on different part of plant and their management practices. Plant diseases appearances were classified into six classes: flower, stem, leaves, pods, root and whole plant. The high quality coloured images and video clip of various symptoms of diseases were captured by using modern digital/video cameras.

System design composed of several basic components: a user interface, a database, a knowledge base and an inference mechanism. System development usually proceeds through several phases including problem selection, knowledge acquisition, knowledge representation, programming, testing and evaluation

(Kumar et al., 2004). The knowledge base contains the rules of inference that are used during the reasoning process. These rules may be if.. then.. else.. nature or any other valid form. The inference mechanism guides the reasoning process through Knowledge base by attempting to match the facts in the database to other rule conditions. The explanation module provides the features to the system to explain its conclusion and reasoning process.

Design Methodology and System Implementation Knowledge Base : Information like data of characteristic of diseases, photographs of symptoms of different diseases on different part and the data of management of these disease were collected from the scientists of National Research Centre on Rapeseed-Mustard especially Pathologists, Extensionists as well as published literature, and coded.

System Design Architecture and Flow Charts : The system architecture and data flow diagram designed to develop efficient photo based rapeseed-mustard diseases management system is shown in Fig.1 (Ganesan V 2006). For user-friendly interface with the system the object oriented programming language such as Visual Basic 6.0 as front-end, and MS-Access-2000 as back-end, has been used to develop the software.

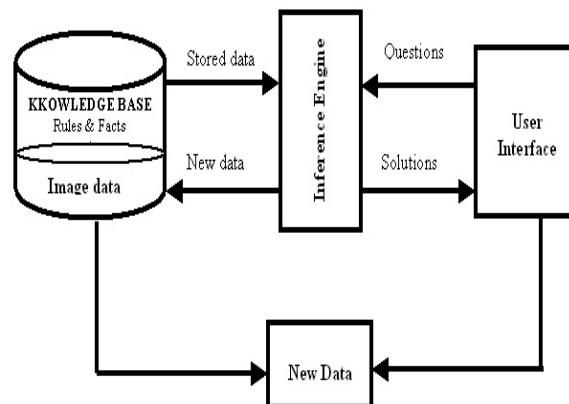


Fig. 1. System Design Architecture

The minimum system requirements for this software are: P.C. with windows 98/2000/XP, 128 MB RAM, 100 MB space on hard disk and Mouse & Keyboard

RESULTS AND DISCUSSION

This is an intelligent computer program that uses knowledge and inference procedure to solve problems that are otherwise difficult enough and require human expertise for their solution. At first level the system allow user has to decide and select infected part(s) of the plant viz., leaf, flower, stem, root, siliqua, etc. the user make selection simply clicking on the check box,

the default choice is to select one part of plant (Fig. 2). At second level after selecting the infected part(s) of plant, user can submit by clicking the option (submit your choice) for system proceed to the next level. At the third level (primary diagnosis) system generates the information about the infection due to possible diseases on the user selected part(s) of the plant. The user can select option (Radio box) closely matching disease symptoms based on combination of text description and visual presentation (Photos) of disease syndrome on different parts of plant (Fig 3) and can click Next button option for system proceed to the next level. At the fourth level (final diagnosis) system identified the disease, the software provides detailed information about the disease such as its causal organism, survival of the pathogen, favourable weather conditions, loss causing potential of the disease, At the fifth level finally system intend to link the identification system to the disease control module

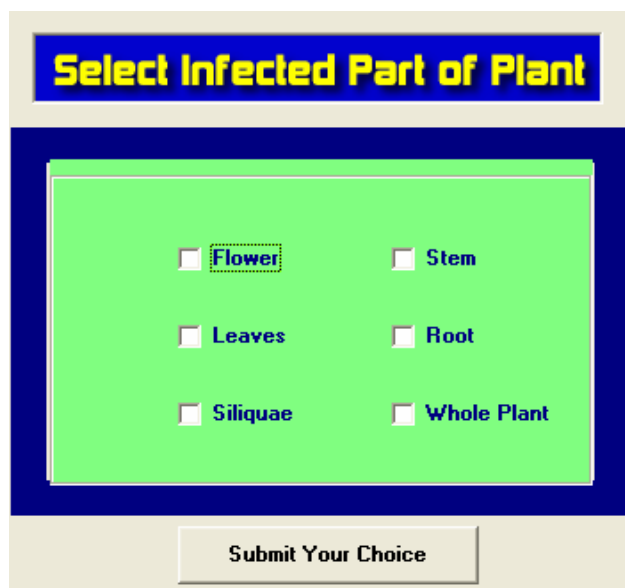


Fig.2. Screen for Select infected part of plant

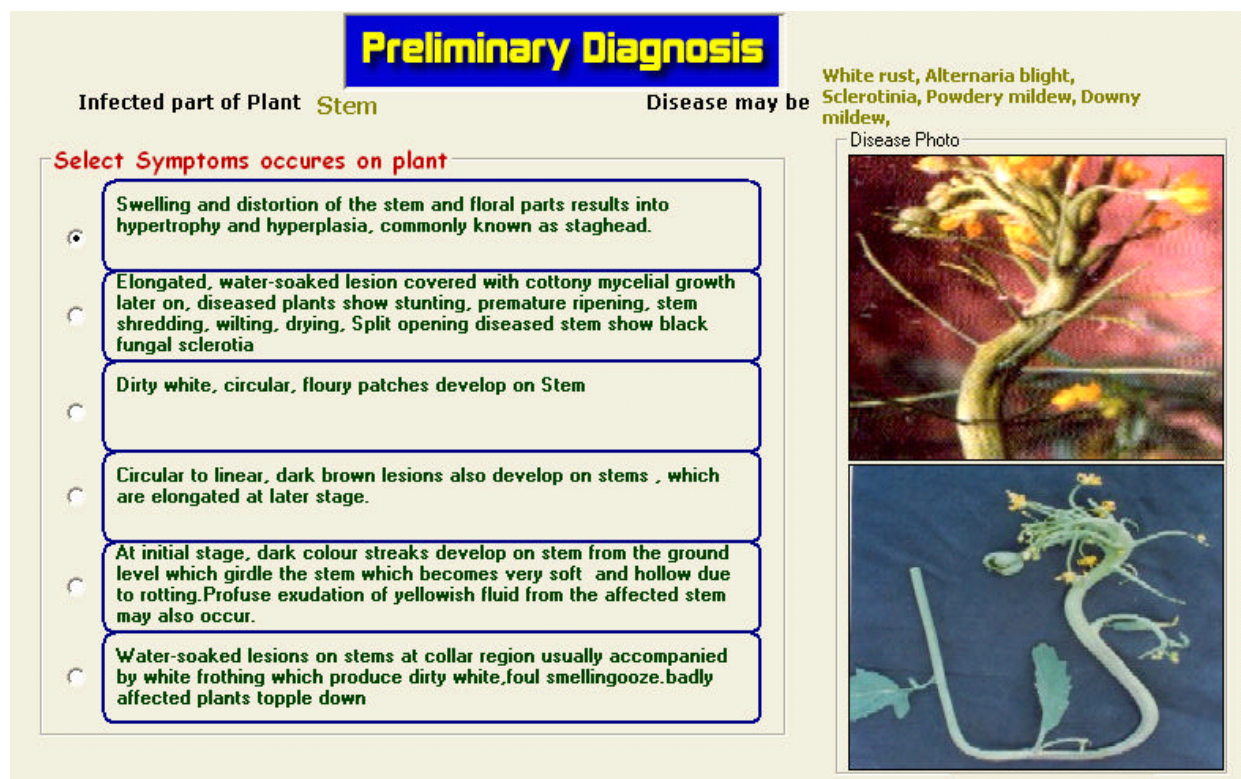


Fig.3. Screen for Select symptoms on plant

so that the information on identified disease for recommendations control can be generate. (Fig.4). Presently, this system is stand-alone and PC-based. In future, it can be advanced to web-based using expert tool development technology (Jensen et al., 2000).

CONCLUSION

The “Image based Rapeseed-Mustard Disease expert

system” developed is an integration of image and textual data. The system can be used by extension personnel, researchers and farmers to identify rapeseed-mustard diseases and enable their management. User can easily identify the disease on the bases of photos of symptoms and text description of disease. The user friendly software developed using windowing environment, thus

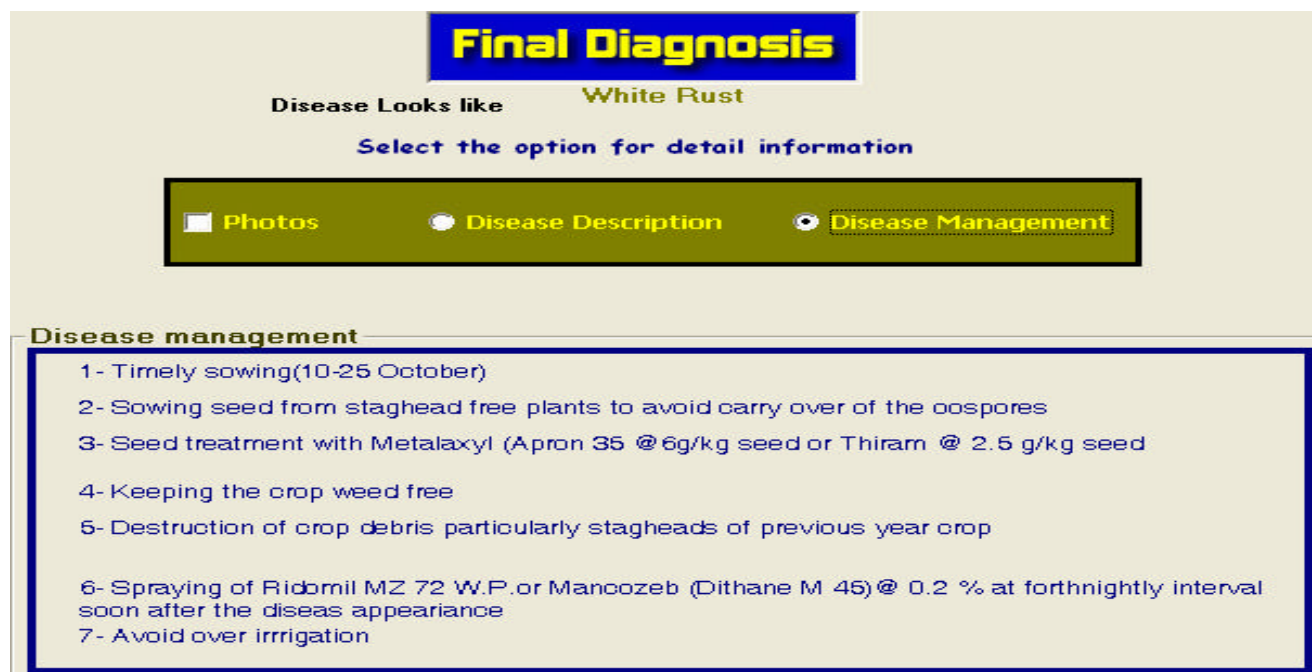


Fig.4. Screen showing detail description of disease

provides enough facilities to identify the disease and to suggest the remedy conveniently.

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