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Banana Knowledge Based System Diagnosis and Treatment

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***Abstract**: This research involved the design of an initial expert system which helps farmers and specialists diagnose and provide appropriate advice on banana diseases. The management of knowledge used in the expert system was also discussed. One of the key elements of this research was to find the appropriate language to diagnose the disease and the current situation in the knowledge base. Expert systems enable effective consultation. Production rules were used to capture knowledge. The expert system was developed using CLIPS with the Delphi 10.2 as user interface. The expert system produced good results in analyzing cases of tested banana disease and enabling the system to determine the correct diagnosis in all cases.*

Keywords: Knowledge Based System; Banana; Diagnosis; Treatment.

1. INTRODUCTION

Bananas are one of the most consumed fruits in the world for good reason. Taking them can help lower blood pressure and reduce the risk of cancer and asthma.

Figure1: The banana

Today, bananas are grown in at least 107 countries and are ranked fourth among the world's food crops in monetary value. Bananas are rich in potassium and fiber. They may help prevent asthma, cancer, high blood pressure, diabetes, cardiovascular disease, and digestive problems. Grown commercially as a food source, bananas also feature prominently in warm region gardens and conservatories, making striking additions to the landscape. When planted in areas with plenty of sun, bananas are not all that hard to grow, but problems with banana plants are bound to crop up nonetheless. What kinds of banana plant pests and diseases are there? Keep reading to find out how to solve problems with banana plants.

Internationalists in agriculture do not treat banana diseases in many places. In fact, the presence of specialists and specialized centers for the treatment of banana diseases is rare in most parts of the world. Diagnosis of banana diseases is very complex. So they need specialists with extensive experience in banana diseases. For all the above reasons,

We have developed this expert system to help specialists and farmers diagnose many of the banana diseases, in order to prescribe appropriate treatment. An expert system is an artificial intelligence computer application; which contains a knowledge base and a conclusion engine; the components and basic details are represented in Figure 2.

A few of the advantages of expert systems are as follows:

- Unlimited work hour: Human experts could not work continuously without a break, but expert systems could work at 24 hours a day since the day they were constructed;
- Low cost of operation: It took a lot of time and money to train or hire a competent engineer, despite of the initial cost of the expert system, the daily cost is much less than using a human engineer.
- Knowledge distribution: Expertise and knowledge are scarce resource. In today's knowledge-concentrated working environment, training a new staff requires lots of practice. When valuable employees leave the company, it is unlikely that the knowledge of him will be maintained. Expert system, on the other hand, could easily copy and restore the expertise knowledge.
- Consistency: Different experts may make different decisions on a same issue according to their understanding of the current situation. Expert systems give consistent output.
- Capability of computing: Because of the preset knowledge base and logical inference program, the expert system would do much better than its human counterpart in some time-consuming, complicated computing problem.

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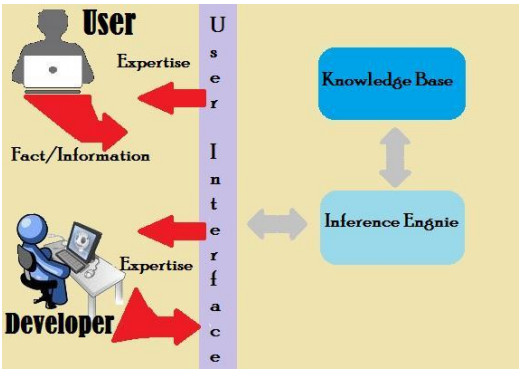

Figure 2: The figure presents the Main Components of an Expert System [17].

The proposed expert system for the diagnosis of banana diseases has been applied using Clips language with Delphi 10.2 as the user interface. It is a system of forward-thinking thinkers who can draw conclusions about the realities of the world using rules and things and take appropriate action as a result. Clips perform any expert system through the interfaces. It is easy for a knowledge engineer to build a system of experts and end users when they use the system.

2. MATERIALS AND METHODS

The proposed experts system diagnoses 9 banana diseases by presenting symptoms of all problems to the user to select from. The proposed expert system asks the user to choose from the symptoms list of all problems. At the end of the dialogue session, the proposed expert system provides the diagnosis and recommendations for the user. Figure 12-17 shows the main user interface of the system.

3. LITERATURE REVIEW

There are many expert systems designed to diagnose agricultural diseases such as potatoes, tomatoes and other diseases. However, there is no expert system for diagnosing banana diseases available for free. A few expert systems were developed to help farmers and specialists diagnose plant diseases using CLIPS [18, 19, 20]. The current expert system specializes in the diagnosis of banana diseases: Banana wilt; Mycosphaerella leaf spot, Yellow sigatoka, Black sigatoka; Anthracnose; Moko disease/bacterial wilt; Tip over or bacterial soft rot; Bunchy top/curly top; Banana bract mosaic virus (BBMV); Banana streak disease (BSV) and Infectious chlorosis (CMV).

1. KNOWLEDGE REPRESENTATION

The main sources of knowledge for this expert system are Vikaspedia and a specialized site for agricultural diseases. The captured knowledge was converted to the structure of the Clips database (rules and object rules). The expert system currently contains bases covering 9 banana diseases:

1. **Banana Wilt**

Disease symptoms:

- Yellowing of the lower most leaves starting from margin to midrib of the leaves.
- Yellowing extends upwards and finally heart leaf alone remains green for some time and it is also affected.
- The leaves break near the base and hang down around pseudostem.
- Longitudinal splitting of pseudostem. Discoloration of vascular vessels as red or brown streaks.

Survival and spread:

- The pathogen spreads through infected rhizomes.

Favorable conditions:

- Continuous cultivation in the infested field or monocroping results in buildup of inoculum.

Figure 3: shows the disease of banana wilt.

2. **Mycosphaerella leaf spot, yellow sigatoka, black sigatoka**

Disease symptoms:

- Early symptoms appear on the third or fourth leaf from the top, i.e., on young leaves.
- Small spindle shaped spots on foliage with greyish center and yellowish halo running parallel to veins.
- If the fruit is nearing maturity at the time of heavy infection, the flesh ripens but evenly and individual bananas appear undersized and their flesh develops a buff pinkish color, and store poorly.

Survival and spread:

- The conidia of the fungus are carried by wind ,rain water and old dried infected leaves and they help to spread the disease

Figure 4: shows the disease of Mycosphaerella leaf spot, yellow sigatoka, black sigatoka

3. **Anthracnose**

Disease symptoms:

- At the initial stage, small, circular, black spots develop on the affected fruits. Then these spots enlarge in size, turn to brown color.
- The skin of the fruit turns black and shrivels and becomes covered with characteristic pink acervuli. Finally the whole finger is affected. Later the disease spreads and affects the whole bunch.
- The disease results in premature ripening and shriveling of the fruits which are covered with pink spore masses.
- Occurrence if black lesions on the pedicel causes withering of the pedicel and dropping of the fingers from the hands.
- Sometimes the main stalk of the bunch may become diseased. Infected fruits become black and rotten.

Survival and spread:

- The spread of the disease is by air-borne conidia and numerous insects which frequently visit banana flowers also spread the disease.

Favorable conditions

- The disease is favored by high atmospheric temperature and humidity, wounds and bruises caused in the fruit and susceptibility of the variety


Figure 5: shows the disease of Anthracnose.

4. **Moko disease/bacterial wilt**

Disease symptoms:

- Leaves become yellow and progress upwards. The petiole breaks and leaves hang.
- When it is cut open discoloration in vascular region with pale yellow to dark brown color.
- The discoloration is in the central portion of the corm.
- Internal rot of fruits with dark brown discoloration.
- When the pseudostem is cut transversely bacterial ooze can be seen.

Survival and spread

- The bacterium survives in infected plant material, vegetative propagative organs, wild host plants, and soil.

Favorable conditions

- High temperatures and high soil moisture generally favors disease.


Figure 6: shows the disease of bacterial wilt

5. **Tip over or Bacterial soft rot**

Disease symptoms:

- This disease is more pronounced on young suckers leading to rotting and emitting of foul odor
- Roting of collar region is a commonest symptom followed by epinasty of leaves, which dry out suddenly
- If affected plants are pulled out it comes out from the collar region leaving the corm with their roots in the soil
- In early stage of infection dark brown or yellow water soaked areas are more in the cortex area When affected plants are cut open at collar region yellowish to reddish ooze is seen.

Survival and spread:

- Bacteria survive in crop debris and infect by water splash through damaged tissues.
- Worse in hot wet weather. The bacteria spread in contaminated water.

Favorable conditions:

- Higher temperatures and high humidity are ideal growing conditions for the bacteria

Figure 7: shows the disease of Bacterial soft rot

6. **Bunchy top/curly top**

Disease symptoms:

- Prominent dark green streaks on the petioles and midrib along the leaf veins.
- Marginal chlorosis and curling of leaves
- Petioles fail to elongate
- Leaves are reduced in size, chlorotic, stand upright and become brittle and are crowded at the top (Bunchy top) and shoe dark green streaks with 'J hook' shape near the midrib.
- Flowers display mottled and streaked discoloration
- Plants show marked stunting

Survival and spread:

- Vector: banana aphid, Pentalonia nigronervosa
- The disease can be spread by infected plant debris, plant wounds and injuries.

Favorable conditions:

- Hot and damp weather with plenty of rainfall trigger the disease to occur.

Figure 8: shows the disease of Bunchy top/curly top

7. **Banana bract mosaic virus (BBMV)**

Disease symptoms:

- The disease is characterized by the presence of spindle shaped pinkish to reddish streaks on pseudostem, midrib and peduncle
- Typical mosaic and spindle shaped mild mosaic streaks on bracts, peduncle and fingers also observed.
- Suckers exhibit unusual reddish brown streaks at emergence and separation of leaf sheath from central axis
- Clustering of leaves at crown with a travelers palm appearance, elongated peduncle and half-filled hands are its characteristic symptom.

Survival and spread:

- The disease is caused by a virus belonging to pot virus group. The virions are flexuous filamentous
- The virus is transmitted through aphid vectors such as Aphis gosypii, Pentolonia nigronervosa and Rhopalosiphum maids. In field the disease spread mainly through suckers

Figure 9: shows the disease of Banana bract mosaic virus

8. **Banana streak disease (BSV)**

Disease symptoms:

- A prominent symptom exhibited by BSV is yellow streaking of the leaves, which becomes progressively necrotic producing a black streaked appearance in older leaves.

Survival and spread:

- The virus is transmitted mostly through infected planting materials, though mealy bugs (Planococcus citric) and more probably Saccharicoccus sacchari are also believed to transmit it. Shoot tip culture does not eliminate it from vegetative propagated materials.

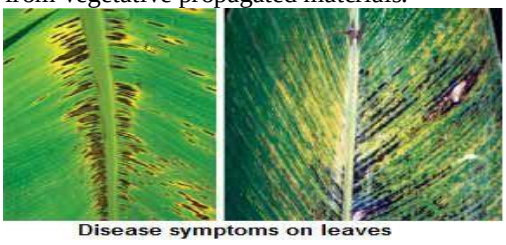

Figure 10: shows the disease of Banana streak disease (BSV)

9. **Infectious chlorosis (CMV)**

Disease symptoms:

- The disease manifests itself in all stages of crop growth.
- Due to repeated use of suckers from infected plants the disease spreads and resulting in the gradual decrease in yield and quality.
- The disease is known to occur in all banana-growing states.
- Light yellow streaks run parallel to leaf veins giving the leaf a striped appearance.
- The streaks run usually from mid rib to edge of the blade.

Survival and spread

- **Virus is disseminated by suckers and Aphis gossipy.**

Figure 11: shows the disease of Infectious chlorosis (CMV):

4. LIMITATIONS

The current system of experts specializes in diagnosing only the following 9 diseases: Banana wilt; Mycosphaerella leaf spot, Yellow sigatoka, Black sigatoka; Anthracnose; Moko disease/bacterial wilt; Tip over or bacterial soft rot; Bunchy top/curly top; Banana bract mosaic virus (BBMV); Banana streak disease (BSV) and Infectious chlorosis (CMV).

5. CONCLUSION

In this paper, a proposed expert system was introduced to help farmers, specialist, and students diagnose banana disease. Farmers, specialist and students can get a faster and more accurate diagnosis than the traditional method. This expert system does not require extensive training to use; it is easy to use and has an easy-to-use interface. The proposed expert system was developed using CLIPS and Delphi 10.2 language as the user interface.

6. FUTURE WORK

This expert system is a basis for the future. It is planned to add more banana diseases and make it easier for users from anywhere and at any time.

7. EXPERT SYSTEM IMAGES

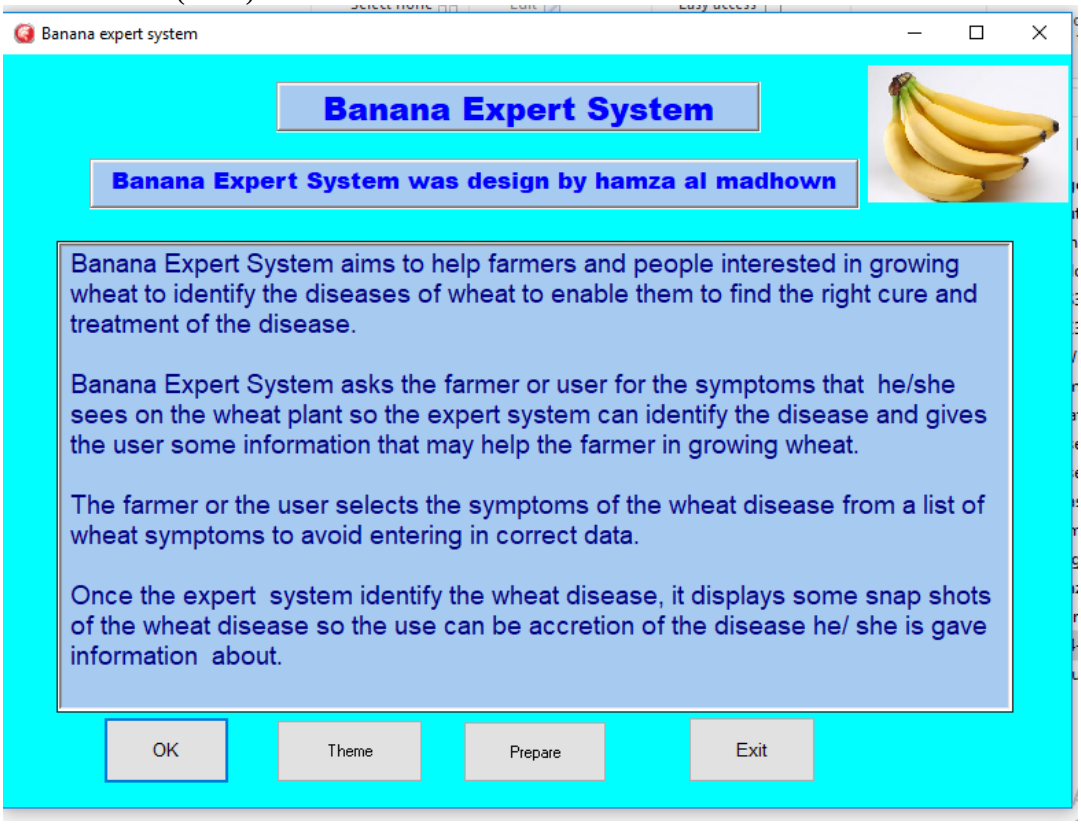

Figure 12: The main screen of the expert system.

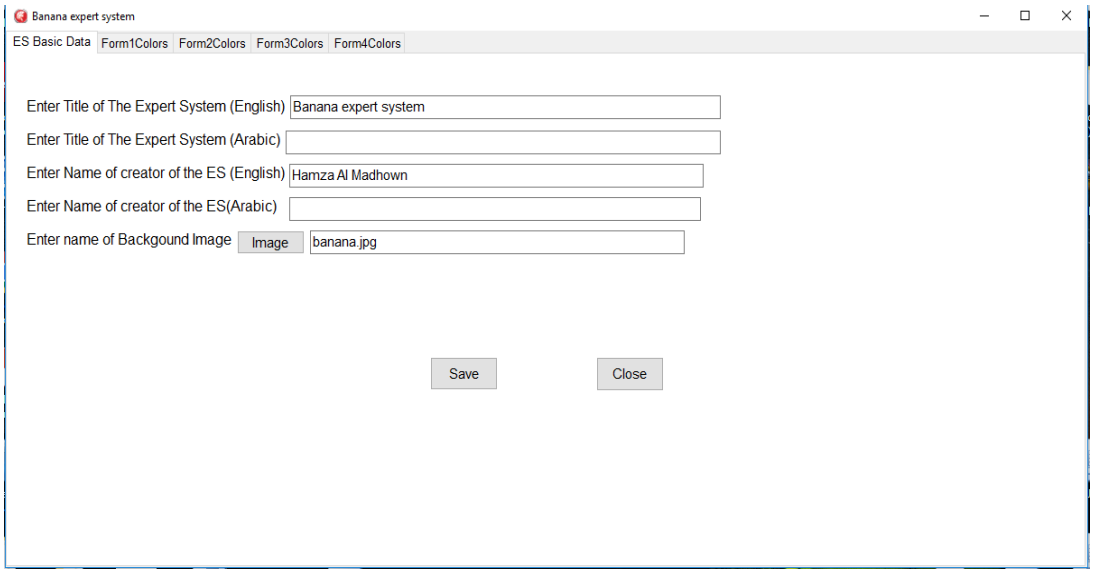

Figure 13: Add Info screen for the main interface.

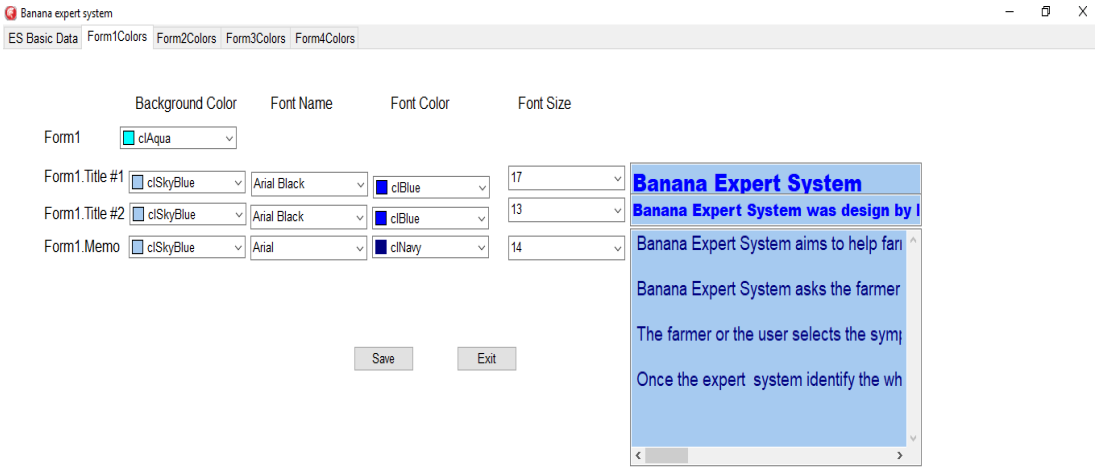

Figure 14: Main interface adjustment screen.

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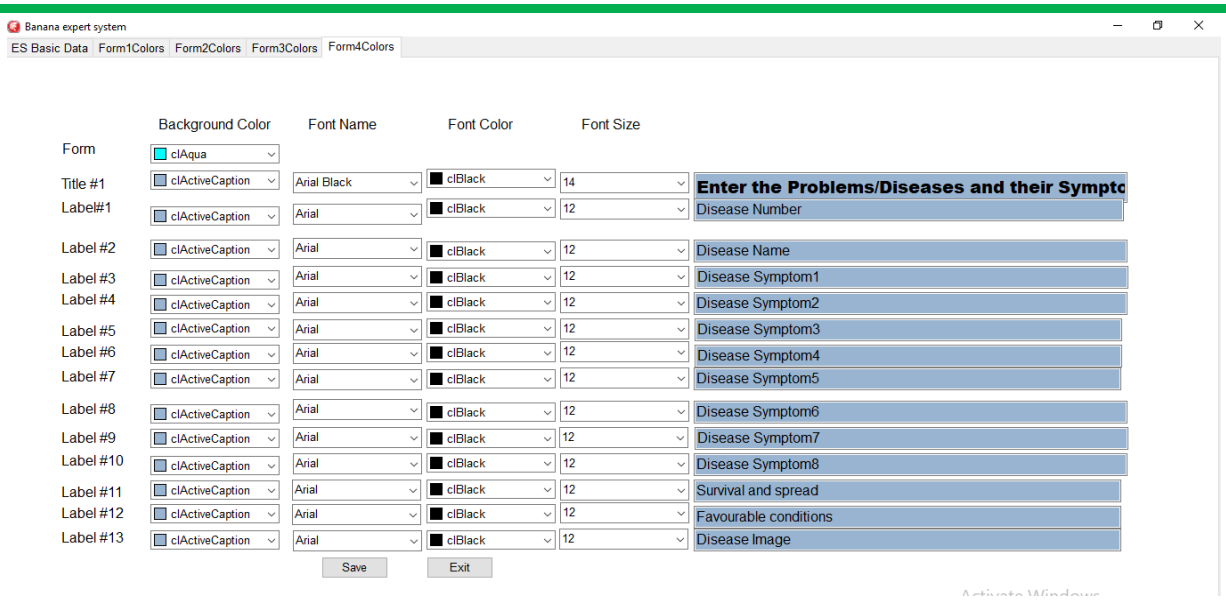

Figure 15: Screen Modifying User Interface.

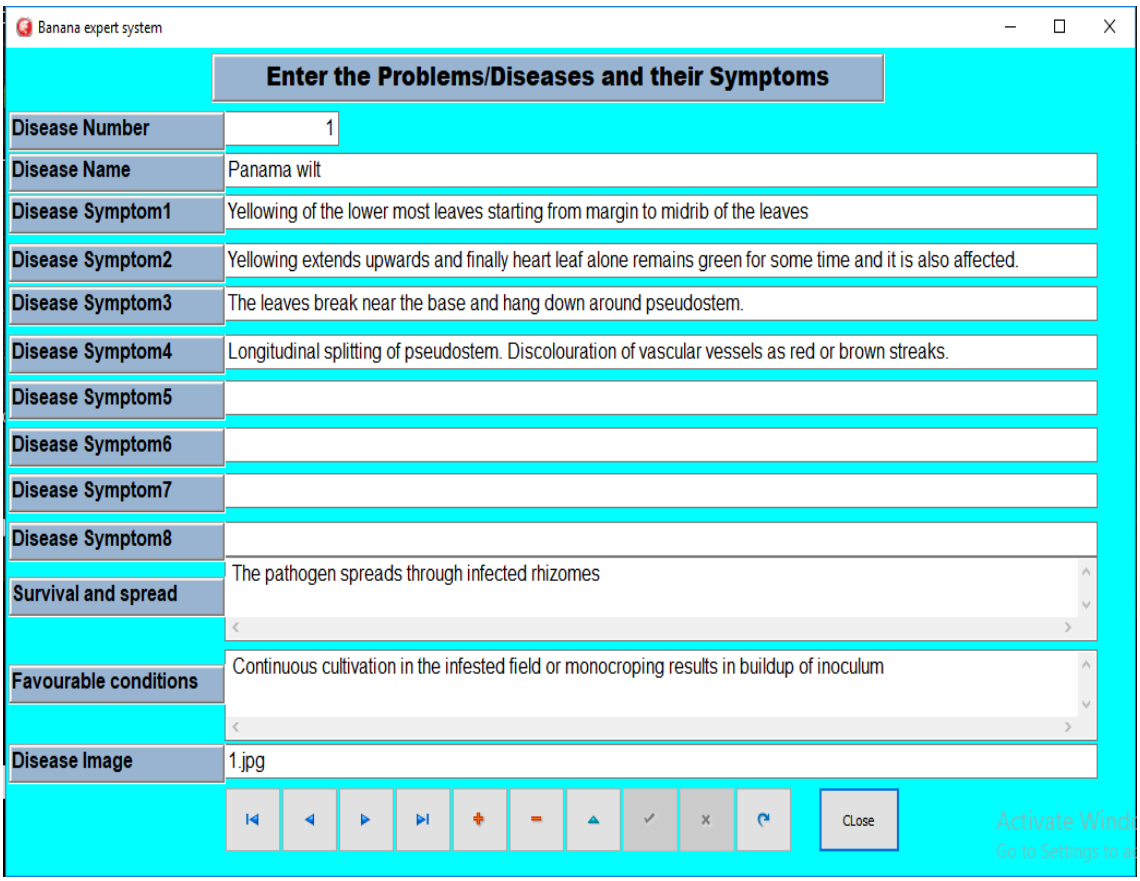

Figure 15: Screen Add Disease Interface.

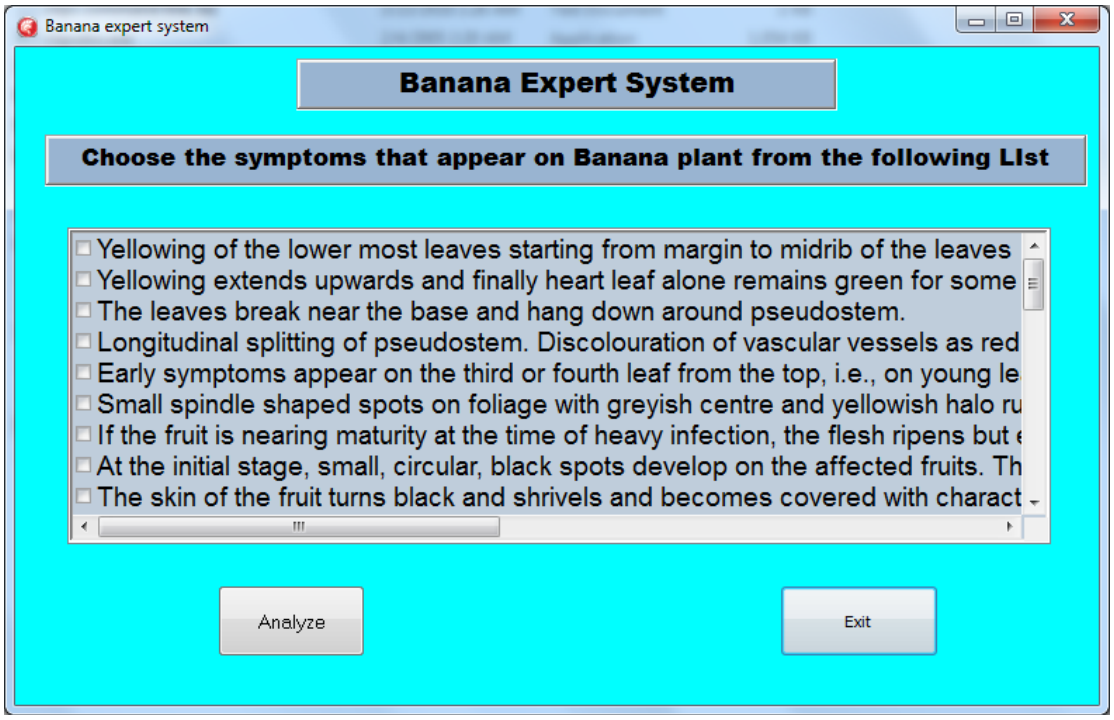

Figure 16: Screen selection sickness

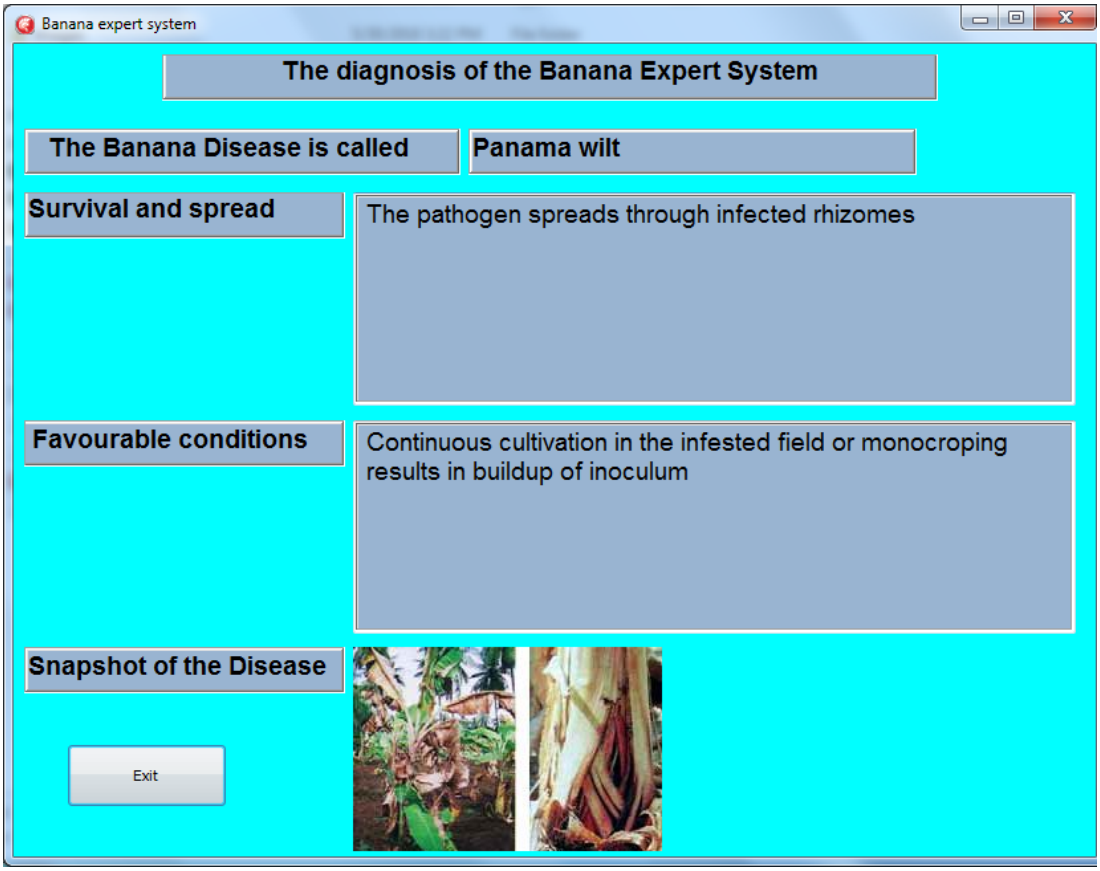

Figure 17: Screen shows the diagnosis of the banana disease

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