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Knowledge Based System for Diagnosing Guava Problems

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Abstract: *The importance of agriculture stems from its ability to strengthen the economy. Agriculture also contributes to the employment of workers in the capacity of agriculture to achieve a high percentage of this equation, in addition to the ability of agriculture to achieve a high degree of self-adequacy, and the development of other sectors. Although the problems and obstacles to agriculture cannot be reduced and limited, both because of problems related to natural and environmental resources, technical problems and obstacles and many other reasons. But here we will take care of the most important problems are diseases affecting plants and trees and how to deal with them before the incursion of the disease. The concentration in this paper on guava disease, so the designed expert guava system aims to help farmers and people interested in guava development to learn about guava diseases to enable them to find and treat the right treatment of the disease. The Guava system calls on farmers or users to observe the symptoms that they see at the guava plant so that the expert system can identify the disease and give the user some information that may help farmers grow guavas.*

Keyword: Knowledge Based System, Guava, expert system

1. INTRODUCTION

Guava is an important fruit due to its great benefits, it is a round yellow tropical fruit with light green or light yellow skin, and the color of its flesh varies from white or pink to dark red, and has pink or white flesh and hard edible seeds. Guava belongs to the myrtle family (Myrtaceae), native to Mexico, Central America, and northern South America, which comprises approximately 150 species of trees and shrubs [1,2,13].

The guava is easy to recognize because of its smooth, thin, copper-colored bark that flakes off, showing the greenish layer beneath; and also because of the attractive, "bony" aspect of its trunk which may in time attain a diameter of 10 in (25 cm). Young twigs are quadrangular and downy. The leaves, aromatic when crushed, are evergreen, opposite, short-petioled, oval or oblong-elliptic, somewhat irregular in outline; 2 3/4 to 6 in (7-15 cm) long, I 'A to 2 in (3-5 cm) wide, leathery, with conspicuous parallel veins, and more or less downy on the underside [2].

The guava has been cultivated and distributed by man, by birds, and sundry 4-footed animals for so long that its place of origin is uncertain, but it is believed to be an area extending from southern Mexico into or through Central America. It is common throughout all warm areas of tropical America and in the West Indies (since 1526), the Bahamas, Bermuda and southern Florida where it was reportedly introduced in 1847 and was common over more than half the State by 1886[2].

The guava fruit is replete with antioxidants and other nutrients like vitamin C and lycopene. It is a powerhouse of fiber too. Just one guava contains 126 mg of vitamin C, which meets a whopping 209% percent of daily recommended values. The fruit also contains 229 mg of potassium, 343 IU of vitamin A, and 27 mcg of folate[12]. Guava indeed is a powerhouse of nutrients. “This humble fruit is extraordinarily rich in antioxidants that are beneficial for skin. Guavas are also rich in manganese which helps the body to absorb other key nutrients from the food. Guavas benefits are credited due to the presence of folate, a mineral which helps promote fertility. On the other hand, A 100 gm of guava contains just 68 calories and 8.92 gm sugar, according to the data of United States Department of Agriculture (USDA). Guavas are also rich in calcium as they contain 18 gm of the mineral per 100 gm of the fruit. It also contains 22 gm of magnesium per 100 gm of the fruit, as well as significant amounts of phosphorus and potassium- 40 and 417 gm per 100 gm, respectively [13].

Artificial Intelligence (AI) has many branches and one of this branch is expert system that were developed in the mid 1960's by AI community. Expert systems are a branch of computer science aimed at transferring human intelligence into computers [3,15-20].

Expert System is a computer system that emulates the decision-making ability of human expert in a restricted domain. It is mainly developed using artificial intelligence concepts, tools and technologies [2129]. An expert system is typically designed to provide capabilities similar to those of a human expert when performing a task [30-38]. Moreover, it can be used to drive vehicles, provide financial forecasts or do things that human experts do [39-48].

Expert system consists of four major components which are: knowledge base, working memory, an inference engine and a user interface [14,49-51]. Figure 1 below represents the structure of an expert system.

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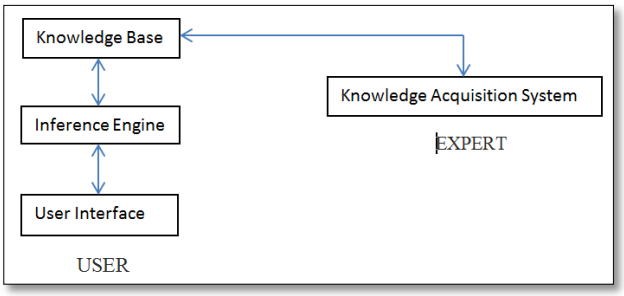

Figure 1: Main components of an Expert System designed by Ibtesam Dheir

- knowledge base : contains essential information about the problem domain, often represented as facts and rules
- inference engine: mechanism to derive new knowledge from the knowledge base and the information provided by the user, often based on the use of rules
- user interface: interaction with end users, development and maintenance of the knowledge base
- Working Memory: Which store temporary information that entered from the end user.

2. MATERIAL AND METHODS

The tendered expert system diagnoses seven of the guava diseases. The proposed expert system depends on the selection of options which selected by the user depending on the disease symptoms. At the end of the dialogue session, the proposed expert system provides the diagnosis and recommendation of the disease including survival and spread, and favorable conditions for the disease to the user.

Figure 2 shows the main interface of the system and the user system. Figure 3 shows symptoms disease, Figure 4 Obtain diagnosis and recommendation.

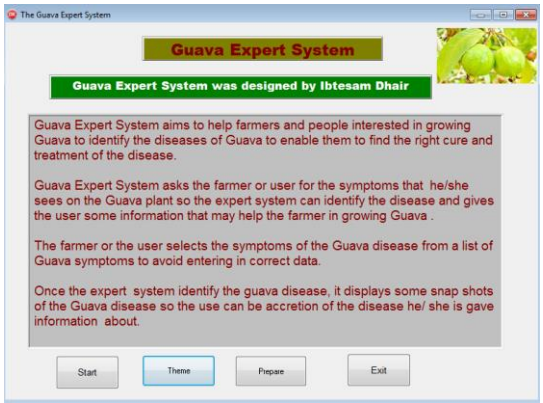

Figure 2 : the main interface of the system and the user system

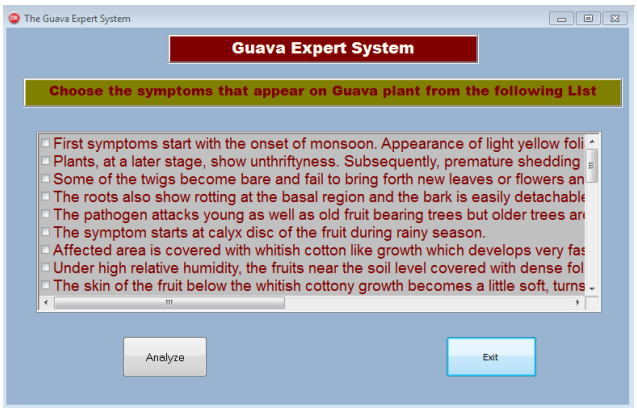

Figure 3: sample dialogue between the expert system and the user.

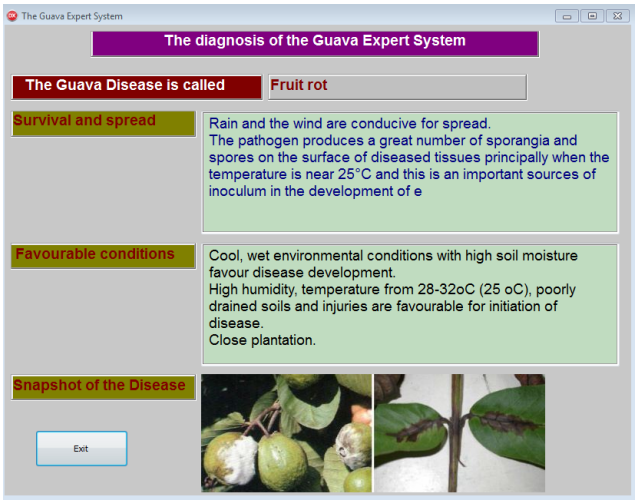

Figure 4: diagnosis and recommendation.

3. LITERATURE REVIEW

Good Expert Systems are systems with good knowledge existing inside them. The knowledge transfers to computer from expert person or client feedback, and sometimes knowledge can be acquired directly from the environment. Nowadays, there is a lot of knowledge-based system that treats a special problem or manages a certain domain; However, There is a lot of Expert System that were designed to diagnose agricultural diseases such as tomato, plant and others diseases [5,6]. But there is no specialized expert system for diagnosis of guava diseases available free and use a language CLIPS linked with Delphi. This expert system is easily used by farmers and people concerned. This is due to the coordinated application interface.

The current expert system specializes in the diagnosis of seven guava diseases: Guava wilt; Fruit rot; Dieback and Anthracnose (fruit rot); Stem canker and dry fruit rot-Physalopara psidii Stevens &Pierce and Diplodia netalensis Evans; Fruit canker (Pestalotia psidii Pat.); Algal leaf and

fruit spot (Cephaleuros virescens Kuntze); and Styler end rot (Phomopsis psidii de Camara).

4. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system either from an expert in the field of agriculture or a website specialized in websites for guava diseases. The captured knowledge has been converted into CLIPS syntax. Currently the expert system covers seven **Guava diseases:**

Guava wilt:

Wilt of guava is one of the most important diseases of guava especially in India and loss due to this disease is substantial [10]. Wilt disease is a major limiting factor for the productivity and production of guava. Since, the disease is soil borne in nature, there are limitations in its control. Although, guava wilt was first reported in 1935 from Babakkarpur, Allahabad [8].

First external symptom of the guava wilt is the appearance of light yellow foliage with slight curling of the leaves on terminal branches and loss of turgidity. Subsequently, browning, drooping and pre-mature shedding of the leaves occur. Some of the twigs become bare and fail to bring forth new leaves or flowers and eventually dry up. Fruits of all the affected branches remain underdeveloped, hard and stony. Later, the entire plant is defoliated and eventually dies. Also, The roots also show rotting at the basal region and the bark is easily detachable from the cortex. Light brown discoloration is also noticed in vascular tissues. Generally, the symptoms appear after the rains, i.e. during October-November, when the fruits are small. As the wilt progresses, the fruits of affected branches remain under developed, hard and stony [8,9].

Figure 5: guava wilt

Fruit rot :

Fruit rots in field (pre harvest rots) or during transit and storage (post harvest rots) are the most serious diseases of guava, which cause maximum loss. It can be said that due to the perishable nature of the fruit and very short self life, guava suffers badly by different rot pathogens. Fruit rot caused by Phytophthora parasitica Dastur was reported by Mitra (1929) from Pusa, Bihar, India. He described that the disease appears in wet season (July-September). The fruits especially affected are those, which have fallen on the ground or which hang near the ground level or which have been placed in storage. The disease starts at styler end. The whitish cottony growth develops very fast as the fruit ripens and is able to cover almost the entire surface within a period of about 3-4 days during humid weather (Figure 6). Under high relative humidity, the fruits near the soil level covered with dense foliage are most severely affected. The fallen fruits are badly affected.The skin of the fruit below the whitish cottony growth becomes a little soft, turns light brown to dark[9,10].

Figure 6: Phytophthora fruit rot on green fruit and foliage

Dieback and Anthracnose (fruit rot)

Pin-head spots are first seen on the unripe fruits which gradually enlarge measuring 5-6 mm in diameter. They are dark brown to black in color, sunken, circular and have minute black stromata in the center of the lesion, which produce creamy spore masses in moist weather. Several spots coalesce to form bigger lesions. The infected area in the unripe fruits becomes corcky and harder and often develops cracks in case of severe infection. However, The plant begins to die backwards form the top of a branch in die back phase. Moreover, Young shoots, leaves and fruits are readily attached, while they are still tender. The greenish color of the growing tip is changed to dark brown and later to black necrotic areas extending backwards. The fungus develops from the infected twigs and then petiole and young leaves which may drop down or fall leaving the dried twigs without leaves [9,11].

Figure 7: Disease symptoms on unripe and mature fruits

Stem canker and dry fruit rot. Physalopara psidii Stevens &Pierce and Diplodia netalensis Evans

Initially the light brown spots mostly at the stalk end or at the calyx end of the fruit develop. In few cases, infection spreads quickly and within 3-4 days entire fruit is affected. Completely infected young and mature fruits become dark brown to almost black in color and ultimately dry up. A number of dry fruits can be seen on infected trees. Moreover, longitudinal cracks in the bark on stem or branches, which are visible during post monsoon period in October-November. On scraping bark, brown to black streaks or bands are present in the sub-cortical region. The affected

bark turns dark brown to greyish and develops large vertical cracks. The disease spreads up and down from one branch to another and ultimately passes on to the main trunk and upper roots. Physalopara psidii causes stem canker and the imperfect stage Diplodia netalensis dry fruit rot. Leaves on the engirdled portions loose their color slowly and become purplish bronze. Completely engirdled trees decline and die gradually in course of 2-3 years. However, The pathogen is also identified as Diplodia natalensis Pole-Evans[9,10].

Fruit canker (Pestalotia psidii Pat.)

Fruit canker caused by Pestalotia psidii Pat. The disease generally occurs on green fruits and rarely on leaves. The first evidence of infection on fruit is the appearance of minute, brown or rust coloured, unbroken, circular, necrotic areas, which in advanced stage of infection, tears open the epidermis in a circinate manner. The margin of lesion is elevated and a depressed area is noticeable inside. The crater like appearance is more noticeable on fruits than on leaves. The canker is confined to a very shallow area and does not penetrate deep into the flesh of the fruit (Figure 8). In older cankers, white mycelium consisting of numerous spores are noticeable. Canker on the green fruits of different varieties exhibit considerable differences in their appearance. In severe cases, raised, cankerous spots develop in great numbers and the fruits break open to expose seeds. The infected fruits remain underdeveloped, become hard, malformed and mummified and drop in great numbers. Sometimes small rusty brown angular spots appear on the leaves . In winter the cankerous spots are cornmon but in rainy season minute red specks are formed.[11]

Figure:8 Canker on the fruit

Algal leaf and fruit spot (Cephaleuros virescens Kuntze)

Cephaleuros infects immature guava leaves during early spring flush. Minute, shallow brown velvety lesions appear on leaves specialy on leaf tips margins or areas near the mid vein and as the disease progress, the lesions enlarge to 2-3 mm in diameter.On leaves the spots may vary from specks to big patches which may be crowded or scattered. Although the alga's zoosporangia arise from thalli on adaxial surfaces of many host species, lesions on guava frequently extend through the entire lamina and sporangia most often occur on the abaxial leaf surface. On immature fruits the lesions are nearly black. As fruits enlarge, lesions get sunken, and get cracked frequently on older blemishes as a result of enlargement of fruits. Penetration of fruit is confined to several layers of cells beneath the epidermis. Fruit lesions are usually smaller than leaf spots. They are darkish green to brown or black in color[9,10].

Figure 9: Algal spots on leaves

Styler end rot (Phomopsis psidii de Camara)

Symptoms develop as minute depressed or flattend spots on the ripening fruits. In these spots, fungus develops in a concentric manner. The affected area gradually increases in size and turn dark brow. Later such area becomes soft. Along with the discoloration of epicarp, the mesocarp tissue also shows discoloration and the diseased area is marked by being pulpy and light brown in colour in contrast to the bright white colour of the healthy area of the mesocarp. Several spots later coalesce and form bigger lesions[9,10].

Figure 10: Stylar end rot (infected and healthy fruit)

5. LIMITATION:

The current proposed expert system is specialized in the diagnosis of seven guava diseases: Guava wilt, Fruit rot, Dieback and Anthracnose (fruit rot), Stem canker and dry fruit rot- Physalopara psidii Stevens &Pierce and Diplodia netalensis Evans, Fruit canker (Pestalotia psidii Pat.), Algal leaf and fruit spot (Cephaleuros virescens Kuntze), and Styler end rot (Phomopsis psidii de Camara).

6. EVALUATION SYSTEM

As a preliminary evolution, many agricultural engineers, Agricultural teachers and other Agriculture students tested this proposed Expert System. They have felt familiar and comfortable with its interfaces, easy usage and simplicity of information. And they were satisfied with its performance and efficiency.

7. CONCLUSION

In this paper, a proposed expert system was presented for helping farmers, specialists and students in diagnosing

disease with seven different possible guava diseases. Farmers can get the diagnosis faster and more accurate than the traditional diagnosis. This knowledge-based system does not need intensive training to be used; it is easy to use and has user friendly interface. It was developed using CLIPS and Delphi XE10.2 languages.

8. FUTURE WORK

This expert system is considered to be more intuitive, useful and base of future ones; more guava diseases are planned to be added and to make it more accessible to users from anywhere at any time.

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