An Example of Agricultural Expert Systems Being Used in India

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Abstract

Expert systems are now being widely used in various sectors of agriculture. Expert systems for pest control and crop protection comprises one of the most important and commonly used types of agricultural expert systems. This paper discusses the success of the Expert System for Management of Malformation Disease of Mango in predicting the occurrences of the malformation disease in mango and prescribing suitable treatment packages. The success of such an expert system calls for the development of more such agricultural expert systems.

Keywords*: Expert system, agricultural expert system, knowledge*

1. Introduction

An expert system is a software that manipulates encoded knowledge to solve problems in a specialized domain that normally requires human expertise [1]. The knowledge of an expert system must be obtained from subject specialists or other sources of expertise, like books and journal publications. Expert systems have numerous application domains including banking, finance, biology, chemistry, meteorology, geology, geophysics, engineering, aerospace and law [1]. And the list is far from being exhaustive.

Prasad and Babu [2] studied the various agricultural expert systems developed in the last three decades and outlined their salient features. Expert systems for pest control and crop protection constitute a very significant class of agricultural expert systems. Pest management and crop protection includes a large number of techniques using varied knowledge in entomology, plant pathology, nematology, weeds and vertebrate pests. This knowledge, gathered over the years, is voluminous and diverse. This makes the field implementation of techniques required to deal with a particular disease of a given crop quite difficult. It has been discovered that the knowledge can be efficiently structured and organised only using a computerized expert system. The current paper unveils the success of one such expert system and thereby verifies the hypothesis proposed by Prasad and Babu [2].

2. Background

Mango (*Mangifera indica*) is an admired fruit and an economically significant cash crop of Asia. The mango malformation disease is known for its notoriety in degrading the yield of the crop. Mango malformation is inducted by a physiological race of *Fusarium monilifrome* var. *subglutinans*. The *Fusarium* secretes a number of toxins inside the host plant that play an important role in the production of the disease symptoms. The *Fusarium* is mutagenic and highly adaptive. Thus, it may breakout epidemic even in areas that are believed to be safe from the onslaught of the disease [3]. A phenolic metabolite of mango called mangiferin (1,3,6,7-tetrahydroxyxanthone-C_2-β-D glucoside) arrests the secretion of toxins like fusaric acid by the *Fusarium* [4].

3. The Expert System

The Expert System for Management of Malformation Disease of Mango (ESMMDM) has been developed to predict the disease occurrence and suggest an appropriate crop protection and pest management strategy [5]. The expert system is based on the information generated from long term research in both laboratory and field conditions. The expert system reduces the time required to solve the problem without waiting for an expert advice and hence makes mango cultivation more efficient and profitable.

The ESMMDM expert system considers the variety and the age of the plant, time since the symptoms were first noticed, the number of malformed shoots, climatic factors, etc. in its diagnosis. The expert system uses a fuzzy logic based reasoning process to analyze the symptoms and prescribes an appropriate pest management and crop protection strategy which may be classified as a high intensity (HI), medium intensity (MI) or a low intensity (LI) treatment [6]. The disease cycle begins in May and the expert system prescribes the treatment package for an entire disease year commencing in May.

The ESMMDM expert system is an interactive software tool with a graphic user interface. It asks some simple multiple choice questions about the test case. A user is required to select one of the options from an interactive control like a radio button or a drop down list box. Photographs have been used to help the user to accurately identify the symptoms. At the end of the diagnosis, the expert system generates a descriptive report of the present case. The report includes the particulars of the symptoms detected and the crop protection and pest management strategy prescribed. If required, the report can be printed. The ESMMDM expert system can be used by extension workers as well as farmers with or without any experience of using computers.

4. The Prescribed Treatments

The ESMMDM expert system prescribes treatment packages composing of physical as well as chemical processes. Such treatment methodologies are known as integrated pest management in plant pathological terminology. A few examples of the measures commonly recommended by the expert system are as follows.

- Pruning of malformed panicles and shoots in May and October.
- Spraying phosphomidon (0.05 %) or dithiocarbamate (0.05 %) in May, October and February.
- Spraying mangiferin copper chelate (40 ppm) or copper fungicide (Blitox 50, 0.2 %) in October and January.
- Spraying mangiferin zinc chelate (40 ppm) or Aminocel Gold (1.5 ml/liter) in December and February.

5. Results

The ESMMDM expert system has been preliminarily tested in North and North-central India by a team of researchers and scientists who observed that on an average 100-300, i.e. 20-50 Kg, more fruits per plant are obtained by using the crop protection and pest management schemes prescribed by the expert system. The members of the testing team have expressed their satisfaction on the performance of the expert system and have advised actual field trials by farmers. As shown in Figure 1, the feedbacks of the farmers and the agricultural extension workers, who are now using this expert system, are currently being used to upgrade and refine the knowledge used by the expert system for the effective development of pest management and crop protection techniques.

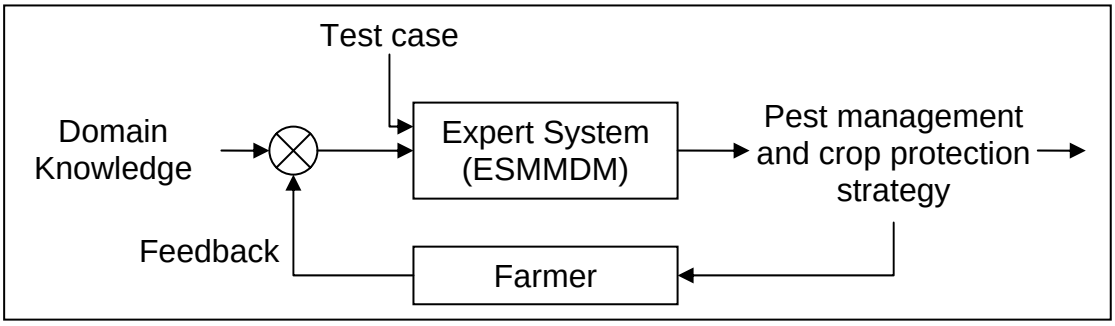

Figure 1: Block diagram displaying the operation of the expert system in actual field setup

6. Conclusions

This paper has briefly discussed the success story of the Expert System for Management of Malformation Disease of Mango. The success of such an expert system solicits the development of more expert systems for scientific and technological knowledge transfer in agriculture. It is also hereby verified that agricultural expert systems can help considerably in increasing the productivity.

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