

Developing an Expert System to Diagnose Tomato Diseases

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Abstract: There is no doubt that tomato diseases are one of the important reasons that destroy the tomato plant and its crops. This leads to clear damage to these plants and they become inedible. Discovering these diseases after a good step for proper and correct treatment. Determining the treatment with high accuracy depends on the method used in the diagnosis. Correctly, expert systems can greatly help to avoid damage to these plants. The expert system diagnoses tomato disease correctly to facilitate farmers to find the correct treatment based on the appropriate diagnosis. Objectives: An expert system has been established based on CLIPS to diagnose tomato plant disease

Keywords: Artificial intelligent, expert system, tomato disease, CLIPS

1. INTRODUCTION

Tomato crop can be grown in moderate soil types that are well cultivated almost. Providing organic materials such as manure can lead to an increase in the yield and success of the crop at a high rate, and it may work to reduce the risks and problems that may be the cause of crop damage. Tomatoes and the following vegetables, such as cucumbers, peppers, cabbage and onions, cannot be grown on the same land more than two or three times a year. On the positive side, a crop or a crop that precedes the tomato must be a type of herbs to restructure the land, such as the molokhia crop, and the diversity of cultivation is important for its soil, meaning that the tomato crop cannot be planted periodically because the soil is not damaged and the multiplicity of diseases that result from this crop and to avoid diseases resulting from the soil which may attack the tomato crop. The cultivation of the tomato crop is very important and the approved plants must be planted whenever possible.

2. EXPERT SYSTEM

An expert system has been established that diagnoses tomato diseases. The expert system helps farmers and facilitates the process of discovering diseases in a clear and good manner. The system also diagnoses tomato diseases by showing a list of symptoms related to tomato diseases. The expert system was programmed using the Clips language. The expert system diagnoses diseases related to tomato diseases through a system that consists of some menus that facilitate its use by the user

At first, a user interface will appear that contains four tasks. If the user clicks on the "Start" icon, the user will see an interface that contains a list of all the symptoms. The user will choose all the symptoms related to the disease he wants.

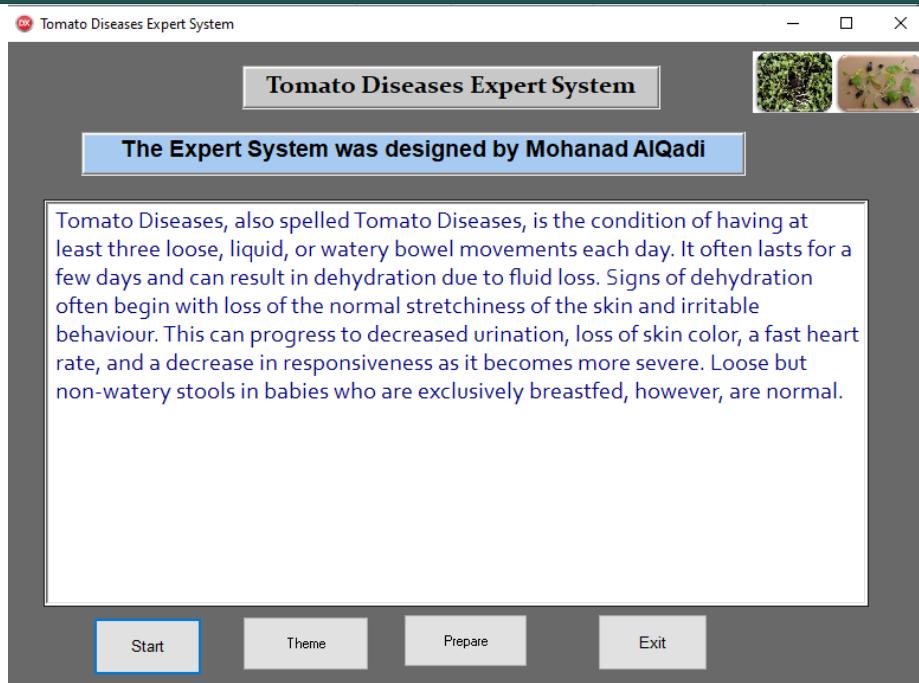


Figure 1 first destination

Then appear list about destination diagnosis to show the symptoms for the user to choose the symptoms that will be treatment

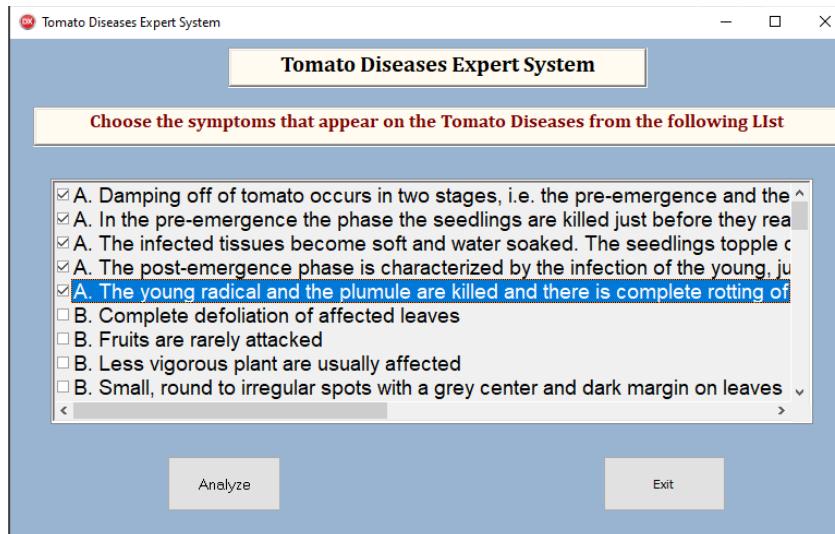


Figure 2 Symptom destination

Then appear list about destination analyze to show the symptoms for the user to show the Favourable Conditions and Survival and spread

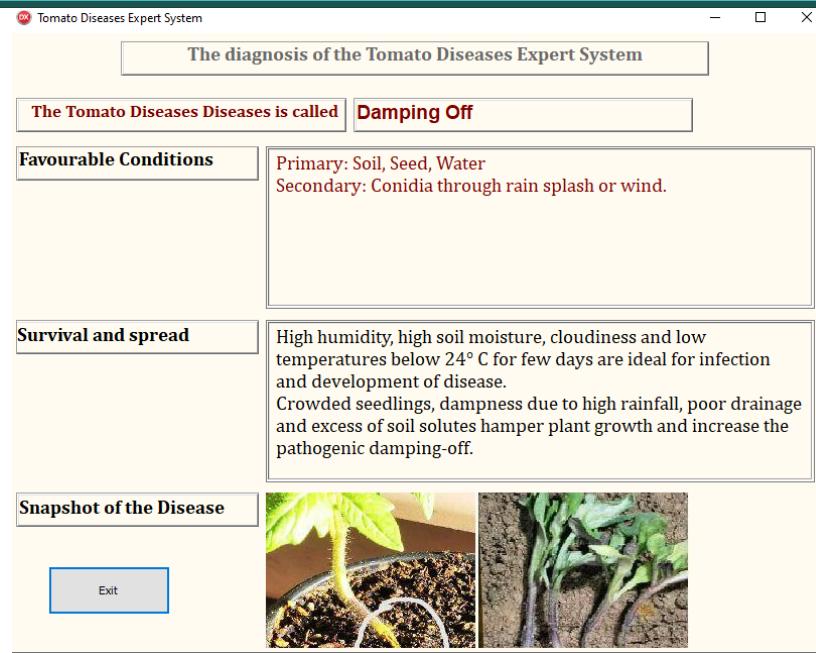


Figure 3 destination analyze

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 Tomato diseases and treatment. That is why we are proposing expert system for diagnosing and treating Tomato problems.

4. KNOWLEDGE REPRESENTATION

There ten diseases to be diagnosed that are represented using CLIPS expert system language [1]:

- Damping Off :** The fungi Pythium and Rhizoctonia cause damping-off of tomato seedlings. Seedlings fail to emerge from the soil in the greenhouse, or small seedlings wilt and die soon after emergence or transplanting. Surviving plants have water-soaked areas on the stem close to the soil line.



Figure 4 : damping-off

2. **Septoria leaf spot:** This destructive disease of tomato foliage, petioles, and stems (fruit is not infected) is caused by the fungus *Septoria Lycopersicon*. Infection usually occurs on the lower leaves near the ground, after plants begin to set fruit. Numerous small, circular spots with dark borders surrounding a beige-colored center appear on the older leaves. [2]



Figure 5 : Septoria leaf spot

3. **Bacterial stem and fruit canker:** Bacterial wilt or Southern bacterial blight is a serious disease caused by *Ralstonia solanacearum* (formerly *Pseudomonas solanacearum*). This bacterium survives in the soil for extended periods and enters the roots through wounds made by transplanting, cultivation, insect feeding damage, and natural wounds where secondary roots emerge.



Figure 6 : Bacterial stem and fruit canker

4. **Early blight:** This disease is caused by the fungi *Alternaria linariae* (formally known as *A. solani*) and is first observed on the plants as small, brown lesions mostly on the older foliage. Spots enlarge and concentric rings in a bull's-eye pattern may be seen in the center of the diseased area.



Figure 7 : Early blight

5. **Bacterial leaf spot:** This disease is caused by several species of the bacterium *Xanthomonas* (but primarily by *Xanthomonas perforans*), which infect green but not red tomatoes. Peppers are also infected. The disease is more prevalent during wet seasons.



Figure 8 : Bacterial leaf spot

6. **Bacterial wilt:** Bacterial wilt or Southern bacterial blight is a serious disease caused by *Ralstonia solanacearum* (formerly *Pseudomonas solanacearum*). This bacterium survives in the soil for extended periods and enters the roots through wounds made by transplanting, cultivation, insect feeding damage, and natural wounds where secondary roots emerge.



Figure 9 : Bacterial wilt

7. **Leaf curl:** Tomato yellow leaf curl virus (TYLCV) is not seed-borne but is transmitted by whiteflies. This disease is extremely damaging to fruit yield in both tomato and pepper crops. Whiteflies may bring the disease into the garden from infected weeds nearby, such as various nightshades and jimsonweed. After infection, tomato plants may be symptomless for as long as 2 to 3 weeks.



Figure 10 : Leaf curl

8. **Mosaic:** Different viruses cause different symptoms on tomatoes. Symptoms of virus infection may appear as light and dark green mottling of the leaves. *Tobacco mosaic virus* (TMV) causes a mottling of older leaves and may cause the malformation of leaflets, which may become shoestring-like in shape.

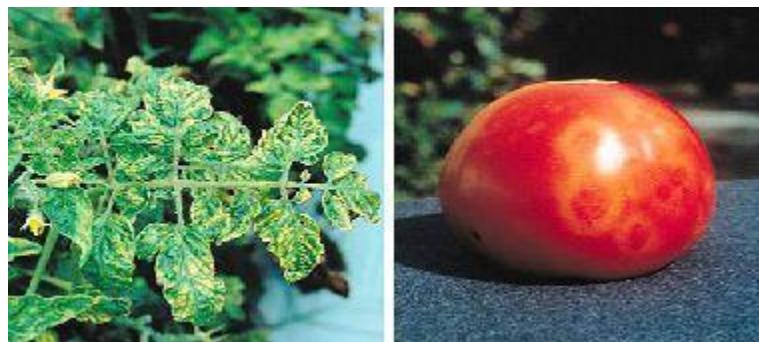


Figure 11 : Mosaic

9. **Tomato spotted wilt disease:** This destructive disease of tomato foliage, petioles, and stems (fruit is not infected) is caused by the fungus *Septoria lycopersici*. Infection usually occurs on the lower leaves near the ground, after plants begin to set fruit.



Figure 12 : Tomato spotted wilt disease

10. **Fusarium:** This is a warm-weather disease caused by the fungus *Fusarium oxysporum*. The first indication of disease in small plants is a drooping and wilting of lower leaves with a loss of green color followed by wilting and death of the plant. Often leaves on only one side of the stem turn golden yellow at first.



Figure 13 : Fusarium

5. CONCLUSION:

Finally, an expert system was established that diagnoses tomato diseases, and these ten diseases are Damping Off, Septoria leaf spot, Bacterial stem and fruit canker, Early blight, Bacterial leaf spot, Bacterial leaf spot, Bacterial leaf spot, Leaf curl, Mosaic, Tomato spotted wilt disease, Fusarium. This expert system diagnoses these diseases in the right and appropriate way that helps farmers to find the appropriate treatment for these diseases.

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