



Expert System on Coconut Pest Management

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Abstract - An Expert System is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise. Expert systems can facilitate knowledge transfer and can guide growers to take decision into different aspects of crop management for increasing the productivity and the profit margin and also combines the experimental and experiential knowledge with the intuitive reasoning skills of a multitude of specialists to aid end users in making the best decisions for their crops. The expert system on coconut pest management can be used to take necessary management steps by identifying the pest and by applying the management practices timely without waiting for the advice of the experts. The expert system can be used efficiently in places where there is shortage of expert advice and timely detection of the pest and management is necessary for reducing the loss.

Keywords – expert system, coconut, pest, management, symptoms

I. INTRODUCTION

Cocos nucifera L. is one of the important plantation crops of tropical world grown in more than 93 countries and supports the livelihoods of millions of people. In India, it is predominantly cultivated in coastal states and Islands. In Andaman and Nicobar islands of India, coconut covers 50% of the cultivable area of islands.

The Andaman and Nicobar Islands come under the humid tropics with average rainfall of about 3000 mm annually. The humid tropical climatic conditions of Andaman & Nicobar Islands facilitate cultivation of wide range of tropical horticultural crops. Since many years these crops dominated the agricultural sector are presently considered as key components for crop diversification. But their importance has increased in recent years due to increased demand of quality foods and their economic potential and suitability to the region. The erratic rainfall pattern and excessive humidity created problems for efficient utilization of immense potential of horticultural crops in Islands. In era of commercial and high value agriculture, horticultural crops are front runners for betterment of small and marginal farmers in the Islands. Therefore, utilization of new scientific innovation and intervention in horticultural sector is become imperative for sustainable agricultural development of these fragile Islands.

Out of the total geographical area of 82, 49,000 ha, only 6% i.e., around 50,000 ha prior to tsunami was under agriculture whereas at present only about 46000 ha is under Agriculture. In fact the agro climatic conditions of these islands are very much congenial for cultivation of plantation, horticulture and spices crops. Coconut and arecanut is the major plantation crop of Andaman & Nicobar Islands and has been associated with socio cultural facts of people of these islands. Topography of these islands is characterized by hilly and mountain terrain coupled with heavy rainfall and undulating nature of soil, which are ideally suitable for growing coconut and arecanut. Though the agro- bio diversity of coconut is unique in these islands, the production and productivity is very poor. The major reasons for the low yield of coconut is due to

- a) Poor genetic makeup and unselected seedling populations of existing plantation.
- b) Overcrowding / dense planting (400 - 500 palms /ha)
- c) Planting on hill slopes having shallow / eroded soil.
- d) Inadequate plant protection measures.
- e) Inadequate soil and nutrient management.
- f) Inadequate knowledge and poor adoption of technologies

Planting of high yielding varieties and adopting modern production technologies can increase the productivity.

A. Soil and Climate

The coconut palm is found to grow under varying climatic and soil conditions. The average temperature in the range of 27°-32°C is optimum for a good crop. Heavy and wide spread rainfall ranging from 1000 to 3000 mm is required by the palm. It can be grown on wide range of soil, however deltaic alluvial soil and red sandy loam soil is ideal for its growth. Well-drained soil, rich in organic matter is highly suitable. Coastal sandy and reclaimed soils with a pH ranging from 5.2 to 8.0 are also suitable. The palms on the sea coast benefit from the humid climate which is less subject to wide fluctuation of temperature. They are also benefited by the better supplies of sub soil moisture due to continuous seepage of fresh water from the higher inland areas to the sea (2).

Out of the 572 Islands, only 36 Islands are inhabited and eight Islands have been covered under the various settlement programs. The Islands have tropical, humid climate with mean rainfall of about 3180 mm per annum. The

average mean temperature varies from 23 to 30°C with over 90 per cent humidity during the rainy season. The Islands receive Southwest monsoon from May to September and Northeast monsoon during October to January (3).

B. Expert System

Studies from the field of artificial intelligence have given birth to a relatively new but rapidly growing technology known as expert systems. An expert system is a computer program which captures the knowledge of a human expert on a given problem, and uses this knowledge to solve problems in a fashion similar to the expert. The system can assist the expert during problem-solving, or act in the place of the expert in those situations where the expertise is lacking [4].

With the recent growing population and high farmer to extension worker ratio, there is a great need for an intuitive knowledge based system, which may suggest suitable solutions to the farmers. Online expert systems have the capability to transfer location specific technology & advice to the farmers efficiently and effectively (5). Direct dissemination of expert knowledge to agricultural producers through computer programs will increase product quality as well as the profit margin [6]. So researchers have to try to develop such an expert system which will guide to Growers to take decision into different aspects of crop management like soil preparation, seed selection, pest management, fertilizer management, weed control, irrigation management, nutrition management etc. (7). Expert systems are a better option over traditional systems (8). It is proven that expert systems in agriculture helps a lot in increasing the crop production (9). Expert system is offered as the second choice after expert on consultation (10).

Expert systems or knowledge based systems are designed to represent and apply factual knowledge in specific areas of expertise to solve problems. In knowledge based programming, we are representing declarative knowledge about a domain; that is, we are representing what we know without deciding in advance precisely how that knowledge will be used [11].

C. Knowledge Acquisition

Knowledge acquisition is the process of transferring knowledge from the knowledge source to knowledge engineer (or expert system builder) [12]. The main source of knowledge in the system is acquired from different published materials like technical bulletins, books, e-manuals etc. The information acquired was represented in the form of symptoms. Special care was taken to describe the symptoms to maintain the accuracy of the pest identified and the management practices to be followed after identification.

D. Knowledge Representation

The knowledge representation problem concerns the mismatch between human and computer 'memory', i.e, how to encode knowledge so that it is a faithful reflection of the expert's knowledge and can be manipulated by computer [11]. The inference engine for this system uses the forward chaining. It takes the symptoms from the user and compares it with the knowledge base and determines the pest affected and shows the management (Fig.1).

II. MATERIALS AND METHODS

A. Coconut Pest Exert System

The acquired information collected from published materials was categorized into object oriented technique where the parts affected are the objects (Table 1).

TABLE I PART AFFECTED

Leaf	L	Growing Point	GP	Spathe	S	Crown	C
Stem	S	Seedling	SD	Nut	N	Button	B
Root	R	Bunch	BN	Leaflet	LF		

B. Attribute for symptom

The attributes used for defining symptoms for each object were given with the symptom description. Rules were created in the knowledge base in the form of IF THEN ELSE. The symptoms were classified into three groups. 1st group contains the rules related to a single symptom used. The same can be confirmed by the image of pest and the symptom. The second group contains the rules related to selecting two symptoms of the same object. The corresponding pest and the management can be retrieved through this group if the user is 100 % sure about the symptom. 3rd group contains the rules with symptoms of different objects. These classes were used to get the correct pest and management practices to be followed along with the images for confirming the pest. The symptoms that were assigned for different objects are given (Table 2).

TABLE II PART AFFECTED AND SYMPTOM

Part affected	Symptom										
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11
Leaf											
Growing Point	GP1										
Spathe	S1	S2									
Stem	ST1										
Seedling	SD1	SD2	SD3	SD4							
Nut	N1	N2	N3	N4							

Root	R1	R2	R3							
Crown	C1									
Button	B1									
Bunch	BN1									
Leaflet	LF1	LF2	LF3	LF4						

The representation of knowledge in rule based reasoning is given

Rule1 (Fig.2)

IF part affected = ‘Nut’ AND

Symptom 1 N1 = ‘Triangular patches close to perianth, brown coloured patches.....’

THEN Pest Image1, Symptom Image1

AND

Pest = Eriophyid mite (*Aceria guerreronis*), Management = ‘Botanical pesticides -Spraying of affected palms with a mixture of 2 percent neem oil.....’

Rule2 (Fig.3)

IF part affected = ‘Leaf’ AND

Symptom1 L1 = ‘triangular cuts’

AND

Symptom 2 L2 = ‘Central core of the spindle is affected’

THEN Pest Image1, Symptom Image1,

Pest = Rhinoceros, *Oryctes rhinoceros* Linn. Management = ‘Integrated pest management involves disposal of breeding.....’

Rule3 (Fig.4)

IF part affected = ‘Crown’ AND Part affected = ‘Button’ AND

Symptom1 C1 = ‘Tapering of crown region’

AND

Symptom2 B1 = ‘Button shedding’

THEN Pest Image1, Symptom Image1,

Pest = White grub, *Leucopholis coneophora* Burm. Management = ‘Control: Regular ploughing or digging of infested soil at the onset of premonsoon.....’. Expert system on coconut pest management is developed using ASP.NET using forward chaining technique.

III. RESULTS AND DISCUSSION

The system contains information on 21 pests of coconut palm i.e., Rhinoceros, *Oryctes rhinoceros* Linn., Leaf eating caterpillar (*Opisina arenosella*), Red palm weevil, *Rhynchophorus ferrugineus* (Oliv.), Eriophyid mite (*Aceria guerreronis*), White grub, *Leucopholis coneophora* Burm., Coreid bug (*Paradasynus rostratus*), Mealy bugs, Soft scales, Whiteflies, Foliage mites (*Raoiella indica* Hirst., *Oligonychus iseilemae* Hirst., *Tetranychus ludeni* Z.), Ash weevils, Skipper butterfly (*Gangara thyrasis* Moore and *Suastus gremius* Fab.), Termites, Small red ant (*Dorylus orientalis* Westwood), Bandicoots (*Bandicota bengalensis* Gray.), Slug caterpillars (*Contheyla rotunda*, *Latoia lepida* Nut borer), Bagworm (*Mentha albipes* M.), Lace bug (*Stephanitis typicus*), Palm aphid (*Cerataphis brasiliensis* (Hempel)), Rodents and Nematode.

The expert system provides the pest and management according to the principle of Bayesian Networks of uncertainty. Bayesian Networks are called belief networks or probabilistic inference networks. It was initially developed by Pearl (1988). The basic idea – Knowledge in the world is modular – most events are independent of most other events. Adopt a model that can use a more local representation to allow interactions between events that only affect each other. Some events may only be unidirectional, others may be bidirectional – make a distinction between these in model. Events may be causal and thus get chained together in a network. Implementation- A Bayesian network is a directed acyclic graph. A graph where the directions are links indicating dependencies that exist between nodes. Nodes represent propositions about events or events themselves. Conditional probabilities quantify the strength of dependencies.

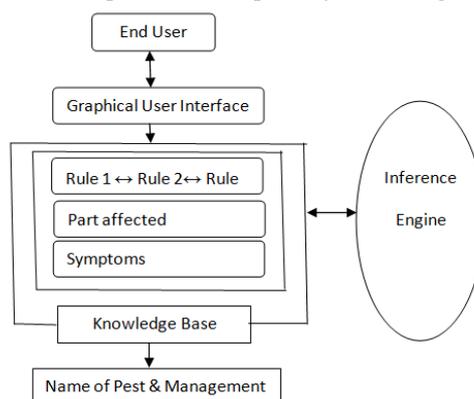


Fig.1

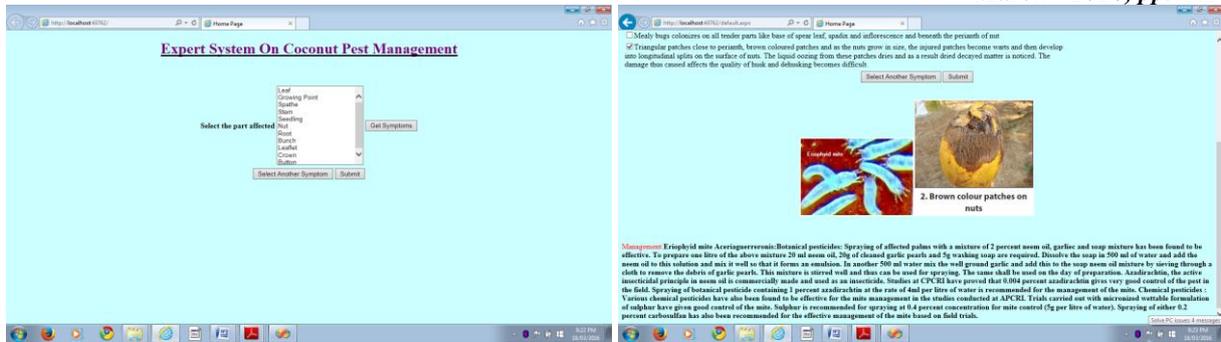


Fig.2 Rule 1



Fig.3 Rule 2

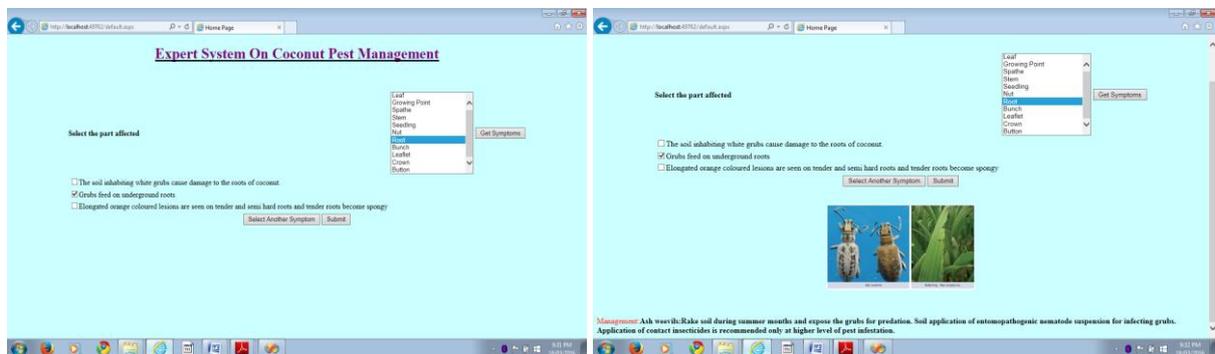


Fig.4 Rule 3

IV. CONCLUSION

An Expert System is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise. Expert systems can facilitate knowledge transfer and can guide growers to take decision into different aspects of crop management for increasing the productivity and the profit margin and also combines the experimental and experiential knowledge with the intuitive reasoning skills of a multitude of specialists to aid farmers in making the best decisions for their crops. The expert system on coconut pest management can be used to increase the production by timely detection of pests and the management practices can be taken up. Experts are not everywhere and every time. The expert system can be used efficiently in places where there is shortage of expert advice and timely detection of the pest and management is necessary for reducing the loss.

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