

Expert System for Areca Plant Disease Detection Using Forward Chaining Method

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Received: 14 August 2020; Review: 28 August 2020; Accepted: 11 September 2020; Published: 25 September 2020

Abstract

Areca palm has been widely planted by the people of the Asahan Regency. This plant is cultivated not only by the farmers, but also by many people living in this regency. Therefore, an expert system is needed to help villagers in detecting areca palm disease. In areca palm cultivation, pests and diseases attack always happen. The purpose of this research is to apply an expert system as a tool to diagnose and also provide advice for control. This expert system, in the form of a consultation scenario, can be done by answering every question (yes or no); all answers are compared to the areca palm plants needs based-on expert experience. The inference method used is forward chaining. The output of this system is the types of diseases, percentages, symptoms, definitions, treatment, and prevention.

Keywords: Areca Palm, Expert System, Forward Chaining.

1. Introduction

Nowadays, data innovation in a gadget has an ability to cover a wide network. Frameworks in computers make it possible to store a lot of information in a short time, and make the computer can think. The computer development can help in solving problems in everyday life and in various fields.

One of the crops grown by local farmers beside oil palm is areca nut. Based on the data from the Agriculture Office of Asahan Regency, areca nut plants are also easy to find. The development of these plants is not complicated, hence, anyone who is not a farmer can cultivate these plants easily (DISBUN 2017). Areca nut cultivation faces various obstacles, especially pests and diseases that can cause a decrease in yield (quality and quantity).

This research proposes an application to check a disease on areca plant using an expert system. Therefore, it can be used by many villagers. Forward chaining was used as a main method. The output of this expert system is to show data about side effects and infections that occur in areca nuts and how to control them.

2. Literature Study

Expert System is a framework that receives human information and inserts it into a computer. Therefore, it has a capacity to think critically like a specialist. With this Expert System, ordinary people can solve their problems or just look for quality data that must be obtained with the help of specialists in their fields (Irawan and Nasution 2018). Expert systems are used to unravel problems that are difficult to unravel by utilizing common projects, given the costs involved in creating specialist frameworks that are far more prominent than standard frameworks (Ritonga and Irawan 2017).

Another study shows that expert system is a visible framework for receiving human information into a computer, with the aim that the computer can handle problems like specialists in solving the problem. The essence of the clinical master's framework is to assist specialist

analytical procedures. It thinks about reality and its side effects to give it determination. It concludes that the clinical master framework uses information about disease and reality about patients to recommend findings (Munaiseche, Kaparang, and Rompas 2018). With this main framework, application administrators can explain a confusing problem that is generally understood by a specialist (Rukun et al. 2017).

This Expert System works by utilizing information from the specialists according to their area of expertise. Expert system consists of two principle segments, i.e. the information base and the ultimate goal of making device information obtained from gathering information in a particular field. Information in this context is characterized as a variety of information and many rules for controlling or handling information to turn into new information. The information base is an important part of an expert system, the capacity of a specialist framework is usually determined by the limits of its information base, while a dynamic engine is an application that assists and assists the client framework in controlling information and selecting the appropriate information to get results (Hawa, Abdullah, and Usman 2015).

Expert systems consist of domain experts, designers, inference engines, knowledge base, user interface, and users. There are relationships between these components. Domain experts connect to the knowledge base to provide rules and facts. Domain experts are usually experts in a field or field. The knowledge base stores collected rules and facts. The knowledge base is also connected to an inference engine which is used to process rules to infer a set of rules or facts. Inference engines are usually designed by programmers or designers. The inference engine is then connected to the user interface which is used to collect data from the user. It is also developed by the designer. This trend can also be followed backwards. The user interface provides information to the inference engine and knowledge base for user data to be processed. Also for knowledge base updates, the need to contact a domain expert is required. All of this can be represented in Figure 1 below (J and A 2018).

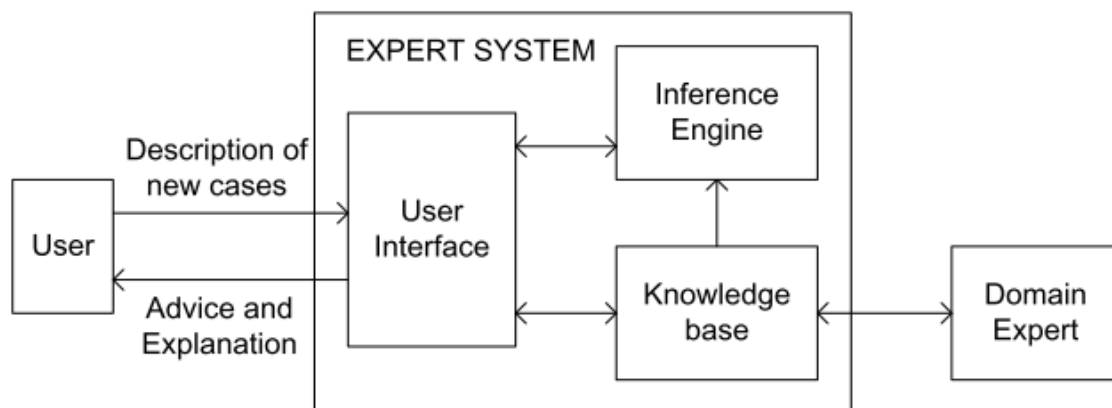


Figure 1. Expert System Architecture (J and A 2018)

In expert system study, several investigative procedures were found, one of which is forward chaining. The forward chaining method can be used to check for certain diseases, e.g. humans, creatures, and plant infections (Sinaga et al. 2019). Nowadays, there have been several developments in the results of expert systems in various fields according to one's expertise. One example of implementing an expert system in the health sector is the application of eye disorders diagnosis and eye care tips with the web-based forward chaining method (Pramesti, Arifudin, and Sugiharti 2016).

Forward chaining is a tracing process that begins by displaying a compelling collection of data or facts leading to a final conclusion. Therefore, the forward chaining method starts from first input information (if section) and then to conclusions (then section) or in a model IF (Enter Information) and THEN (conclusion). Input information can be data, evidence, findings or knowledge, while conclusions may be interesting, explanation, or diagnosis (Rukun et al. 2017).

The forward chaining design phases are symptom data, disease data, decision tree, and inference engine (Shofi, Wardhani, and Anisa 2016). Another phases in the research method on forward chaining are determining initial facts, determining rules, determining decision trees, and acquiring knowledge (Samsudin 2018),(Riyadi and Samsudin 2016).

The forward chaining method has several characteristics, namely: (1) Planning, monitoring and control (2) Presenting for the future (3) antecedents for consequences (4) Data guidance, bottom-up reasoning (5) Hoping to get what solutions follow the facts (6) The extent of the first search is easier (7) antecedents determine the search (8) Explanation is not facilitated (Arhami 2005).

Research on expert systems, especially using the forward chaining method in agriculture, has been carried out in the diagnosis of disease in cocoa (Hawa, Abdullah, and Usman 2015). Another implementation in the field of human diseases using forward chaining method was an expert system for diagnosing gastric disease (Samsudin 2018).

Similar research on areca nut has been carried out by Salim with several diseases and pests in areca nut, namely Brontispa longissima, Tirathaba, Aphids, Male Flower Borer, Grasshopper (*Valanga nigricornis*), Leaf blight disease (Salim 2012). The results showed the diseases and pests in areca nut can be identified. Therefore, in this study, an expert system is applied using the forward chaining method. The expert system proposed in this study aims for diagnosing areca nut disease will be implemented on a website. The website has many advantages, such as a multimedia information, among others. The process is carried out using a web browser such as Mozilla Firefox and Google Chrome, etc. (Irawan and Simargolang 2018).

3. Research Method

This research used several steps as shown in Figure 2. The data was collected from references related to research topics, including journals, e-books, etc. The problem is identified as something that hinders the research objectives. Problems must be followed up to find a solution. This will need system requirements analysis, which identifies the requirements needed in making an application for diagnosing areca nut disease. System requirements analysis includes areca nut disease data.

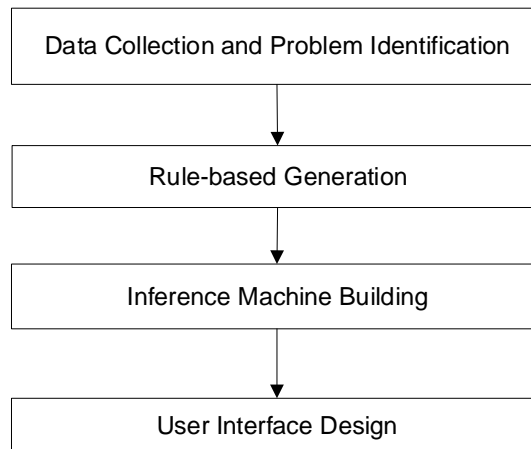


Figure 2. Research Steps

The formation of a knowledge base was carried out after the data was collected. The formation of a knowledge base is classified with a code on each data. Several data is needed in this study, i.e. symptoms of disease data, disease data, and solutions data. Furthermore, the formation of an inference machine according to the forward chaining method. And the last is the design of the user interface which is a display of communication to the user.

4. Result and Discussion

4.1 Data Collection and Problem Identification

Data collection is obtained from the results of agricultural research which is then identified and analyzed. Additional data results were from interviews to farmers and the Asahan District Agriculture Office staffs. The results are symptom data, areca nut disease and solutions.

4.2 Rule-Based Generation

In the concept of an expert system for examining diseases of areca plants, it is very necessary to find the symptoms using the forward chaining method. Examination of diseases in areca plants will be grouped into symptoms of disease, areca plant disease, and data solution.

1. Symptoms of Disease

The knowledge base of areca plant diseases can be seen Table 1.

Table 1. Symptoms of Disease

Code	Symptoms
GP01	On the leaf lamina, visible yellow spots 3-10 mm in diameter
GP02	Yellowish brown spots on the leaves
GP03	You can see irregular spots on the leaves that are yellowish
GP04	You can see irregular spots on the part of the stem that is yellowish
GP05	Withered plants
GP06	The leaves are yellowish and there are necrotic lines on the leaf lamina
GP07	Leaf growth shrinks
GP08	Blackish flesh
GP09	At the base of the spindle the color gradually turns yellow brown
GP10	The tops rot and cause a distinctive odor
GP11	Wet spots visible on the surface of the fruit near the flower petals
GP12	The color of the fruit turns dark green
GP13	Fall fruit
GP14	Dry and yellowing leaves
GP15	Leaves droop and break easily
GP16	The stem looks irregular brown spots and oozes out
GP17	Root rotting plant
GP18	Leaf bones turn yellow from tip to base
GP19	Fallen female flower
GP20	Leaves visible 0.5-1.0 cm wide spots
GP21	The lower surface of the leaf is covered by bacteria
GP22	The leaves cause irregular spots or grayish white
GP23	yellowish
GP24	The leaves become short, shrink and broom-shaped
GP25	The color changes to dark green
GP26	The stem is tapered and the distance between the stem segments shortens
GP27	The crown of the tree is shaped like a rose causing flowering

Code	Symptoms
GP28	become imperfect
GP29	Changes in color on the infected part of the stem and tissue

2. Areca plant disease

Diseases in areca plants can be seen in the Table 2.

Table 2 Areca Plant Diseases

Code	Areca Plant Diseases
PP01	Yellow Leaf Spot
PP02	Leaf Blight
PP03	Red Rust
PP04	Root/Coolar Rot
PP05	Fruit Rot
PP06	Bud Rot
PP07	Yellow Leaf Disease
PP08	Foot Rot
PP09	Die Back
PP10	Bacterial Leaf Stripe
PP11	Band
PP12	Stem Bleding
PP13	Nut Splitting

3. Data Solution

Solution data from areca plant disease can be seen in Table 3.

Table 3. Solution Data

Code	Diseases	Solutions
SPP01	<i>Yellow Leaf Spot</i>	Spraying with Dithane can reduce attack
SPP02	Leaf Blight	Fertilization of N and K ₂ O or by giving shade can suppress disease
SPP03	<i>Red Rust</i>	To avoid it, it is necessary to make enough shade
SPP04	<i>Root/Coolar Rot</i>	This disease is usually seen in nurseries with poor drainage systems. So that drainage in the nursery must be considered
SPP05	<i>Fruit Rot</i>	Chemical control can be done with copper oxychloride fungicides and garden phytosanitation (cleaning)
SPP06	<i>Bud Rot</i>	Cleaning the planting site from infected plants will prevent the spread of disease
SPP07	<i>Yellow Leaf Disease</i>	Control in an integrated manner with fertilization, use of fungicide 2 g phorate granules per tree and phytosanitary
SPP08	<i>Foot Rot</i>	To avoid this disease, it is necessary to regulate the drainage system and clean the garden. Some antagonistic microorganisms such as <i>Trichoderma</i> sp, <i>Streptomyces</i> sp. can be a biological agent for controlling this disease
SPP09	<i>Die Back</i>	Control can be done with the fungicide Dithane 4 g / l of water when the female flowers open and the next 20-24 days
SPP10	<i>Bacterial Leaf Stripe</i>	Spraying with tetracyclin antibiotics 1 g / 2 L of water every 2

Code	Diseases	Solutions
SPP11	Band	weeks Disease control is carried out by improving drainage and soil loosening. Mixed administration Copper sulfate with lime ratio 1: 1 with a dose of 225 g per tree per 6 months may improve growing environmental conditions
SPP12	Stem Bleding	This disease is thought to develop due to shallow groundwater and poor drainage. To avoid attacks Xyleborus sp. that can enter through the hole, then it is affixed with tar and insecticide
SPP13	Nut Splitting	Improved drainage and spraying with Borax 2 g / 1 liter of water at an early stage can reduce disease attacks

4.3 Inference Machine Building

Figure 3 shows the formation of the inference engine.

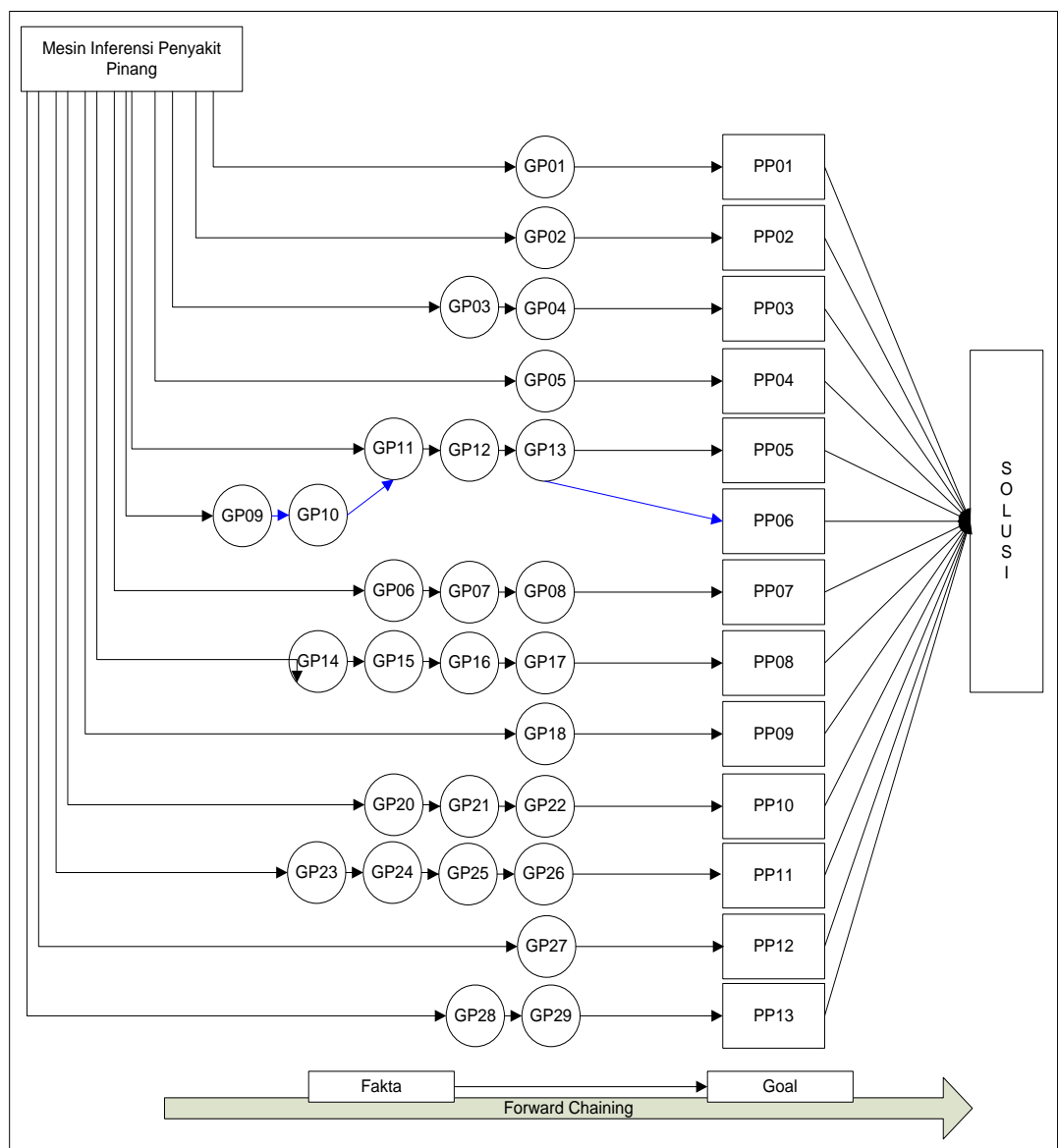


Figure 3., Forward Chaining Inference Engine for Areca Nut

Search engine was prepared for solutions to areca plant disease with the symptoms of areca nut disease (Figure 3). After the inference engine is formed the production rules are prepared as shown in Table 4.

Table 4. Production Rules

No	Production Rule	Solution
1	IF GP01 THEN PP01	SPP01
2	IF GP02 THEN PP02	SPP02
3	IF GP03 AND GP04 THEN PP03	SPP03
4	IF GP04 THEN PP04	SPP04
5	IF GP11 AND GP12 AND GP13 THEN PP05	SPP05
6	IF GP09 AND GP10 AND GP11 AND GP12 AND GP13 THEN PP06	SPP06
7	IF GP06 AND GP07 AND GP08 THEN PP07	SPP07
8	IF GP14 AND GP15 AND GP16 AND GP17 THEN PP08	SPP08
9	IF GP18 THEN PP09	SPP09
10	IF GP20 AND GP21 AND GP22 THEN PP10	SPP10
11	IF GP23 AND GP24 AND GP25 AND GP26 THEN PP11	SPP11
12	IF GP27 THEN PP12	SPP12
13	IF GP28 AND GP29 THEN PP13	SPP13

4.4 User Interface Design

After the knowledge base and inference engine have been established, the next step is designing a web-based user interface.



Figure 4. Implementation of the Diagnosis Form

The diagnostic form shows an important role in determining the outcome. In the diagnostic form, there are questions related to disease symptoms using the forward chaining method.

Hasil Diagnosa	
Biodata User (Pasien)	
Nama	: tika
Usia	: 24 tahun
Jenis Kelamin	: Perempuan
Alamat	: Indrapura
Hasil Diagnosa	
Tipe Penyakit DM	: Bercak Daun Menguning (Yellow leaf spot)
Persentase	: 100 persen
Gejala Umum	: 1. Pada lamina daun terlihat bercak-bercak kuning berdiameter 3-10 mm. 2. Bercak-bercak coklat kekuningan pada helaian daun. 3. Terlihat bercak tak beraturan pada bagian daun yang berwarna kekuningan.
Definisi	: Bercak Daun Menguning (Yellow leaf spot)
Pengobatan	: memberikan obat anti Bercak Daun Menguning (Yellow leaf spot)
Pencegahan	: merawat tanaman pinang dengan baik
Waktu Diagnosa	: 01 Agustus 2019 11:25:53
<input type="button" value="Cetak"/>	

Figure 5. Diagnosis Results

The diagnostic results show diagnostic data information, types of diseases, general symptoms, diseases, and treatment and prevention.

5. Conclusion

The study has been implemented a forward chain-based expert system. The result showed the inference engine has been successfully predict a deasese, starting from the fact symptoms of areca nut collection and the areca nut disease prediction. Therefore, a solution for handling the disease can be taken which can become beneficial information to farmers for which the farmers can take good care of areca plants. This system is also useful for the Asahan Regency Agriculture Office in socializing how to properly care for areca plants by showing symptoms of the disease. So that not only the data of areca planters is high, but the areca nut production can also be balanced.

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