

Rule Based System for Diagnosing Bean Diseases and Treatment

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ABSTRACT: Background: A bean is the seed of one of several genera of the flowering plant family Fabaceae, which are used as vegetables for human or animal food. They can be cooked in many different ways, including boiling, frying, and baking, and are used in many traditional dishes throughout the world. Beans are one of the longest-cultivated plants. Broad beans, also called fava beans, in their wild state the size of a small fingernail, were gathered in Afghanistan and the Himalayan foothills. In a form improved from naturally occurring types, Beans were an important source of protein throughout old and new world history, and still are today. **Objectives:** The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment. **Methods:** In this paper, the design of the proposed Expert System was produced to help farmers and those interested in agriculture in diagnosing many of the Bean diseases such as Fusarium wilt, Charcoal rot or ashy stem blight, Bacterial leaf spot and blight, Mung bean yellow mosaic virus, Cercospora leaf spot. The proposed expert system presents an overview of Bean diseases are given, the cause of diseases outlined and the treatment of disease whenever possible is given out. CLIPS Expert System language was used for designing and implementing the proposed expert system. **Results:** The proposed Bean diseases diagnosis expert system was evaluated by Agricultural experts and some friends interested in agriculture and they were satisfied with its performance. **Conclusions:** The proposed expert system is very useful for Farmers and those interested in agriculture.

Keywords: Bean, Expert Systems, CLIPS, Diseases

1. INTRODUCTION:

Beans are members of the legume family, which includes beans, lentils, peas, peanuts and soybeans. These plants contribute to soil health through nitrogen fixation, a process where atmospheric nitrogen is converted into a form of nitrogen plants can use. Each acre of land in planted to beans will produce 1,500 to 2,800 pounds of beans, depending on location, weather and soil conditions. In 2015, U.S. farmers in 19 states produced more than 2.97 billion pounds of dry beans. The top five beans producing states were North Dakota, Michigan, Minnesota, Nebraska and Idaho. In 2015, the top five types of beans produced in the U.S. were pinto beans (32%), black beans (19%), navy beans (15%), kidney beans (7%) and small red beans (4%).

Agriculture specialists do not treat beans diseases in many places. The presence of specialists to treat plant diseases in general and bean, in particular, is rare in the greatest parts of the world. Plant diseases in general and bean, in particular, are very common these days because due to the industrial revolution, climate changes, and other impacts.

Diagnosis of bean diseases is very complex because the symptoms on their plants make them a lake, which makes them stand up to an important question of whether these symptoms are a disease or an insect or a deficiency in an element. So they need Specialists in Plant Diseases with wide experience of bean diseases. For all the aforementioned reasons, we have developed this expert system to help in diagnosing many of the bean diseases, in order to prescribe the appropriate treatment [16]. An expert system is a computer application of Artificial Intelligence (AI) [2,4,6]; which contains a knowledge base and an inference engine [3]; the main components and details are represented in Figure 1.

Components of Expert Systems in AI

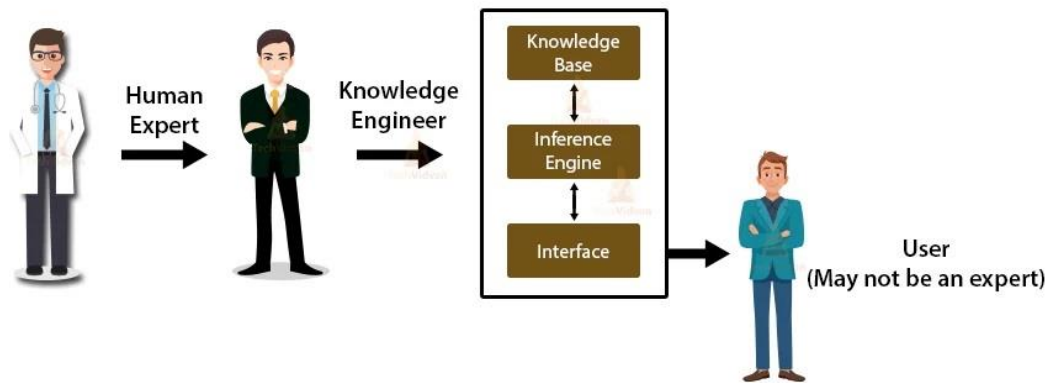


Figure 1: The figure presents the Main Components of an Expert System, Designed by the authors

The proposed Expert System for bean diseases diagnosis was implemented using, CLIPS Rule-Based Programming Language. It is a forward chaining reasoning expert system that can make inferences about facts of the world using rules, objects and take appropriate actions as a result. The user interface was implemented in Delphi Embarcadero RAD Studio XE6. CLIPS is easy for the knowledge engineer to build the Expert System and for the end users when they use the system.

2. MATERIALS AND METHODS

The proposed expert system performs diagnosis for five bean diseases by diagnosis of symptoms. The proposed expert system will ask the user to choose symptoms on each screen. At the end of the dialogue session, the proposed expert system provides the diagnosis and recommendation of the disease to the user. Figure 2 shows a sample dialogue between the expert system and the user. Figure 3 shows the form of entering data about diseases and symptoms. Figure 4 shows the list of symptoms. Figure 5 shows how the users get the diagnosis and recommendation.

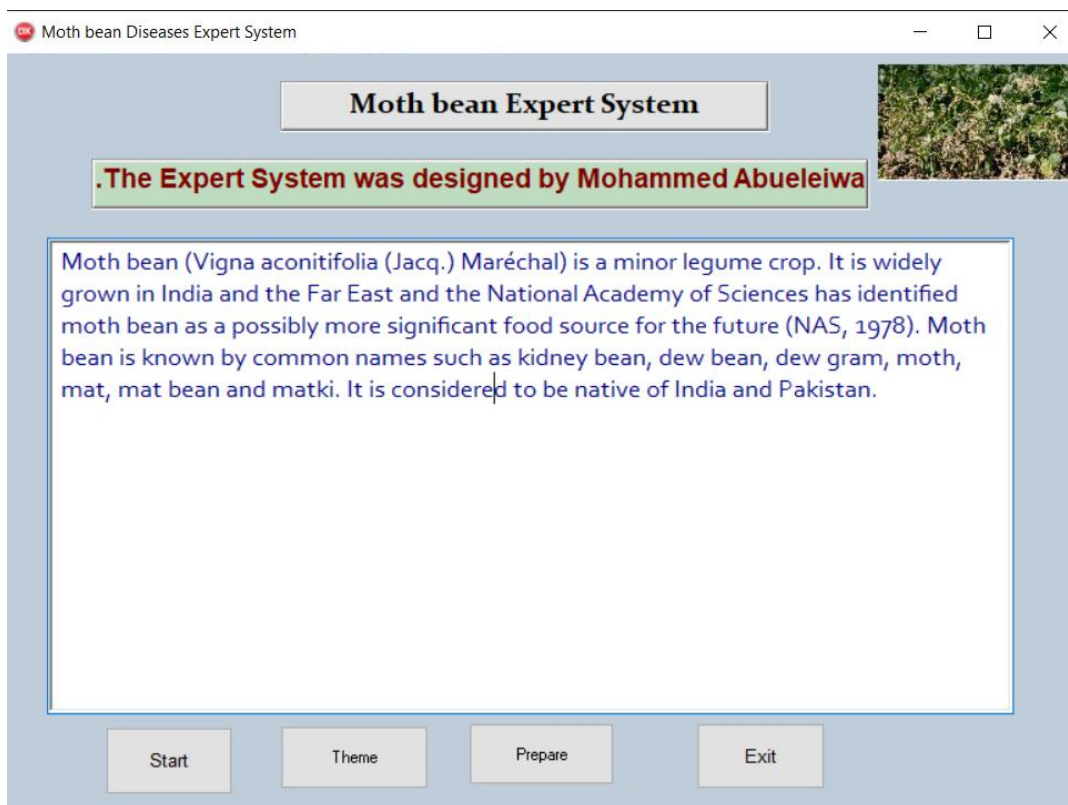


Figure 2: The User Interface of Expert System

Enter the Problems/Diseases and their Symptoms

Disease ID: 1

Disease Name: Fusarium wilt

Disease Symptom 1: The first symptom of the disease in the field is drooping of the plants followed by sudden death. The leaves may also

Disease Symptom 2: Pod formation is severely affected. In collar regions of the wilted plants, necrosis and discolouration can be seen.

Disease Symptom 3: The diseased plants can be pulled out easily than the healthy ones.

Disease Symptom 4: When the diseased stem is cut, there is a dark brown, discoloured band around the vascular system. Infection occurs

Disease Symptom 5: The fungus survives for indefinite periods in the soil.

Disease Symptom 6:

Disease Symptom 7:

Disease Symptom 8:

Disease Symptom 9:

Disease Symptom 10:

Disease Symptom 11:

Disease Symptom 12:

Disease Symptom 13:

Favourable Conditions: Fusarium wilt is more severe during hot, dry weather conditions and particularly when plants are under stress

Survival and spread: This fungal disease may spread through infected plant debris and in seeds.

Image Name: 1.jpg

Buttons: Close

Figure 3: Form for entering the systems and diseases

Moth bean Diseases Expert System

Choose the symptoms that appear on the Diseases from the following List

- Minute pycnidia are also seen on the infected pods and seeds.
- Pod formation is severely affected. In collar regions of the wilted plants, necros
- The disease symptom starts as yellowing of lower leaves, followed by drooping
- The diseased plants can be pulled out easily than the healthy ones.
- The first symptom of the disease in the field is drooping of the plants followed
- The fungus survives for indefinite periods in the soil.
- The infection when spreads to pods, they open prematurely and immature seed
- The rotten root as well as stem tissues contains a large number of minute black
- The stem portion can be easily pulled out leaving the rotten root portion in the s

Buttons: Analyze, Exit

Figure 4: The figure shows symptoms of diseases.

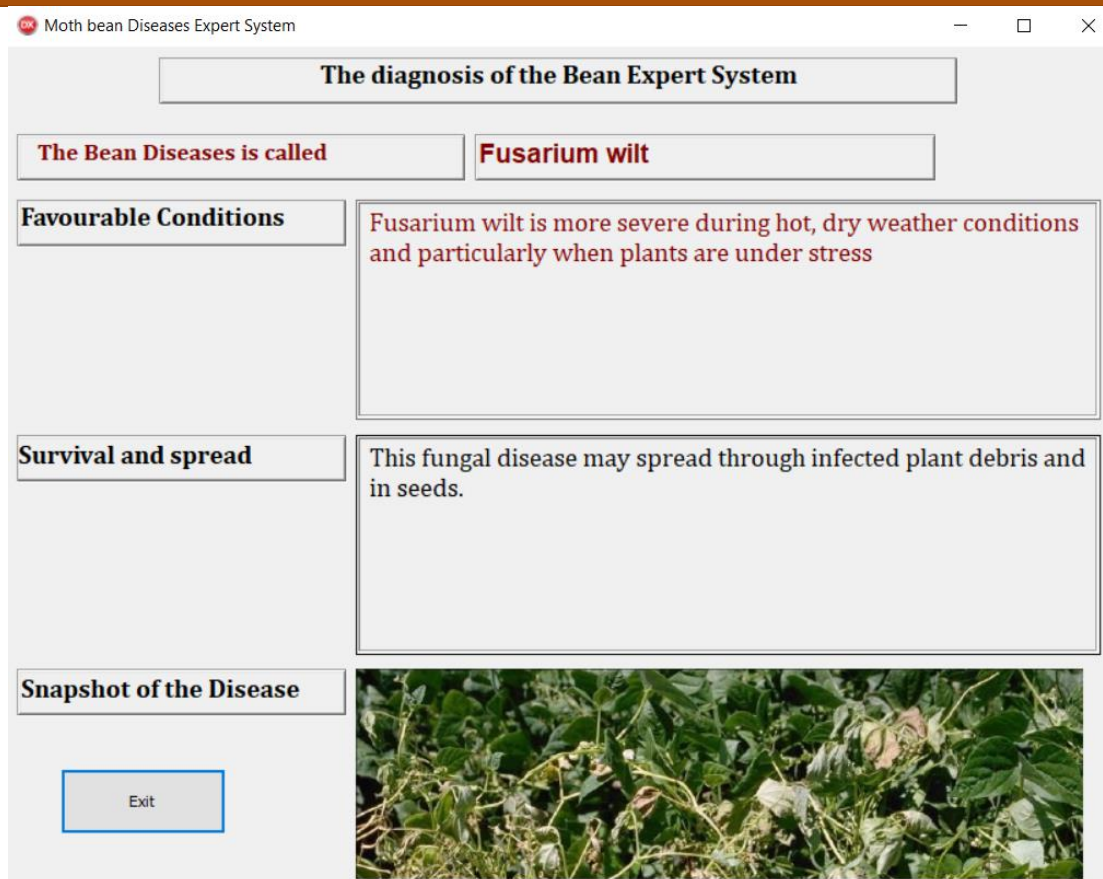


Figure 4: The figure shows diagnosis and recommendation of the expert system.

3. LITERATURE REVIEW:

3.1 Previous Studies

There are many expert systems developed in agriculture [2-25] like: papaya plant disease diagnosis, grapes diagnosis and treatment, onion rule based system for disorders diagnosis and treatment, diagnosing tobacco diseases, banana knowledge based system diagnosis and treatment, spinach expert system: diseases and symptoms, knowledge based system for apple problems using clips, diagnosing banana disorders, black pepper expert system, knowledge based system for diagnosing guava problems, an expert system for citrus diseases diagnosis, expert system for sesame diseases diagnosis, expert system for the diagnosis of mango diseases, expert system for diagnosing sugarcane diseases, expert system for the diagnosis of wheat diseases, coffee diseases, diagnosing and treating potatoes problems, safflower disease diagnosis and treatment, castor diseases and diagnosis, coconut diseases diagnosis, plant disease diagnosis, and apple trees.

There are many expert systems implemented for educations [26-28], like: guiding freshman students in selecting a major in Al-Azhar University, selecting exploratory factor analysis procedures, calculating inheritance in Islam. In general health [29-65] like: anemia expert system diagnosis, diagnosing coronavirus (covid-19), short-term abdominal pain (stomach pain) diagnosis and treatment, diagnosing breast cancer, diagnosing skin cancer, ankle problems, hip problems, hair loss diagnosis, chest pain in infants and children, diagnosis of dengue disease, high blood pressure, ankle diseases, thyroid problems, problems of teeth and gums, diagnosing cough problem, lower back pain, rickets diagnoses and treatment, neck pain diagnosis, diagnosing facial-swelling, throat problems, kidney, depression diagnosis, diabetes diagnosis, polymyalgia rheumatic, silicosis, endocrine diagnosis and treatments, arthritis diseases diagnosis, hepatitis, diagnosis of seventh nerve inflammation (bell's palsy) disease, knee problems diagnosis, and uveitis disease diagnosis. In control [69-70,] like: modeling and controlling smart traffic light system. In maintenance [66-68], like: photo copier maintenance, desktop pc troubleshooting, and diagnosing wireless connection problems.

3.2 Comments about previous studies

Although, there are many expert systems in agriculture field, there are no expert system for diagnosing beans diseases and treatment. That is why we are proposing an expert system for diagnosing and treating beans problems.

4. KNOWLEDGE REPRESENTATION:

The main sources of knowledge for this expert system are farmers and specialized websites for Plant Diseases. The captured knowledge has been converted into CLIPS Rule-Based Programming Language (Facts and Rules) [7]. Currently, the expert system has 24 rules, which cover seven Bean diseases:

Fusarium wilt is a common vascular wilt fungal disease, exhibiting symptoms similar to Verticillium wilt. This disease has been investigated extensively since the early years of this century. The pathogen that causes Fusarium wilt is *Fusarium oxysporum* (*F. oxysporum*).



Figure 5: The figure shows **Fusarium wilt** disease.

The cause may be for this disease is the presence of these four conditions:

- The first symptom of the disease in the field is drooping of the plants followed by sudden death. The leaves may also turn yellow and drop off prematurely.
- Pod formation is severely affected. In collar regions of the wilted plants, necrosis and discoloration can be seen.
- The diseased plants can be pulled out easily than the healthy ones.
- When the diseased stem is cut, there is a dark brown, discolored band around the vascular system. Infection occurs directly through the root hairs.
- The fungus survives for indefinite periods in the soil.

Charcoal rot or ashy stem blight: Ashy stem blight, also known as charcoal rot, is a fungal disease of cucurbits. This means that your melons, squash, and cucumbers are susceptible. It can also affect common beans, black-eyed peas, lima beans, chickpeas, corn, fenugreek, soybeans, sorghum, and sunflowers.



Figure 6: The figure shows Charcoal rot or ashy stem blight.

The cause may be for this disease is the presence of these four conditions:

- The disease symptom starts as yellowing of lower leaves, followed by drooping and defoliation.
- The stem portion near the ground level shows dark brown lesions and bark at the collar region shows shredding.

- The sudden death of plants is seen in patches. In the grown-up plants, the stem portion near the soil level shows large number of black pycnidia.
- The stem portion can be easily pulled out leaving the rotten root portion in the soil.
- The infection when spreads to pods, they open prematurely and immature seeds shriveled and become black in color.
- Minute pycnidia are also seen on the infected pods and seeds.
- The rotten root as well as stem tissues contains a large number of minute black sclerotia on the infected pods and seeds.

Leaf spots and foliar blights: Leaf spots and foliar blights are the most common symptoms of diseases caused by *Acidovorax*, *Pseudomonas* and *Xanthomonas*. Small, water-soaked areas form initially on leaf edges, at stomates and at wounds occasionally.



Figure 7: The figure shows Leaf spots and foliar blights disease.

The cause may be for this disease is the presence of these four conditions:

- Halo blight occurs primarily when temperatures are cool.
- Light greenish-yellow circles that look like halos form around a brown spot or lesion on the plant. With age, the lesions may join together as the leaf turns yellow and slowly dies.
- Stem lesions appear as long, reddish spots. Leaves infected with common blight turn brown and drop quickly from the plant.

Mung bean yellow mosaic virus: Mungbean yellow mosaic virus (Begomovirus) is a major exotic disease of mung beans causing leaf discoloration and yield losses. The virus is spread between plants by the Silverleaf white fly (*Bemisia tabaci*), which is present in Australia.



Figure 8: The figure shows Mungbean yellow mosaic virus disease.

The cause may be for this disease is the presence of these four conditions:

- The leaves show sharply defined patches of unusual coloration.
- The causal agents of these symptoms may be nutrient imbalance

Cercospora leaf spot: Cercospora is a genus of ascomycete fungi. Most species have no known sexual stage, and when the sexual stage is identified, it is in the genus Mycosphaerella. Most species of this genus cause plant diseases, and form leaf spots.



Figure 9: The figure shows Cercospora leaf spot disease.

The cause may be for this disease is the presence of these four conditions:

- On infected leaves (especially those more mature) look for brown or rust-coloured lesions that vary from circular to angular, are 2-10 mm, and may coalesce.
- Lesions may have a grey centre with a slightly reddish border.
- Conidia develop at the centre on short conidiophores.
- Severely affected leaves become chlorotic. Lesions may dry and portions may fall out, giving the leaf a shot-hole appearance.
- Lesions and blemishes may occur on branches, stems and pods.

5. LIMITATIONS:

The currently proposed expert system is specialized in the diagnosis of only the following five Bean diseases: Fusarium wilt, Charcoal rot or ashy stem blight, Bacterial leaf spot and blight, Mung bean yellow mosaic virus, Cercospora leaf spot.

6. SYSTEM EVALUATION:

As a preliminary evolution, some students at the College of Agriculture and some interested in agriculture 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 those interested in agriculture. Bean may suffer from five different diseases they have. Farmers and those interested in agriculture can get the diagnosis faster and more accurately than the traditional diagnosis. This expert system does not need intensive training to be used; it is easy to use and has a user-friendly interface. It was developed using CLIPS Rule-Based Programming Language.

8. FUTURE WORK:

This expert system is considered to be a base for future ones; more bean diseases are planned to be added to make it more accessible to users from anywhere at any time.

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