CROP CARE - X1.0, A MODEL EXPERT SYSTEM FOR THE DIAGNOSIS AND MANAGEMENT OF CROP PESTS AND DISEASES

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ABSTRACT: CropCare-X1.0, a personal computer based expert system software was developed for the diagnosis and management of crop pests and diseases that can be identified on the basis of characteristic visual symptoms. The consultation module of the system provides for running a consultation session to diagnose the pest/disease and the updation module helps in updating the knowledge base of the system. Both the modules are provided with an user friendly interface. CropCare release X1.0 can diagnose and suggest control measures for important pests and diseases of major horticultural crops. This system can be run on any IBM compatible PC XT/AT machine.

Key Words: Computers, expert systems, plant protection.

INTRODUCTION

An expert system is regarded as the embodiment within a computer, of a knowledge based component, from an expert skill in such a form that the system can offer intelligent advice or take an intelligent decision about a processing function. A desirable additional characteristic which many would consider fundamental is the capability of system on demand to justify its own line of reasoning in a manner directly intelligible to the enquirer (Janakiramann et al., 1992).

The expert system technology is one of the rapidly emerging fields of Artificial Intelligence (AI). It has acquired a distinct identity with the advent of MYCIN, an expert system for medical diagnosis in 1976 (Buchanan and Shortliffe, 1984). Since then, many expert systems have been developed for oil exploration, medical diagnostics, mining, etc. Unfortunately, not many efforts have been made for its application in crop protection in India. Although, concerted efforts of agricultural scientists have resulted in appropriate plant protection technologies, there is a general feeling that a big time and space gap still exists between technology development in the laboratory and its application on land by farmers. In this context, development of expert systems for diagnosis and management of crop pests and diseases and making it available to village level extension workers through computer networks is of great practical significance.

Therefore, an attempt was made to develop an expert system for the diagnosis and management of pests and diseases of important horticultural crops.

MATERIALS AND METHODS

Hardware and Software

The expert system, CropCare-X1.0 was developed on a HCL Busybee-386 computer with 33 Mhz speed, 8 MB RAM, 240 MB HD, SVGA
colour monitor, 1.44 and 1.2 MB FDD and 101 keys key board. The source code of this system was written in Turbo Prolog 2.0 running on MS DOS 6.2 operating system and compiled as an executable (exe) file.

Knowledge acquisition representation

The information or knowledge required for creating the knowledge base of CropCare was obtained from the literature. In CropCare knowledge is represented in the form of rules. The rules are not a part of programme but are stored in a separate file viz., Crop.kbf. This helps knowledge base to be expandable and modular.

Inference Engine

The inference engine of CropCare works making use of Prolog's in-built inference mechanism viz. forward chaining and unification.

User Interface

All the modules in CropCare are interactive and menu driven. The message displayed in message window tells the user what is expected from him and what options are available to him. All that user has to do is selecting an item by pressing the specified key.

Explanations in CropCare

CropCare provides for the 'HOW' explanation. During the consultation, the user has two options i.e. either to say 'yes' or 'no'. After the consultation is over the user can ask the system to explain its conclusion. The system will then display a chain of reasoning used to arrive at that conclusion.

File design in CropCare

The two modules of CropCare together with their user interface function on the basis of instructions and information provided in the following files.

i) CropCare.exe: this file contains the executable programme code of the expert system

ii) Crop.kbf: This file contains the knowledge base/rule base of CropCare. A typical example from the Crop.kbf showing format of rule for the diagnosis of tomato leaf curl disease is shown below.

Newsselected ("leafcurl"),-
Newsymptom ("dwarfing, puckering and severe curling of leaves").

Newsymptom ("excessive branching and stunting of plants"),

Conclude ("leaf curl").

iii) Enquiry.qry : this file contains the information about appropriate questions to be put to the user for a given symptoms. A typical example from enquiry.qry showing the format of the queries put to the user for the diagnosis of tomato leaf curl disease.

Newsymptom ("dwarfing, puckering and severe curling of leaves"): positive ("Is there dwarfing, puckering and severe curling of leaves (y/n). newsymptom ("excessive branching, stunting of plants").

Positive ("Is there excessive branching and stunting of plants (y/n)."

iv) Control.dat: This file contains information about the control measures for the pests and diseases included in rule base. A typical example from control.dat showing control measures for tomato leaf curl disease is shown below.

Dis-detected ("leaf curl")-
tech-conclude ("remove and destroy the infected plants and spray monocoltophos @ 0.04% for the control of insect vector").

v) Cond.pro: This file is used to store information required for providing 'HOW'
explanation based on the user’s during the consultation session.

RESULTS AND DISCUSSION

The expert system for diagnosis and management of crop pests and diseases, resulted from this study was named CropCare-X1.0. This system has two modules, consultation module and updation module. Both the modules are supported by an interactive and menu driven user interface. Consultation module facilities for running a consultation session by the user for diagnosis of a pest/disease problem. This is done in three steps.
1. Putting a series of queries to the user,
2. Processing of user’s response with in-built inference engine and
3. Diagnosis of pest/disease problem based on the rules given in the rule base.

In case, the system could not identify a pest/disease problem for reasons such as overlapping symptoms or outbreak of new pest/disease problem etc., it displays a message expressing its inability to diagnose and advises the user to consult nearest plant protection expert. It also provides an option to user/expert through its updation module for updating its knowledge base with respect to the new pest/disease for future use. The updation module prompts the user/expert to enter the name, symptoms, control measures and queries of a new pest/disease in a specified window, which will then automatically update the contents of respective system files.

CropCare can diagnose important pests and diseases of major horticultural crops (Tomato, Eggplant, Mango, Banana and Rose) that can be diagnosed based on the characteristic visual symptoms they produce, and has the provision for expanding it for many others. The system can provide comprehensive control measures or the pests/diseases diagnosed by it. It is also capable of providing ‘how’ explanation if the user want to know how a particular pest/disease is diagnosed. Another advantage of this system is that it can be run on any PC XT/AT even if it is not having a Turbo Prolog compiler as the entire program was compiled into an executable file form. Further, this system can also be invoked from windows 95.

It inability to diagnose those pests/diseases that require laboratory tests for diagnosis, lack of interface to spread sheet and graphics software are some of the limitations of CropCare. Therefore, there is a scope for making further improvements in the system. Providing an interface to graphics software for storing and displaying of scanned multicoloured images of infected specimens will help in more objective diagnosis. Also, expanding the knowledge base for handling laboratory data, providing situation specific control measures and technical information on pathogens and pesticides will further increase the efficiency of the system.

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REFERENCES


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