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A Proposed Expert System for Broccoli Diseases Diagnosis

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Abstract *: **Background**: Broccoli is an edible green plant in the cabbage family (family Brassicaceae, genus Brassica) whose large flowering head, stalk and small associated leaves are eaten as a vegetable. A leaf of Broccoli might be affected of Several Diseases descriped in this paper . When symptoms is encountered, it requires some kind of medical care. If appropriate Survival of Broccoli Diseases is not taken quickly, it can lead to Broccoli to die . **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 which was produced to help Farmers in diagnosing many of the broccoli diseases such as : Damping Off,Club root of crucifers or Finger and toe disease,Alternaria leaf spot,Black rot,Downy mildew, and White rust.*

Keywords: Artificial Intelligence, Expert Systems, CLIPS, broccoli diseases, Language.

1. INTRODUCTION

Broccoli is a fast-growing annual plant that grows 60–90 cm (24–35 inches) tall. Upright and branching with leathery leaves, broccoli bears dense green clusters of flower buds at the ends of the central axis and the branches. If left unharvested, those buds bear yellow flowers with four petals and produce silique fruits (a dry capsule).

Figure 1: The figure presents the structure of the broccoli.

Broccoli diseases in many places are not treated by plants specialists. Indeed, the presence of farmers and specialized centers for the treatment of plants is rare in much of the world. broccoli diseases are very common these days.

Diagnosis of broccoli diseases is a very complex. So they need farmers with wide experience of broccoli diseases. For all the aforementioned reasons, we have developed this expert system to help farmers in diagnosing many of the broccoli diseases, in order to prescribethe appropriate treatment .
Expert System is a computer application of Artificial Intelligence (AI) , which contains a knowledge base and an inference engine [3]; the main components and details are represented in figure 2.

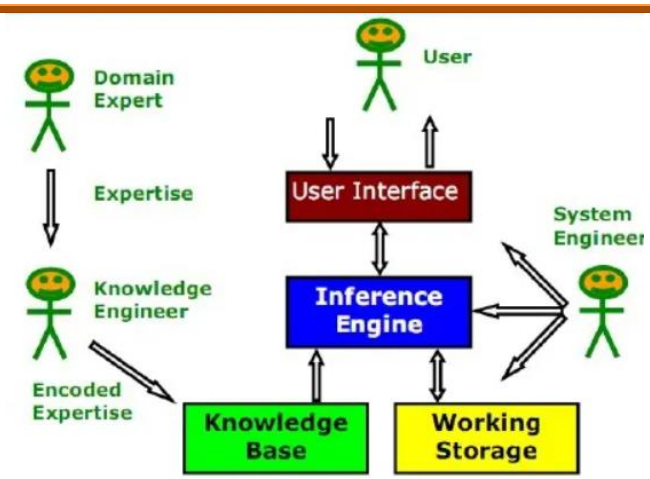

Figure 2: The figure presents the Main Components of an Expert System.

The proposed Expert System for broccoli Diseases Diagnosis was implemented using, clips. It is a forward chinning reasoning expert system that can make inferences about facts of the world using rules, objects and take appropriate actions as a result.It's 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 six broccoli diseases of all stages of the planet life. The proposed expert system will ask the user to choose the syptomes they see on the planet . At the end of the dialogue session, the proposed expert system provides the diagnosis and survival also the favourable conditions of the disease to the user. Figure 3 shows a sample dialogue between the expert system and the user. Figure 4 shows how the users get the diagnosis and recommendation.

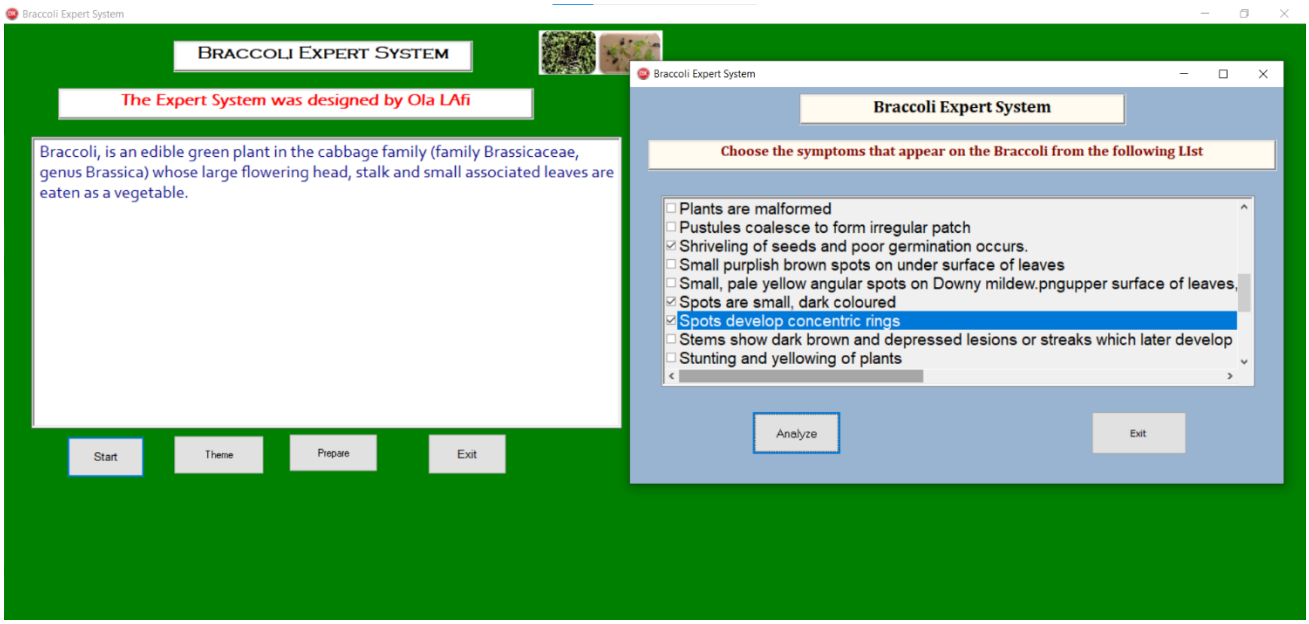

Figure 3: The figure presents shows when the system asks the user.

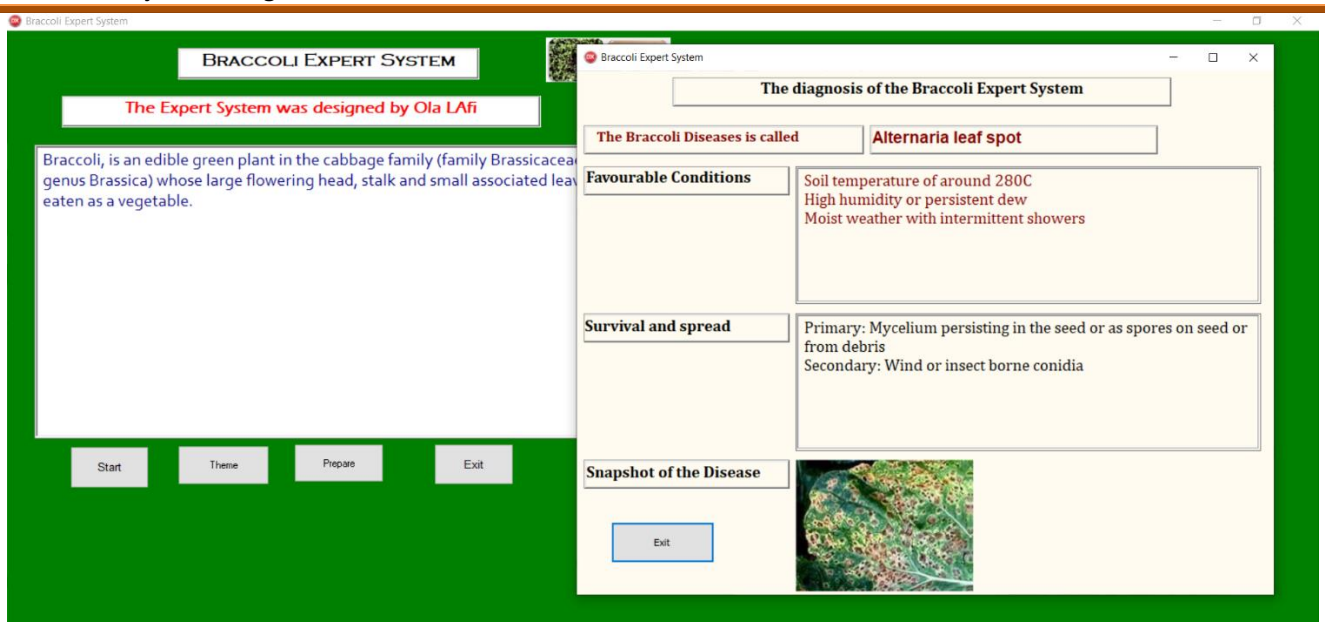

Figure 4: The figure shows diagnosis and recommendation of the expert system.

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 of broccoli diseases available free. That is why we are proposing expert system for diagnosing and treating broccoli problems.

4. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are Farmers and specializes websites for broccoli diseases. The captured knowledge has been converted into CLIPS base syntax (Facts, Rules). Currently the expert system has 10 rules which cover six broccoli diseases [1]:

Damping Off

Disease symptoms:

- Damping off occurs in two stages, i.e. the pre-emergence and the post-emergence phase.
- In the pre-emergence phase the seedlings are killed just before they reach the soil surface.
- The young radical and the plumule are killed and there is complete rotting of the seedlings.
- The post-emergence phase is characterized by the infection of the young, juvenile tissues of the collar at the ground level.
- The infected tissues become soft and water soaked. The seedlings topple over or collapse.

Figure 5: The figure shows Damping off problems

Club root of crucifers or Finger and toe disease

Disease symptoms:

- Stunting and yellowing of plants
- Leaves become yellowish and wilt on hot days.
- Club like swelling of root and rootlets
- Club root is particularly prevalent on soils with a pH below 7, whereas it has been observed that the disease is often less serious on heavy soils and on soils containing little organic matter.

Figure 6: The figure shows Club root problems

Alternaria leaf spot

Common on cabbage, cauliflower and mustard.

Disease symptoms:

- Spots are small, dark coloured
- They enlarge, soon become circular with a 1mm in diameter
- Under humid conditions groups of conidiophores will be formed in the spot
- Spots develop concentric rings
- Finally the spots coalesce leading to blighting of leaves.
- Shriveling of seeds and poor germination occurs.
- Linear spots also appear on petioles, stems, pods and seeds

Figure 7: The figure shows Alternaria leaf spot problems

Black rot

Serious on cabbage, cauliflower, knol-khol and radish
Disease symptoms:

- First appear as chlorotic or yellow (angular) areas near the leaf margins
- Yellow area extends to veins and midrib forming characteristic 'v' shaped chlorotic spotswhich later turn black
- Veins and veinlets turn brown and finally black
- Vascular blackening extend beyond affected veins to midrib, petiole and stem
- In advanced stages, infection may reach the roots system and blackening of vascular bundles occurs. Bacterial ooze can also be seen on affected parts
- If the infection is early, the plants wilt and die
- If the infection is late plants succumb to soft rot and die.

Downy mildew

Severe in radish, cabbage, cauliflower, mustard and knol-khol.
Disease symptoms:

- Small purplish brown spots on under surface of leaves
- Small, pale yellow angular spots on upper surface of leaves, with downy growth on the under surface. The spots coalesce and the leaves shrivel and dries up prematurely
- In cabbage, these spots expose the heads to soft rot
- Cauliflower curds look brownish
- Stems show dark brown and depressed lesions or streaks which later develop downy growth of fungus.

Figure 8: The figure shows Downy mildew problems

White rust

Disease symptoms:

- White, shiny raised blisters (pustules) on the lower surfaces of leaves, stems and flowers
- Pustules coalesce to form irregular patches
- The epidermis ruptures exposing white spore mass which gives the pustule a powdery appearance
- Distortion of the floral parts including petals, pistils and anthers due to hypertrophy and hyperplasia
- Plants are malformed

Figure 9: The figure shows White rust problems

5. LIMITATIONS

The current proposed expert system is specialized in the diagnosis only the following six broccoli diseases : Expert System which was produced to help Farmers in diagnosing many of the broccoli diseases such as : Damping Off,Club root of crucifers or Finger and toe disease,Alternaria leaf spot,Black rot,Downy mildew,White rust

6. SYSTEM EVALUATION

As a preliminary evolution, Mr.Sameer Nahal and other farmers 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 in diagnosing patients with six different possible broccoli diseases. Farmers and who's intersted in farming 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 developed using CLIPS Expert System language.

8. FUTURE WORK

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

9. EXPERT SYSTEM SOURCE CODE

(defrule disease1

(Damping off occurs in two stages, i.e. the pre-emergence and the post-emergence phase.)
(In the pre-emergence phase the seedlings are killed just before they reach the soil surface.)
(The infected tissues become soft and water soaked. The seedlings topple over or collapse.)
(The post-emergence phase is characterized by the infection of the young, juvenile tissues of the collar at the ground level.)
(The young radical and the plumule are killed and there is complete rotting of the seedlings.)

```
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "1"  crlf )
)
(defrule disease2
(Stunting and yellowing of plants)
(Leaves become yellowish and wilt on hot days.)
(Club like swelling of root and rootlets)
(Club root is particularly prevalent on soils with a pH below 7, whereas it has been observed that the disease is often less serious on heavy soils and on soils containing little organic matter.)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "2"  crlf )
)
(defrule disease3
(Spots are small, dark coloured)
(They enlarge, soon become circular with a 1mm in diameter)
(Spots develop concentric rings)
(Finally the spots coalesce leading to blighting of leaves.)
(Shriveling of seeds and poor germination occurs.)
(Linear spots also appear on petioles, stems, pods and seeds)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "3"  crlf )
)
(defrule disease4
(First appear as chlorotic or yellow (angular) areas near the leaf margins)
(Yellow area extends to veins and midrib forming characteristic ‘v’ shaped chlorotic spotswhich later turn black)
(Veins and veinlets turn brown and finally black)
(Vascular blackening extend beyond affected veins to midrib, petiole and stem)
(In advanced stages, infection may reach the roots system and blackening of vascular bundles occurs. Bacterial ooze can also be seen on affected parts)
(If the infection is early, the plants wilt and die)
(If the infection is late plants succumb to soft rot and die.)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "4"  crlf )
)
(defrule disease5
(Small purplish brown spots on under surface of leaves)
(Small, pale yellow angular spots on Downy mildew.pngupper surface of leaves, with downy growth on the under surface. The spots coalesce and the leaves shrivel and dries up prematurely)
(In cabbage, these spots expose the heads to soft rot)
(Cauliflower curds look brownish)
(Stems show dark brown and depressed lesions or streaks which later develop downy growth of fungus.)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "5"  crlf )
)
```

```
(defrule disease6
(White, shiny raised blisters (pustules) on the lower surfaces of leaves, stems and flowers)
(Pustules coalesce to form irregular patches)
(The epidermis ruptures exposing white spore mass which gives the pustule a powdery appearance)
(Distortion of the floral parts including petals, pistils and anthers due to hypertrophy and hyperplasia)
(Plants are malformed)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "6"  crlf )
)
(defrule endline
(disease identified)
=>
  (close fdatao)
)
(defrule readdata
  (declare (salience 1000))
  (initial-fact)
  ?fx <- (initial-fact)
=>
  (retract ?fx)
  (open "data.txt" fdata "r")
  (open "result.txt" fdatao "w")
  (bind ?symptom1 (readline fdata))
  (bind ?symptom2 (readline fdata))
  (bind ?symptom3 (readline fdata))
  (bind ?symptom4 (readline fdata))
  (bind ?symptom5 (readline fdata))
  (bind ?symptom6 (readline fdata))
  (bind ?symptom7 (readline fdata))
  (bind ?symptom8 (readline fdata))
  (bind ?symptom9 (readline fdata))
  (bind ?symptom10 (readline fdata))
  (bind ?symptom11 (readline fdata))
  (bind ?symptom12 (readline fdata))
  (bind ?symptom13 (readline fdata))
  (bind ?symptom14 (readline fdata))
  (assert-string (str-cat "(" ?symptom1 ")"))
  (assert-string (str-cat "(" ?symptom2 ")"))
  (assert-string (str-cat "(" ?symptom3 ")"))
  (assert-string (str-cat "(" ?symptom4 ")"))
  (assert-string (str-cat "(" ?symptom5 ")"))
  (assert-string (str-cat "(" ?symptom6 ")"))
  (assert-string (str-cat "(" ?symptom7 ")"))
  (assert-string (str-cat "(" ?symptom8 ")"))
  (assert-string (str-cat "(" ?symptom9 ")"))
  (assert-string (str-cat "(" ?symptom10 ")"))
  (assert-string (str-cat "(" ?symptom11 ")"))
  (assert-string (str-cat "(" ?symptom12 ")"))
  (assert-string (str-cat "(" ?symptom13 ")"))
  (assert-string (str-cat "(" ?symptom14 ")"))

   (close fdata))
```

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