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A Proposed Expert System for Passion Fruit Diseases

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Abstract*: Plant diseases are numerous in the world of agriculture. These diseases cause a lot of trouble to most farmers. Among these common diseases, we single out the diseases that affect the Passion fruit, which is affected by about seven diseases, with different symptoms for each disease. Today, technology is facilitating human life in all areas of life, and among these facilities are expert system, a computer program that uses artificial-intelligence methods to solve problems within a specialized domain that ordinarily requires human expertise. The first expert system was developed in 1965 by Edward Feigen Baum and Joshua Lederberg of Stanford University in California, U.S. Dendral, as their expert system was later known, was designed to analyses chemical compounds. Expert systems now have commercial applications in fields as diverse as medical diagnosis, petroleum engineering, and financial investing and other areas, and with reference to expert systems and their importance to humans, an integrated expert system has been created in the agricultural field that diagnoses Passion diseases using CLIPS Expert System language. The system was used to design and implement the proposed expert system. The system facilitates the diagnosis of Passion -related diseases. There is no doubt that this expert system will help farmers and those involved in the agricultural field to diagnose Passion -related diseases.* ***Objectives****: is to help farmers diagnose Passion diseases in the correct way and how to treat these diseases*. ***Method:*** *The system contains a program project that diagnoses 7 diseases that affect Passion and the seven diseases are: Brown spot, Septoria spot, Root and crown rot, Fusarium wilt, Anthracnose, Woodiness virus, Scab.* ***Results:*** *The expert system was evaluated by farmers and praised for helping them with it.* ***Conclusion****: The expert system for diagnosing Passion diseases is effective and usable.*

Keywords: Expert Systems, CLIPS, Passion Fruits, Diseases.

INTRODUCTION

Plant diseases in the world of agriculture are many and different. These diseases cause a lot of trouble to most farmers. One of these common diseases is the diseases of Passion fruits, which are affected by about 7 different diseases with different symptoms for each disease. Passion trees are affected by a large number of diseases and can be infected with them, whether it is a house tree or planted for commercial purposes. Not all diseases affect Passion trees at once. They appear in a regular sequence depending on the weather and the development of the cause, and managing the disease for one season can improve the quantity and quality of the fruits the tree produces.

Figure 1: One of the Passion diseases

today technology works to facilitate life for humans in all areas of life, and among these facilities are the expert systems that have become part of It is not part of human life as it contains several systems and areas, for example: Artificial Intelligence (AI), [2] which refers to systems or devices that simulate human intelligence to perform tasks and which can improve themselves based on some human information, and other areas, and by reference To expert systems and their importance to humans, an integrated expert system has been established in the agricultural field that works to diagnose Passion diseases using CLIPS Expert System language was used to design and implement the proposed expert system. There is no doubt that this expert system will help farmers and those involved in the agricultural field in diagnosing diseases related to Passion fruit.

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MATERIAL AND METHOD

The intended expert system diagnoses seven "primary" diseases of the Passion fruit that are related to the fruit. At first, the system gives a simple overview of the system in general. As in Figure 2 below.

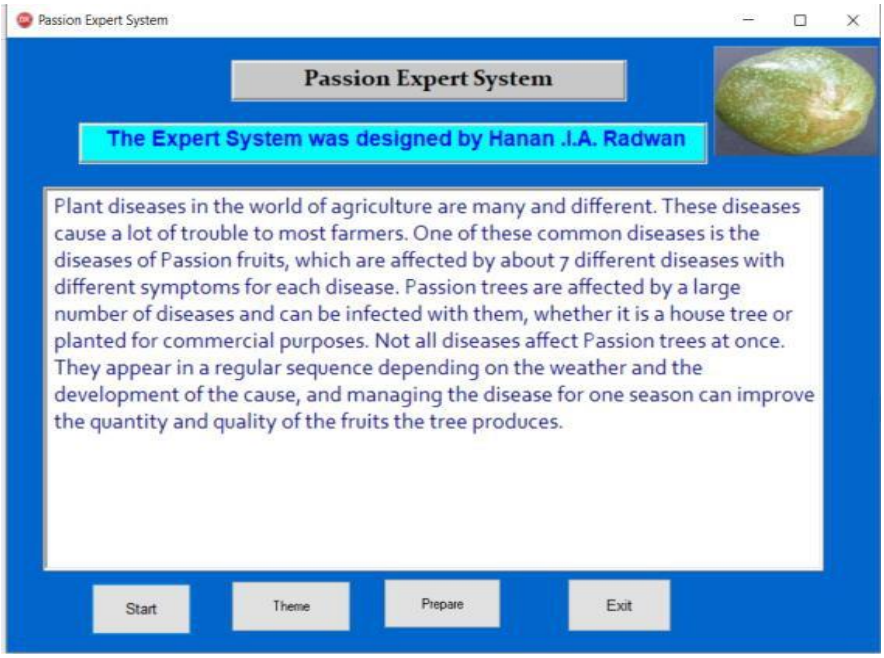

Figure 2: The Main Interface for ES

When clicking on the "Start" icon, the user will be directed to an interface consisting of a set of symptoms arranged alphabetically in order to facilitate the user in using the system. . Figure 3 below shows, next, the user selects symptoms from the list attached to the image below, and these symptoms are initially alphabetized to facilitate diagnosis of the passion disease.

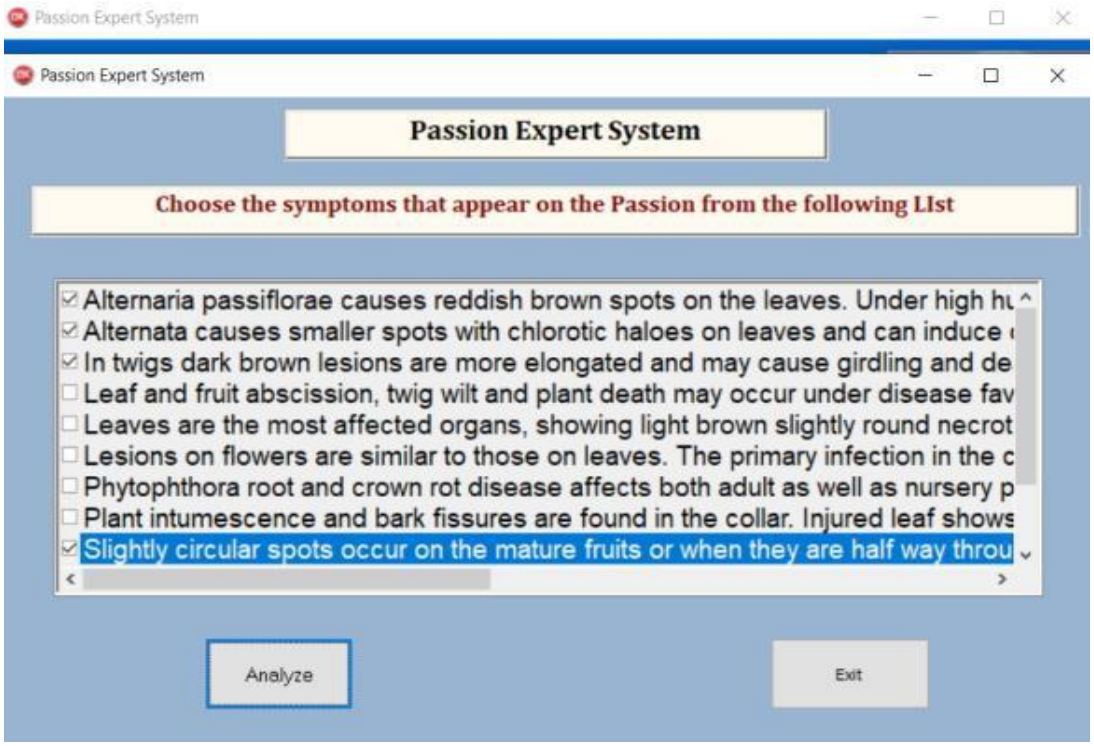

Figure 3: The Diagnosis Interface

After identifying the symptoms of the disease, the user presses "Analysis" to go to the new interface of the analysis process, and this interface consists of Survival and spread and Favourable conditions, then a picture of that disease attached to its data.

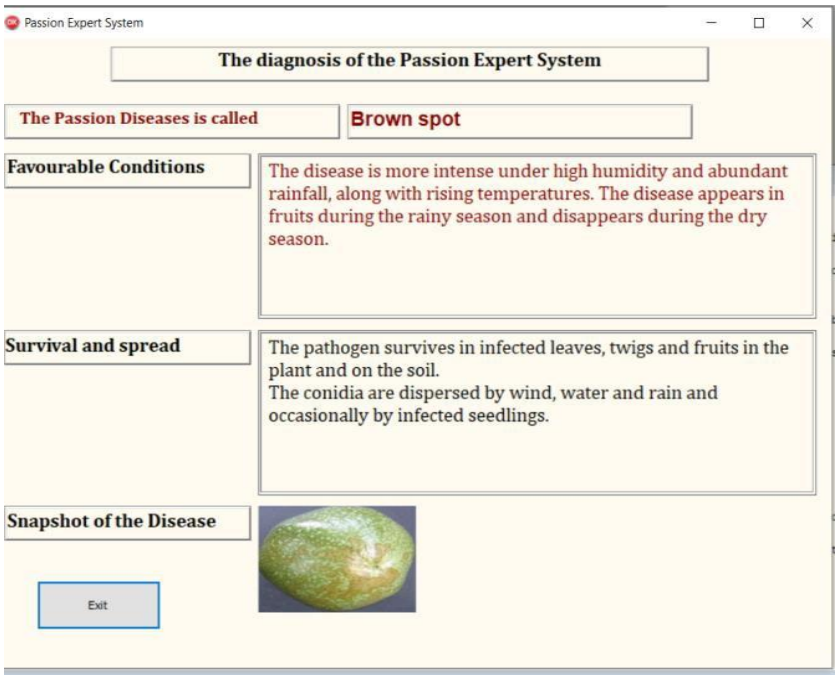

Figure 4: Analyze Diseases

After that, we can add or modify disease symptoms through the "Preparation" page.

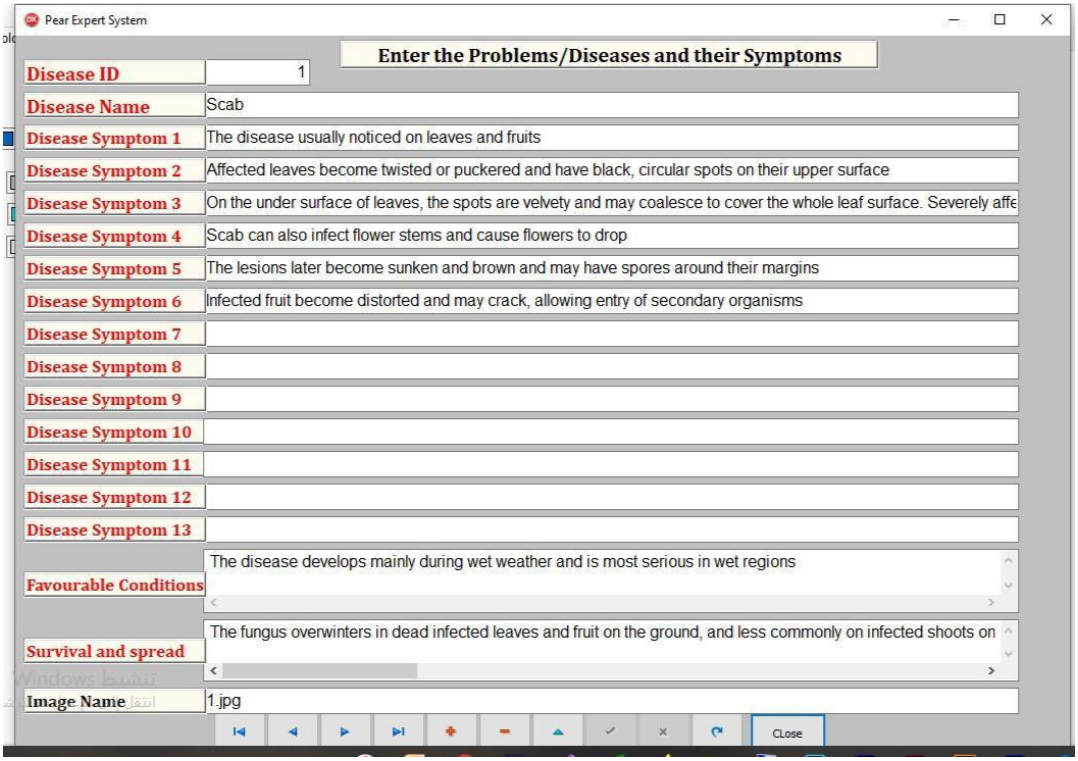

Figure 5: Program Interface

LETERATURE REVIEW

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.

Comments about previous studies

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

KNOWLEDGE REPRESTATION

As we said earlier, the expert system diagnoses 7 diseases of the passion fruit, all of these diseases have been listed with symptoms and based on these symptoms, the disease will be diagnosed and treated correctly, and in detail these diseases are[70]:

Brown spot

Alternaria passiflorae causes reddish brown spots on the leaves. Under high humidity, spots normally grow larger up to 2 cm in diameter become round and zonate .Spores can form a black thin mass covering the middle of the lesion, being more abundant on the abaxial surface. Abscission of the affected leaves occur rapidly causing intense defoliation. In twigs dark brown lesions are more elongated and may cause girdling and death of the terminal portion of these organs. Slightly circular spots occur on the mature fruits or when they are half way through their growth process. They are reddish brown, sunken affecting the pulp and damaging the commercial value. Alternate causes smaller spots with chlorotic haloes on leaves and can induce defoliation. The stem lesions rarely kill vines. Spots on fruits have dark green and greasy margins.

Figure 6: Brown spot

Septoria spot

Leaves are the most affected organs, showing light brown slightly round necrotic spots normally encircled by a chlorotic halo. A single lesion per leaf is sufficient to cause abscission, and even leaves without visible symptoms may fall prematurely. When the disease reaches 15-20% of leaves in the same plant, partial or even complete leaf abscission is observed. In young twigs, lesions may promote girdling leading to wilt and twig tips death. Lesions on flowers are similar to those on leaves. The primary infection in the calyx may reach the stalk, causing the early drop of flowers. The infection may occur at any stage of the development of the fruits, affecting maturation or development. Leaf and fruit abscission, twig wilt and plant death may occur under disease favoring conditions.

Figure 7: Septoria spot

Root and Crown rot

Phytophthora root and crown rot disease affects both adult as well as nursery plants. Mild cholorosis is followed by wilting, defoliation and death. Cortical tissues of the plants are exposed. Plant intumescence and bark fissures are found in the collar. Injured leaf shows a burned appearance. Occurrence of foliar blight followed by drop of flowers is observed. There is a change in leaf color from colorless to pale green, with leaves reaching a light copper colour. The affected plant shows burned -like black twig tips and flowers which eventually die. Large grayish- green aqueous spots can be viewed in fruits, which easily fall down.

Figure 8: Root and Crown rot

Fusarium wilt

The glossy green leaves of young passion fruit plants show a pale green colour and mild die back. Drop of lower leaves, general plant wilting and sudden death take place as the disease progresses. In adult plants, the disease causes yellowing of young leaves, followed by plant wilt and death. Symptom development may be unilateral or encompasses the entire plant. The vascular system becomes darkened at the root, collar, stem and twig areas. The disease typically affects the xylem vascular system, leading to the impermeability of vascular walls and preventing the translocation of water to other plant parts. Under high relative humidity conditions, lesions and fissures can be found in the plant collar and stems.

Figure 9: Fusarium wilt

Anthracnose

Spots, initially 2-3 mm in diameter and oily in appearance, are produced on the leaf. They become dark brown, round or irregularly shaped and 1 cm in diameter. As foliar lesions coalesce, large areas of the leaf die, resulting, eventually, in abscission. Affected flowers abort, and immature fruit abscise. Lesions on fruit initially are superficial and light brown, and later become sunken and greyish to dark brown. The fruit skin becomes papery and acervuli are formed on lesions here and on leaves.

Figure 10: Anthracnose

Woodiness virus

Infection causes a noticeable reduction in the development of plant. Leaves display severe mosaic, rugosity and distortion. Plants affected with PWV and CWV produce woody and deformed fruits. Severe mosaic, epinasty, defoliation and premature death of plants are associated with infection of PWV. Other common symptoms are leaf mottling and ring spot on the younger leaves. Fruits are symptom less or may show mild molting. Chlorotic spots on the leaves and dappled or faded fruits are often found.

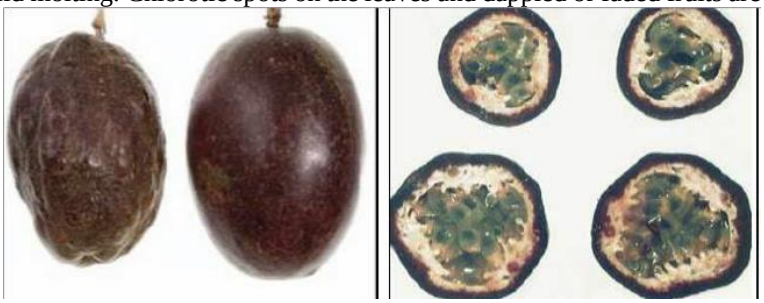

Figure 11: Woodiness virus

Scab

Infected plant show small round spots on the leaves. Spots are initially translucent, later become necrotic showing greenish- grey centers which correspond to fungal fructification. Lesions can perforate leaves, occur on veins and cause them to be deformed leading to abscission. Similar spots may appear on bud sepals or open flowers. Twigs and twig tips initially show lesions similar

to the ones on leaves, which later turn into cankers of elongated and sunken aspect that become greenish - grey, where the pathogen fructification takes place. As scar tissue forms, branches become weakened and break in the wind. On small fruits, symptoms are slightly sunken with small dark circular spots. On bigger fruits lesions on fruit skin grow and become cork like, prominent and brownish. Lesions do not reach the inner fruit and consequently do not affect juice quality. Several lesions may form on the same fruit causing it to be deformed and stunted. The disease mainly affects young tissues of leaves, branches, tendrils, flower buds and fruits, when not controlled cause significant damages. In field orchard conditions it causes death of the twigs, can delay flowering and reduce the commercial quality of fruit.

Figure 12: Scab

LIMITATIONS

The system contains a program project that diagnoses 7 diseases that affect passion and the seven diseases are: Brown spot, Septoria spot, Root and crown rot, Fusarium wilt, Anthracnose, Woodiness virus, Scab.

CONCLUSION

In conclusion, an expert system has been created that diagnoses passion diseases in a thoughtful and professional manner to make it easier for users who grow this passion tree in order to treat it in the right way. CLIPS Expert System language was used to design and implement the proposed expert system. The system works with interfaces Easy to use, smooth and flexible.

EXPERT SYSTEM SOURCE CODE

```
(defrule disease1
(Alternaria passiflorae causes reddish brown spots on the leaves. Under high humidity, spots normally grow larger up to 2 cm in diameter become round and zonate)
(Spores can form a black thin mass covering the middle of the lesion, being more abundant on the abaxial surface.Abscission of the affected leaves occur rapidly causing intense defoliation)
(In twigs dark brown lesions are more elongated and may cause girdling and death of the terminal portion of these.organs)
(Slightly circular spots occur on the mature fruits or when they are half way through their growth process. They are reddish brown, sunken affecting the pulp and damaging the commercial value)
(Alternata causes smaller spots with chlorotic haloes on leaves and can induce defoliation. The stem lesions rarely kill vines. Spots on fruits have dark green and greasy margins)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "1"  crlf)
)

(defrule disease2
(Leaves are the most affected organs, showing light brown slightly round necrotic spots normally encircled by a chlorotic
halo. A single lesion per leaf is sufficient to cause abscission, and even leaves without visible symptoms may fall prematurely)
(When the disease reaches 15-20% of leaves in the same plant, partial or even complete leaf abscission is observed. In young twigs, lesions may promote girdling leading to wilt and twig tips death)
(Lesions on flowers are similar to those on leaves. The primary infection in the calyx may reach the stalk, causing the early drop of flowers. The infection may occur at any stage of the development of the fruits, affecting maturation or
development)
```

(.Leaf and fruit abscission, twig wilt and plant death may occur under disease favoring conditions)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "2" crlf)
)

(defrule disease3
(Phytophthora root and crown rot disease affects both adult as well as nursery plants. Mild cholorosis is followed by wilting, defoliation and death. Cortical tissues of the plants are exposed)
(Plant intumescence and bark fissures are found in the collar. Injured leaf shows a burned appearance. Occurrence of foliar blight followed by drop of flowers is observed)
(There is a change in leaf color from colorless to pale green, with leaves reaching a light copper colour. The affected plant shows burned -like black twig tips and flowers which eventually die. Large grayish- green aqueous spots can be viewed in fruits)
(not (disease identified))
=>
(assert (disease identified)
(printout fdatao "3" crlf)
)

(defrule disease4
(The glossy green leaves of young passion fruit plants show a pale green colour and mild die back. Drop of lower leaves, general plant wilting and sudden death take place)
(In adult plants, the disease causes yellowing of young leaves, followed by plant wilt and death. Symptom development may be unilateral or encompasses the entire plant)
(The vascular system becomes darkened at the root, collar, stem and twig areas. The disease typically affects the xylem vascular system, leading to the impermeability of vascular walls and preventing the translocation of water to other plant parts)
(Under high relative humidity conditions, lesions and fissures can be found in the plant collar and stems)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "4" crlf)
)

(defrule disease5
(Spots, initially 2-3 mm in diameter and oily in appearance, are produced on the leaf. They become dark brown, round or irregularly shaped and 1 cm in diameter. The centers of spots become brittle and may break apart. Lesions also develop on petioles)
(As foliar lesions coalesce, large areas of the leaf die, resulting, eventually, in abscission. Dark brown spots, 4-6 mm in diameter, are produced on the branches and tendrils, eventually turning into cankers. Severe lesions can cause the death of a shoots)
(Affected flowers abort, and immature fruit abscise. Lesions on fruit initially are superficial and light brown, and later become sunken and greyish to dark brown. They may be larger than 1 cm in diameter and may reach interior portions of the fruit. As fr)
(The fruit skin becomes papery and acervuli are formed on lesions here and on leaves. Under high humidity, masses of red and orange spores form in acervuli. Dieback, characterized by reduced elongation of shoots, shortened internodes and an eventual wilt)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "5" crlf)
)

(defrule disease6
(Infection causes a noticeable reduction in the development of plant. Leaves display severe mosaic, rugosity and distortion)
(Plants affected with PWV and CWV produce woody and deformed fruits. Severe mosaic, epinasty, defoliation and. premature death of plants are associated with infection of PWV)
(Other common symptoms are leaf mottling and ring spot on the younger leaves. Fruits are symptom less or may show mild

```
molting. Chlorotic spots on the leaves and dappled or faded fruits are often found)
(not (disease identified))

=>
(assert (disease identified))
(printout fdatao "6"  crlf)
)

(defrule disease7
(Infected plant show small round spots on the leaves. Spots are initially translucent, later become necrotic showing greenish-grey centers which correspond to fungal fructification)
(Lesions can perforate leaves, occur on veins and cause them to be deformed leading to abscission. Similar spots may appear on bud sepals or open flowers. High numbers of lesions on flower buds or on peduncles can greatly reduce the ).number of flower buds)
(Twigs and twig tips initially show lesions similar to the ones on leaves, which later turn into cankers of elongated and sunken aspect that become greenish - grey, where the pathogen fructification takes place. As scar tissue forms,branches become weaken)
(On small fruits, symptoms are slightly sunken with small dark circular spots. On bigger fruits lesions on fruit skin grow and become cork like, prominent and brownish. Lesions do not reach the inner fruit and consequently do not affect juice quality Seve)
(The disease mainly affects young tissues of leaves, branches, tendrils, flower buds and fruits, when not controlled cause significant damages. In field orchard conditions it causes death of the twigs, can delay flowering and reduce the commercial quality)
(not (disease identified))
=>
(assert (disease identified)
(printout fdatao "7"  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))
(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")"))
(close fdata)
)
```

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