

An Expert System for Sesame Diseases Diagnosis Using CLIPS

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Abstract: Background: Sesame is a flowering plant in the genus *Sesamum* also called benne. Numerous wild relatives occur in Africa and a smaller number in India. It is widely naturalized in tropical regions around the world and is cultivated for its edible seeds, which grow in pods or "buns". World production in 2016 was 6.1 million tons, with Tanzania, Myanmar, India, and Sudan as the largest producers. Sesame seed is one of the oldest oilseed crops known, domesticated well over 3000 years ago. *Sesamum* has many other species, most being wild and native to sub-Saharan Africa. *Sesamum indicum*, the cultivated type, originated in India and is tolerant to drought-like conditions, growing where other crops fail. **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 Agriculture experts in diagnosing many of the sesame diseases such as: Phyllody, Dry root rot, *Phytophthora* blight and *Alternaria* blight. The proposed expert system presents an overview about sesame diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS Expert System and Delphi languages were used for designing and implementing the proposed expert system. **Evaluation:** The expert system in the diagnosis of Sesame diseases was assessed by farmers and agricultural engineers and they were satisfied with its quality of performance and ease of use. **Conclusions:** The Proposed expert system is very useful for Agriculture experts, patients with sesame problems and newly graduated Agricultural students.

Keywords: Artificial Intelligence, Expert Systems, CLIPS, sesame diseases, agricultural experts.

1. INTRODUCTION

Sesame seed is considered to be the oldest oilseed crop known to humanity. The genus has many species, and most are wild. Most wild species of the genus *Sesame* are native to sub-Saharan Africa. *S. indicum*, the cultivated type, originated in India.

Archaeological remnants suggest Sesame was first domesticated in the Indian subcontinent dating to 5500 years ago. Charred remains of sesame recovered from archeological excavations have been dated to 3500-3050 BC. Fuller claims trading of sesame between Mesopotamia and the Indian subcontinent occurred by 2000 BC. Some reports claim sesame was cultivated in Egypt during the Ptolemaic period, while others suggest the New Kingdom. Records from Babylon and Assyria, dating about 4000 years ago, mention sesame. Egyptians called it sesemt, and it is included in the list of medicinal drugs in the scrolls of the Ebers Papyrus dated to be over 3600 years old. Archeological reports from Turkey indicate that sesame was grown and pressed to extract oil at least 2750 years ago in the empire of Urartu. The historic origin of sesame was favored by its ability to grow in areas that do not support the growth of other crops. It is also a robust crop that needs little farming support it grows in drought conditions, in high heat, with residual moisture in soil after monsoons are gone or even when rains fail or when rains are excessive. It was a crop that could be grown by subsistence farmers at the edge of deserts, where no other crops grow. Sesame has been called a survivor crop. (look to the Fig1 : sesame plant).



Fig1: sesame plant

Diagnosis of sesame diseases is a very complex because the sesame plant is small in size and other diseases may affect the plant. So they need Agriculture expert with wide experience of sesame diseases. For all the aforementioned reasons, we have developed this expert system to help Agriculture expert in diagnosing many of the sesame diseases, in order to prescribe the appropriate treatment.

Expert System is a computer application of Artificial Intelligence (AI)[16-20] , which contains a knowledge base and an inference engine , the main components and details are represented in Fig 2.

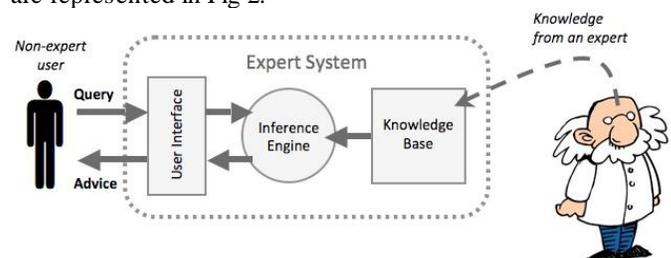


Fig 2 : Expert System

The proposed Expert System for Sesame Diseases Diagnosis was implemented using, CLIPS language which stands for C Language Integrated Production System. It is a forward chinning reasoning expert system that can make inferences about facts of the world using rules, facts and take appropriate actions as a result.

2. MATERIALS AND METHODS

The proposed expert system performs diagnosis for four sesame diseases of all stages of the sesame plant by choosing the symptoms that appear into plants. The proposed expert system will ask the user to choose the symptoms that appear into plants. At the end of the dialogue session, the proposed expert system provides the diagnosis and recommendation of the disease to the user. Fig 3 shows a sample dialogue between the expert system and the user. Fig 4 shows how the users get the diagnosis and recommendation.

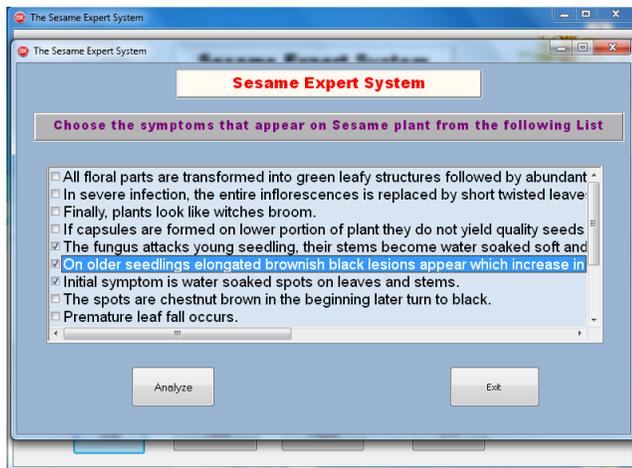


Fig 3 : sample dialogue between the expert system and the user



Fig 4 shows how the users get the diagnosis and recommendation.

3. LITERATURE REVIEW

There are many expert systems that are developed for diagnosing human medical problems like [32-43, 51], plant and trees problem like: general plant [4], mango [8], Black pepper [2], banana [1, 38] onion [3], potato [30], Pineapple [6], watermelon [4] and other kinds of diseases[52-60] . But there is no specialized expert system for diagnosing sesame diseases available free. Although many plant diseases have common symptoms. The proposed expert system was designed and developed specifically to aid farmers in diagnosing sesame diseases. Some of these Expert Systems are specialized in one specific disease and others in five diseases; but the current proposed expert system is specialized in the diagnosis of four sesame diseases : Phyllody, Dry root rot, Phytophthora blight and Alternaria blight.

4. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are Agriculture experts and specializes websites for sesame diseases. The captured knowledge has been converted into CLIPS Knowledge base syntax(Facts and Rules).

Phyllody (Phytoplasma): All floral parts are transformed into green leafy structures followed by abundant vein clearing in different flower parts.

In severe infection, the entire inflorescences is replaced by short twisted leaves closely arranged on a stem with short internodes, abundant abnormal branches bend down. Finally, plants look like witches broom. If capsules are formed on lower portion of plant they do not yield quality seeds.

Transmission and favourable conditions: The disease is transmitted through jassids and the phytoplasma survives in leaf hopper throughout its life.



Fig 5 : sesame phyllody

Dry Root Rot : The fungus attacks young seedling, their stems become water soaked soft and incapable of supporting the seedling which falls over and dies.

On older seedlings elongated brownish black lesions appear which increase in length and width girdling the stem and plant dies.

Survival and spread: The pathogen survives in seed and soil.

Favourable conditions: High soil temperatures and moisture stress conditions favour the development of the pathogen.



Fig 6 : sesame Dry Root Rot

Phytophthora blight: Disease can occur at all stages of the plant.

- Initial symptom is water soaked spots on leaves and stems.
- The spots are chestnut brown in the beginning later turn to black.
- Premature leaf fall occurs.
- In humid weather, severity of disease increases, main root is affected, diseased plants are easily pulled out and produce shriveled seeds and gives blighted appearance.

Survival and spread: The pathogen survives in soil.

Favourable conditions: High soil moisture favours the development of the pathogen. The disease is severe in the area of heavy soil with high rainfall.



Fig 7 : sesame Phytophthora blight

Alternaria blight: The pathogen attacks all parts of the plant at all stages.

Small, dark brown water soaked, round to irregular lesions, with concentric rings, 1-8 mm in diameter appear on the leaves and under excessive atmospheric and soil humidity the spot increases in size and number.

The lesions may also appear on the midrib and veins of the leaves.

Milder attacks cause only defoliation, in severe cases the plant may die.

Transmission and favourable conditions: The pathogen is seed borne. Temperature of 20-30o C and high humid conditions favour the disease.

5. LIMITATIONS

The current proposed expert system is specialized in the diagnosis only the following four sesame diseases: Phyllody, Dry root rot, Phytophthora blight and Alternaria blight.

6. CONCLUSION:

In this paper, a proposed expert system was presented for helping Agriculture experts in diagnosing patients with four different possible sesame diseases. Agriculture experts and sesame diseases patients 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 and Delphi languages.

7. FUTURE WORK:

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

8. EXPERT SYSTEM SOURCE CODE:

```
;;;=====
;;; Sesame Expert System
;;;
;;; This expert system diagnoses some of the sesame
;;; problems.
;;;
;;; To execute, merely load, reset and run.
;;;=====
```

```
..*****
;;
;:* DEFFUNCTIONS *
..*****
;;
```

```
(deffunction ask-question (?question $?allowed-values)
  (printout t ?question)
  (bind ?answer (read))
  (if (lexemep ?answer)
      then (bind ?answer (lowcase ?answer)))
  (while (not (member ?answer ?allowed-values)) do
    (printout t ?question)
    (bind ?answer (read)))
```

```

(if (lexemep ?answer)
  then (bind ?answer (lowercase ?answer)))
?answer)

(defun yes-or-no-p (?question)
  (bind ?response (ask-question ?question yes no y n))
  (if (or (eq ?response yes) (eq ?response y))
    then TRUE
    else FALSE))

(defrule d1-s1 ""
  (not (d1-s1 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d1 s1 (yes/no)?")
    then
      (assert (d1-s1 yes))
      else (assert (d1-s1 no))
    )
  )

(defrule d1-s2 ""
  (d1-s1 yes)
  (not (d1-s2 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d1 s2 (yes/no)?")
    then
      (assert (d1-s2 yes))
      else (assert (d1-s2 no))
    )
  )

(defrule d1-s3 ""
  (d1-s2 yes)
  (not (d1-s3 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d1 s3 (yes/no)?")
    then
      (assert (d1-s3 yes))
      else (assert (d1-s3 no))
    )
  )

(defrule d1-s4 ""
  (d1-s3 yes)
  (not (d1-s4 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d1 s4 (yes/no)?")
    then
      (assert (d1-s4 yes) (disease "Phyllody"))
      else (assert (d1-s4 no))
    )
  )

)

)

(defrule d2-s1 ""
  (or (d1-s1 no) (d1-s2 no) (d1-s3 no) (d1-s4 no))
  (not (d2-s1 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d2 s1 (yes/no)?")
    then
      (assert (d2-s1 yes))
      else (assert (d2-s1 no))
    )
  )

)

(defrule d2-s2 ""
  (d2-s1 yes)
  (not (d2-s2 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d2 s2 (yes/no)?")
    then
      (assert (d2-s2 yes) (disease "Dry root rot"))
      else (assert (d2-s2 no))
    )
  )

)

(defrule d3-s1 ""
  (or (d1-s1 no) (d1-s2 no) (d1-s3 no) (d1-s4 no))
  (or (d2-s1 no) (d2-s2 no))
  (not (d3-s1 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d3 s1 (yes/no)?")
    then
      (assert (d3-s1 yes))
      else (assert (d3-s1 no))
    )
  )

)

)

(defrule d3-s2 ""
  (d3-s1 yes)
  (not (d3-s2 ?))
  (not (disease ?))
  =>
  (if (yes-or-no-p "Does the sesame have d3 s2 (yes/no)?")
    then
      (assert (d3-s2 yes))
      else (assert (d3-s2 no))
    )
  )

)

)

(defrule d3-s3 ""
  (d3-s2 yes)

```

```

(not (d3-s3 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d3 s3 (yes/no)?")
    then
      (assert (d3-s3 yes) )
      else (assert (d3-s3 no))
    )
)

(defrule d3-s4 ""
(d3-s3 yes)
(not (d3-s4 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d3 s4 (yes/no)?")
    then
      (assert (d3-s4 yes) (disease "Phytophthora blight"))
      else (assert (d3-s4 no))
    )
)

(defrule d4-s1 ""
(or (d1-s1 no) (d1-s2 no) (d1-s3 no) (d1-s4 no) )
(or (d2-s1 no) (d2-s2 no) )
(or (d3-s1 no) (d3-s2 no) (d3-s3 no) (d3-s4 no) )
(not (d4-s1 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d4 s1 (yes/no)?")
    then
      (assert (d4-s1 yes) )
      else (assert (d4-s1 no))
    )
)

(defrule d4-s2 ""
(d4-s1 yes)
(not (d4-s2 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d4 s2 (yes/no)?")
    then
      (assert (d4-s2 yes) )
      else (assert (d4-s2 no))
    )
)

(defrule d4-s3 ""
(d4-s2 yes)
(not (d4-s3 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d4 s3 (yes/no)?")
    then
      (assert (d4-s3 yes) )
      else (assert (d4-s3 no))
    )
)

(defrule d4-s4 ""
(d4-s3 yes)
(not (d4-s4 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d4 s4 (yes/no)?")
    then
      (assert (d4-s4 yes) (disease "four"))
      else (assert (d4-s4 no))
    )
)

(or (d1-s1 no) (d1-s2 no) (d1-s3 no) (d1-s4 no) )
(or (d2-s1 no) (d2-s2 no) )
(or (d3-s1 no) (d3-s2 no) (d3-s3 no) (d3-s4 no) )
(not (d4-s1 ?))
(not (disease ?))
=>
(if (yes-or-no-p "Does the sesame have d4 s1 (yes/no)?")
    then
      (assert (d4-s1 yes) )
      else (assert (d4-s1 no))
    )
)

(defrule system-banner ""
(declare (salience 10))
=>
(printout t crlf crlf)
(printout t "The Sesame Expert System")
(printout t crlf crlf)
)

(defrule print-disease ""
(declare (salience 10))
(disease ?item)
=>
(printout t crlf crlf)
(printout t "The disease name is:")
(printout t crlf crlf)
(format t " %s%n%n%n" ?item))
)

...*****
...* STARTUP AND DIAGNOSIS RULES *
...*****

```

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