Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 3, Issue 6; April-June, 2016, pp. 561-563

http://www.krishisanskriti.org/Publication.html

Expert System for Identification of Diseases in Tobacco (*Nicotiana tabacum*)

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Abstract—*Tobacco (Nicotiana tabacum L.) is a commercial crop in many countries. Tobacco crop has demonstrated its importance in the Indian economy through its contribution to employment generation (directly or indirectly supports 38 million people) as well as annual revenue of Rs.25, 000 crores to the national exchequer through foreign exchange earnings and internal excise taxes. It is grown in Andhra Pradesh, Bihar, Gujarat, Karnataka, Orissa, Tamil Nadu and West Bengal. Like any other crop, tobacco also suffers from various diseases. Important diseases affecting the tobacco are Frogeye spot, Brown spot, Black shank, Damping-off, Wilt, Root-knot, Mosaic and Leaf curl diseases. Plant protection involves the correct and timely identification of these diseases and their control. The identification of diseases is the difficult task and often requires consultation with specialists. An accurate and rapid diagnosis can avoid losses by taking appropriate management practices. Scientists have developed various management practices for many diseases of tobacco, detailed digital photographs of symptoms are made available and precautionary measures are established.*

Based on the information on diseases and their symptoms, an online expert system for disease identification in tobacco has been developed using Agridaksh tool by ICAR-IASRI in collaboration with ICAR-CTRI to provide global accessing of all information on various diseases of tobacco and their symptoms. Under this system, a knowledge model has been created, a knowledge acquisition, ontology based problem identification and a knowledge retrieval system for tobacco disease has been developed. This system is useful to enhance the efficiency of farmers, agricultural extension personnel, development agencies for crop management and to increase the crop yield. It determines the best strategy for disease management, identification and diagnosis.

Keywords*: Tobacco, disease, symptoms, knowledge model, ontology, database*

1. INTRODUCTION

Tobacco, *Nicotiana tabacum*, is an herbaceous annual or perennial plant in the family Solanaceae grown for its leaves. The tobacco plant has a thick, hairy stem and large, simple leaves which are oval in shape. The tobacco plant produces white, cream, pink or red flowers which grow in large clusters. Tobacco may also be referred to as Virginia tobacco or cultivated tobacco and originates from South America. Tobacco is a stimulant and the dried leaves of the tobacco plant can be cured and used to produces tobacco cigarettes, cigars and snuff or for pesticide production. Tobacco grows very well in a wide range of climates. The type of soil depends on the variety of tobacco being grown but the best yields are usually obtained in loam to sandy loam soils. Tobacco plants are easily damaged by waterlogged soils and quality can be affected by high salinity. Plants should therefore be grown in a well-draining and well aerated soil [4].

Tobacco production and quality are widely affected by fungal, viral and nematode diseases in both nursery and field crop. The yield losses ranging between 21-53% from various diseases have been documented [6]. Important diseases affecting the tobacco are Frogeye spot, Brown spot, Black shank, Damping-off, Wilt, Root-knot, Mosaic and Leaf curl diseases. Plant protection involves the correct and timely identification of these diseases and their control. The identification of diseases is the difficult task and often requires consultation with specialists. An accurate and rapid diagnosis can avoid losses by taking appropriate management practices. Scientists have developed various management practices for many diseases of tobacco, detailed digital photographs of symptoms are made available and precautionary measures are established. However the end users have not been able to utilize the information for want of easy access and ineffective extension mechanism. Manifestation of diseases symptoms on leaf may generally mislead in the process of disease identification. Symptoms of some diseases like wilt, black shank and anthracnose stem infection, some viral diseases are often confusing requiring expert opinion. Unfortunately, specialized assistance is not always available everywhere for disease identification. Now-a-days, the information technology is widely used in agriculture exclusively for diagnosing and managing many problems. Enhancement of information technology created new vistas of scientific

information, social interaction, communication and learning leading to the automated systems and information delivery in order to handle the hard core tasks like management of tobacco diseases in the present context.

In order to overcome the identification of diseases in tobacco, "expert system for identification of diseases in tobacco (*Nicotiana tabacum)"* have been developed. The primary goal of expert systems is to enable decision makers to do their job efficiently. An expert system is defined as "a computer program designed to model the problem solving ability of human expert" [1]. It is also defined as "a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise [3]". Expert systems typically have three components viz., knowledge base, inference engine and user interface. The knowledge base is the component that contains the knowledge obtained from the domain expert. Normally, the way of representing knowledge is using rules. The inference engine is the component that manipulates the knowledge found in the knowledge base as needed to arrive at a result of solution. The user interface is the component that allows the user to query the system and receive the results of those queries [2].

Expert system increases the probability, frequency and consistency of making good decisions, additive effect of knowledge of many domain experts, facilitates real-time, low-cost expert-level decisions by the non-expert, enhance the utilization of most of the available data and free the mind and time of the human expert to enable to concentrate on more creative activities.

2. MATERIALS AND METHODS

An expert system in tobacco named as "Tobacco – AgriDaksh" was developed by ICAR-IASRI, New Delhi in collaboration with ICAR-CTRI, Rajahmundry, Andhra Pradesh using AgriDaksh tool. The system aimed to design and develop various modules on Tobacco such as insect pests and diseases, Abiotic stresses, Varieties, Soil types and Nutrient disorders, Weed management and World tobacco scenario etc,.

AgriDaksh, a tool for building online expert system for agricultural crops has been developed at Division of Computer Applications, ICAR-IASRI. AgriDaksh is available online at http://agridaksh.iasri.res.in. AgriDaksh enables domain experts to build online expert system in their crops with minimal intervention of knowledge engineers and programmers. With its use, it is possible to build online expert system for each and every crop in significantly less time and resources. Online expert systems have the capability to transfer location specific technology and advice to the farmers efficiently and effectively. This in turn can reduce losses due to diseases and pests infestation, improve productivity with proper variety selection and increase in income of the farmer [5].

Using this tool, one of the expert system module on "identification of diseases in tobacco" was developed. A prototype of the expert system was built and validated. All the stages of the tobacco crop, parts effected by the diseases, various symptoms of the diseases data were stored in the database. All the images of stages, effected parts, symptoms were stored in a digitized form. The data was stored as rules of inference for use during the reasoning process. The interface engine was designed to accept the user input queries and responses to questions through the Input Output interface. The user-friendly interface was developed with GUI which allows the user to communicate with system in a simple selection way through drop down option menus. Through user-interface, the user is allowed to view, query the diseases information.

3. RESULTS AND DISCUSSION

The expert system on identification of diseases in tobacco was developed based on the technical aspects and various symptoms affected by tobacco crop. The web based disease identification system was hosted at http://agridaksh.iasri.res.in/tobacco.jsp . The home page of this website consists of Origin of the crop, Tobacco varieties, Production technologies, Nursery management, Package of practices, Success stories, Crop protection, Problem identification and Varieties modules. The "Problem identification" modules gives the expert solution for identification of diseases in tobacco. Within this module, there is a sub-menu with three option viz., "Pest identification", "Disease diagnosis" and "Variety selection", wherein one can identify the disease by selecting the "Disease diagnosis" option.

The characters like different stages of the tobacco crop, different parts effected by the diseases, various symptoms of the diseases have been used for disease identification. The disease identification module allows user to select the stage of the crop like Field or Nursery.

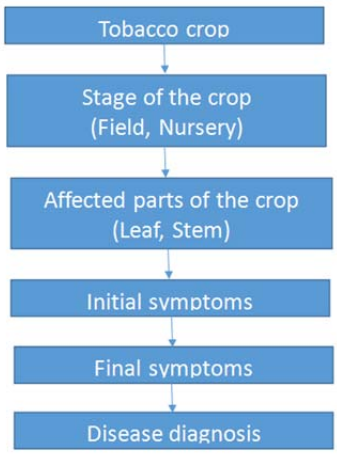

Fig. 1: Methodology for disease diagnosis

After that it allows to select the parts effected by the diseases like Leaf or Stem. Most important characteristics helpful in the identification of disease is symptoms with photograph. After selection of parts effected by the diseases, it gives the list of all initial symptoms of the diseases and after that it gives the final symptoms of the diseases. From these lists, user can select the symptoms thus it gives the information about the disease affected by their tobacco crop (Fig. 1).

4. CONCLUSION

Expert system on identification of disease in tobacco is a web based application designed to help and suggest in diagnosis for tobacco diseases. Diagnosis made by 'Problem identification' are based on visual observations of the symptoms expressed by infected parts viz., leafs and stems. The user interface allows user to select the stage of the crop, affected plant part(s) and symptoms appearing on these parts. Based on the input made by the user, the disease is identified and control measures are suggested. This system is useful to enhance the efficiency of farmers, agricultural extension personnel, development agencies for crop management and to increase the crop yield. It determines the best strategy for disease management, identification and diagnosis.

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