Development of A Rule based System for Safflower Disease Diagnosis

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Abstract: Background: Safflower *is a highly branched, herbaceous, thistle-like annual plant. Any section of the safflower plant sections can suffering from a disease that weakens the ability to grow and eliminates its production. Therefore, in this paper will identify the pests and diseases present in safflower culture and detect the symptoms in each disease. Also images are showing the symptom form in this disease.* ***Objectives:*** *The main objective of this expert system is to obtain appropriate diagnosis of the disease.* ***Methods:*** *In this paper, the expert system is designed for the ability of agricultural engineers to detect and diagnose disease of safflower like as: alternaria blight, cercospora leaf spot, powdery mildew, head rot and wilt, mosaic, ramularia leaf spot, rust, wilt, and root rot. This system displays the disease symptoms, survival and spread, favorable conditions and image for each disease. Clips and Delphi expert system languages are used for designing and implementing the proposed expert system.* ***Results:*** *The expert system in the diagnosis of safflower diseases was evaluated by farmers and agricultural engineers and they were satisfied and accepted with its quality of performance.* ***Conclusions:*** *The expert system is easy for farmers and people have experience in the plant of safflower to detect and diagnosis the symptoms that may face this plant from several disease.*

Keywords: Artificial Intelligence, Expert Systems, Clips, Delphi, safflower diseases, Language.

1. INTRODUCTION

Safflower is a plant. The flower and oil from the seeds are used as medicine. Safflower seed oil is taken by mouth for preventing heart disease, including hardening of the arteries (atherosclerosis) and stroke. It is also used to increase hair growth, treat fever, and for weight loss, diabetes, tumors, coughs, breathing problems, clotting conditions, pain, coronary heart disease, chest pain, and other uses. Women sometimes use safflower oil by mouth for absent or painful menstrual periods, or to stimulate menstruation; they use safflower flower to cause an abortion. Safflower oil is applied to the skin to reduce scars and stretch marks. Safflower yellow, a component of safflower flower, is injected into the vein for chest pain (angina) and for stroke. In foods, safflower seed oil is used as a cooking oil. In manufacturing, safflower flower is used to color cosmetics and dye fabrics. Safflower seed oil is used as a paint solvent. [1]

Figure 1: safflower

An expert system is a computer system that emulates, or acts in all respects, with the decision-making capabilities of a human expert. It has main components: Knowledge base, it's obtainable from books, magazines, knowledgeable persons, etc. Inference engine, it draws conclusions from the knowledge base. [2] In the below figure 2 display the main components.
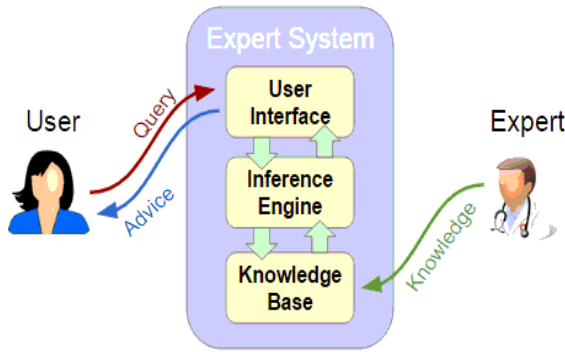
Figure 2: main components of expert system

The Expert system for Safflower Diseases Diagnosis was implemented using Clips Object language and Delphi Object language. Clips is a decent example of an expert system shell, it illustrates many of the concepts and methods used in other expert system shells, it allows the representation of knowledge, and its use for solving suitable problems.

2. MATERIALS AND METHODS

The expert system accomplish diagnosis for nine safflower diseases display in the leaves, can applied by display all symptoms in list and select it to analysis the disease. The expert system will ask the user to choose the symptoms that appear on safflower plant from the list. Then click analyze button to diagnosis the safflower disease name, survival and spread, favorable conditions and snapshot of the disease. The expert system has been designed for change the theme for user interface like font color, background color, font name, and font size. Also it has many forms, each form displays specific format. For example figure 3 displays the basic data for the expert system such as name and image. In the figure 4 displays the format of the first user interface include name of expert system and who designed it and background about the system. In figure 5 displays the format of symptoms screen that display all symptoms in the list. In figure 6 displays the format of result screen that include all details that diagnosis of the disease. Figure 7 displays the format of screen entering details of disease.
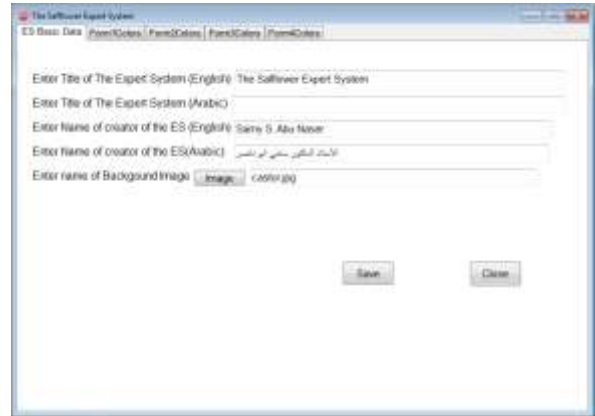

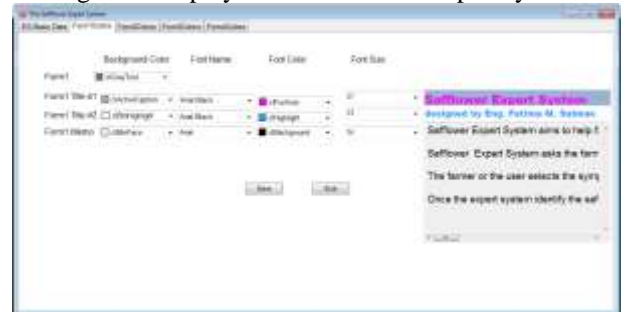Figure 3: display the basic data for expert system

Figure 4: display format of the main page in expert system

Figure 5: display format of selection symptoms.

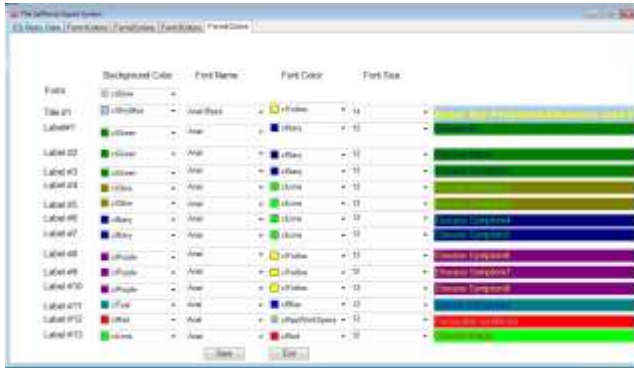Figure 6: display format of details screen of disease

Figure 7: displays the format of entering diseases details

Figure 8 displays the main page of the safflower expert system include the details and the important of the safflower expert system

Figure 8: main page of safflower expert system

In figure 9 is the user interface for choosing the symptoms that appear on a safflower plant and click in the button analyze to display the details that is displayed in the figure 9

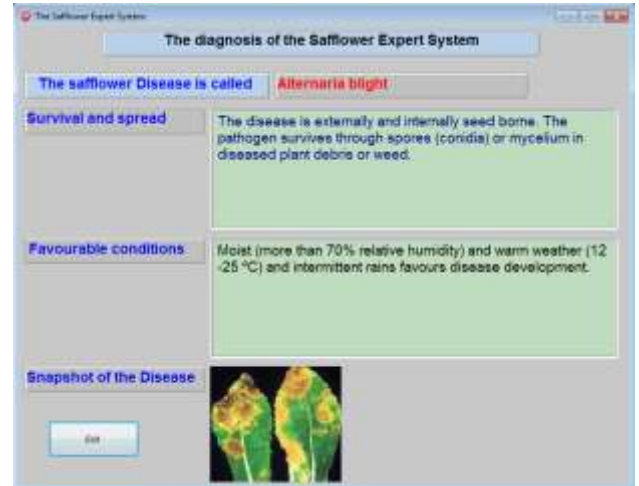Figure 9: user interface to select the purpose symptoms

Figure 10: user interface display the details for safflower disease

3. LITERATURE REVIEW

A few expert systems were designed to diagnose human diseases [37-43, 45-63,65-92]. An expert system which helps farmers and specialists to diagnose and provide appropriate advice on plant and trees problem like: general plant [2], mango [74], black pepper [64], banana [48, 58], onion [44], potato [84], pineapple [89], watermelon [35, 36], tomatoes [60], seedling classification [61], castor [91], and other kinds of diseases. However, there is no expert system found to diagnosis safflower diseases.

4. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are agriculture and specializes websites for safflower diseases. The captured knowledge has been converted into CLIPS Object Knowledge base. Currently the expert system has a number of rules which cover nine safflower diseases [1-5]:

Alternaria blight: it has some of disease symptoms like:
- It is the most destructive disease.
- Dark necrotic lesions 2-5 mm in diameter are formed first on hypocotyls and cotyledons.
- In mature plants, small brown to dark brown concentric spots of 1-2 mm appear on leaves.
- Symptoms also appear on stem and severely infected plant gets blighted.
- Brown discolouration appears on the stem, dark brown spots with concentric rings up to 1 cm in diameter appear on the leaves which later develop into large lesions.
- Seeds also may be affected. Dark sunken lesions are produced on the testa. It may rot and damping off of seedlings occur.

Figure 11: Alternaria blight

Cercospora leaf spot: it has some of disease symptoms like:
Safflower plants few weeks after planting or at flowering stage are commonly attacked.

- Circular to irregular brown sunken spots of 3-10 mm diameter are formed on leaves.
- Spots are surrounded by yellow halos.
- Symptoms first appear on lower leaves and spread to upper leaves.
- Stems and nodes may also be affected.
- In severe infections bracts are also affected with reddish brown spots.
- Affected flower buds turn brown and die.

Figure 12: Cercospora leaf spot

Powdery mildew: it has some of disease symptoms like:

- The disease is characterized by whitish powdery growth on leaves
- Later the fungus spreads over the entire leaf. Leaves turn yellow and dry up

Figure 13: Powdery mildew

Head rot and wilt: it has some of disease symptoms like:

- Plants become yellowish, turn brown and ultimately die
- Large black sclerotia of the fungus are formed on the crown inside the stem, floral heads and adjoining roots
- Shredding of the stem takes place

Figure 14: Head rot and wilt

Mosaic: it has some of disease symptoms like as:

- In CMV infected safflower plants young leaves show irregular yellow or light patches alternating with normal green areas.
- Leaves may become blistered and distorted and infected plants are stunted.
- In few plants primary leaves are produced, forming a rosette of leaves exhibiting mosaic mottling and from the center of this, the axis bearing secondary leaves are produced.
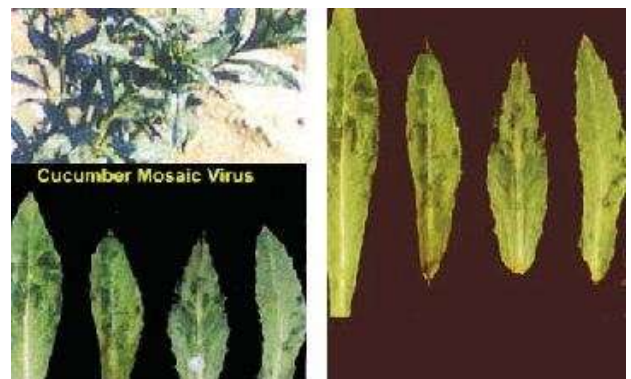

Figure 15: Mosaic

Ramularia leaf spot: it has some of disease symptoms like as:

- Round and irregular spots of 100 mm or more in diameter occur on both sides of leaves
- Whitish dense mass of conidia remain at the center which reflects light, dry spots are brown in color.

Figure 16: Ramularia leaf spot

Rust: it has some of disease symptoms like as:
- Seedling infection causes twisting towards one side
- Chesnut brown postules are formed on hypocotyl leading to collapse of seedling
- On older plants girdling and hypertrophy of the stem base may occur
- Small powdery chesnut brown postules of 1-2 mm in size develop on leaf surface which later turn black.

Figure 17: Rust

Wilt: it has some of disease symptoms like as:
- Yellowing of leaves on one side of plant starts particularly from lower leaves followed by wilting the progresses upwards
- Lesion at soil line is first symptom noticed which extends inside and affects the vascular system
- Plant starts to wilt, drooping more often
- Infected heads have aborted seed.

Figure 18: Wilt

Root rot: it has some of disease symptoms like as:

- Dark cortical lesions occur slightly below or at the soil level on the stem, which later extend upwards
- Lesions frequently girdle the stem
- Root development is reduced and finally seedlings die

Figure 18: Root rot

5. LIMITATIONS
Currently the proposed expert system is specialized in the diagnosis nine safflower diseases: alternaria blight, cercospora leaf spot, powdery mildew, head rot and wilt, mosaic, ramularia leaf spot, rust, wilt, and root rot.

6. SYSTEM EVALUATION
As an introductory evolution, a group of farmers and Agricultural specialists tested this proposed Expert System and they were satisfied with its performance, efficiency, user interface and ease of use.

7. CONCLUSION
In this paper, a proposed expert system was presented for helping farmers and Agricultural specialists in diagnosing plants with nine different possible safflower diseases. Agricultural specialists and farmers can get the diagnosis faster and more accurate than the traditional diagnosis. This expert system does not need intensive training to be used; it is easy to use and has user friendly interface. It was using CLIPS and Delphi XE10.2 languages.

8. FUTURE WORK
This expert system is considered to be a base of future ones; more Safflower diseases are planned to be added and to make it more accessible to users from anywhere at any time.

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