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Expert System Diagnosing Diseases in Coffee Plants Using Certainty Factor Method

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Abstract

Diagnosing diseases in Arabica coffee plants using the Certainty Factor Method. Diagnosing diseases of Arabica coffee plants must be fast and precise in accordance with technological developments. Making this coffee plant disease diagnosis application aims to make it easier for coffee farmers or the public to find out the types of diseases in coffee plants and how to control them based on the symptoms of coffee plant diseases that are entered and an answer will come out, namely the name of the disease from the questions entered and how to control it. Expert systems are used as a tool to solve problems that are usually solved by an expert.

Keywords*: Expert System, Coffee, Certainty Factor*

1. Introduction

With the increasing development of the times and the development of technology to diagnose a disease, including diseases in coffee plants. So we need an intelligent system that can quickly find out the type of disease in coffee plants using the Certainty Factor method, which can provide an optimal alternative solution for diagnosing individual diseases.

This system can help someone to find out the type of disease in coffee plants based on disease symptoms and will come out with answers to questions and solutions to cure or destroy diseases and pests found in coffee plants using the Certainty Factor method. Coffee is one of the most important commodities, not only as a source of livelihood but also occupying the national economic order, coffee farming contributes quite a lot as a source of foreign exchange in supporting high national development, so that it can be used as a source of farmers' income. The low productivity of coffee is caused by inadequate plant cultivation techniques, thus encouraging various plant growth disorders.

In general, an expert system is a system that seeks to adopt human knowledge to a computer that is designed to model problem solving abilities like an expert. With this system, ordinary people can solve their problems or just look for quality information that can only be obtained with the help of experts in their fields.This expert system will also be able to assist the activities of experts as experienced assistants and have the required knowledge. In its preparation, the expert system combines inference rules with a certain knowledge base provided by one or more experts in a particular field. The combination of the two things is stored in the computer, which is then used in the decision-making process to solve certain problems.

2. Method

To achieve the goals set by the research in the previous chapter, the author uses the Certainty Factor method in data processing and decision making. This uncertainty can be in the form of probabilities or possibilities that depend on the outcome of an event. Uncertain results are caused by two factors, namely uncertain rules and uncertain user answers to a question posed by the system.

In data processing and decision making on the results of plant disease diagnosis, Certainty Factor Coffee has a rule IF E THEN H is as follows:

$$CF(H,e) = CF(E,e) * CF(H,E) \quad (1)$$

$$CFcombineCF[H,E]1,2= CF[H,E]1 + CF[H,E]2 * [1-CF[H,E]1] \quad (2)$$

$$CFcombineCF[H,E]old,3=CF[H,E]old +CF[H,E]\ 3 * (1-CF[H,E]\ old] \quad (3)$$

Information :

CF(E,e) : *Certainty Factor evidence* E which is influenced by evidence e

CF(H,E) : C*ertainty Factor* hypothesis assuming the evidence is known with certainty, namely when CF(E,e) = 1.

CF(H,e) : *Certainty Factor* hypothesis that is influenced by evidence e

An overview of the system flow (flowchart) of the application of the Certainty Factor method in an expert system for diagnosing chicken diseases can be seen in the following figure:

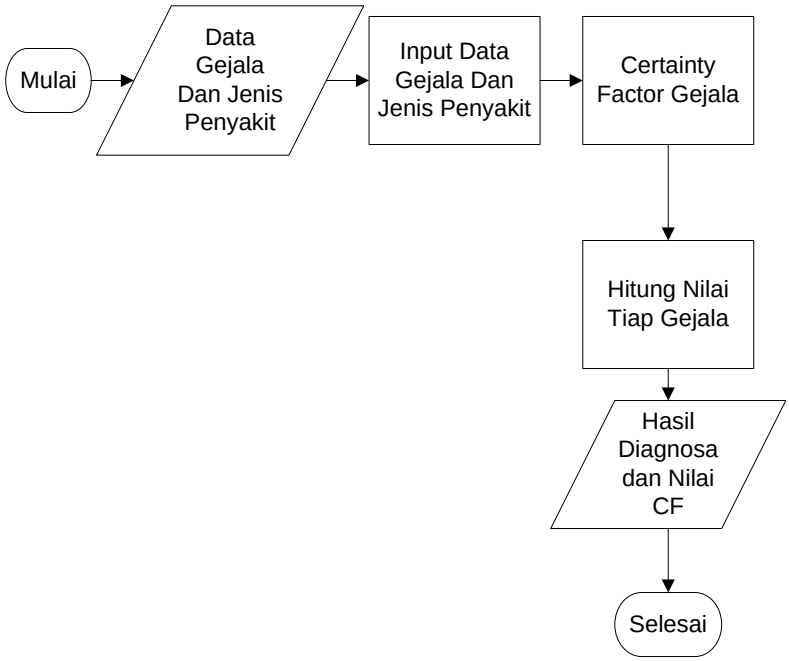

Figure 1. Flowchart of the Application of the Certainty Factor Method

The following is a list of symptoms of the disease, types of diseases and solutions for handling diseases.

Table 1.
Types of Diseases & Solutions

Code	Type of disease	Solution
J1	White Root Mushroom	1. Dismantle the affected plants until the roots are then burned. 2. The hole used for demolition is left open so that the environment is clean of spores 3. For coffee plants that have not been attacked, the fungus Tricoderma SP can be applied at a dose of 200 grams per tree. 4. For every coffee plant that is attacked, eight plants around it must be applied with Trichoderma SP. 5. Don't bury dead wood plants 6. Do not plant cassava in an infected garden site.
J2	Leaf Rust	1. Using coffee varieties that are resistant to leaf rust 2. Control using organic pesticides
J3	Leaf Spots	1. Provide adequate shade to the plants 2. Fertilize in a balanced way 3. Reduce the humidity of the coffee garden 4. Perform pruning and weed removal.
J4	Peeled Mushroom	1. The sick stem or branch that is still small is cut below the base of the diseased part. 2. Sick stems or branches that are large enough are recommended to also cut the surrounding branches 3. All pieces of diseased stems and branches are collected and then burned.

Table 2.
Symptoms of Coffee Plant Diseases

No	Disease	Symptom	MB	MD
1	White Root Mushroom (JPA)	On the stem of the plant there are thick white threads	0.99	0.00
2	White Root Mushroom (JPA)	Leaves turn yellow and dull overall	0.90	0.05
3	White Root Mushroom (JPA)	Leaves dry and fall	0.90	0.05
4	Leaf Rust	Leaves turn yellow and dull overall	0.93	0.05
5	Leaf Rust	Leaves dry and fall	0.93	0.05
6	Leaf Spots	Leaves turn yellow and dull overall	0.85	0.06
7	Leaf Spots	Leaves turn yellow and partially dull	0.90	0.03
8	Leaf Spots	Spots appear on coffee cherries	0.95	0.00
9	Leaf Spots	Coffee cherries undergo sudden rot	0.97	0.00
10	Peeled Mushroom	Leaves dry and fall	0.90	0.005
11	Peeled Mushroom	Stems and Twigs become Soft and Withered	0.95	0.05

4. Results

Symptom :
[G1] On the stem there are thick white threads
[G2] Leaves dry and fall

CF Disease 1 (P1)
Weight : P1G1 ([0.99],[0.00])
: P1G4([0,90],[0,05])

CF[HE]1,1B = CF[H,E]old0B + (CF[H,E]1 * (1-CF[H,E]old0B))
= 0 + (0.99 * (1 – 0.00))
= 0.99

CF[HE]1,1D = CF[H,E]old0D + (CF[H,E]1 * (1-CF[H,E]old0D))
= 0 + (0.00 * (1 – 0.00))
= 0.00

CF[HE]1,2B = CF[H,E]old1B + (CF[H,E]1 * (1-CF[H,E]old1B))
= 0.99 + (0.90 * (1 – 0.99))
= 0.99

CF[HE]1,2D = CF[H,E]old1D + (CF[H,E]1 * (1-CF[H,E]old1D))
= 0.00 + (0.05 * (1 – 0.00))
= 0.05

CF = CF[HE]1,2B - CF[HE]1,2D
= 0.99 – 0.05
= 0.94
= 94%

CF Disease 2 (P2)
Weight : P2G4 ([0,90],[0,05])
CF[HE]2,1B = CF[H,E]old0B + (CF[H,E]2 * (1-CF[H,E]old0B))
= 0 + (0.93 * (1 – 0.00))
= 0.93

CF[HE]2,1D = CF[H,E]old0D + (CF[H,E]2 * (1-CF[H,E]old0D))
= 0 + (0.05 * (1 – 0.00))
= 0.05

CF = CF[HE]2,1B - CF[HE]2,1D
= 0.93 – 0.05
= 0.88
= 88%

CF Disease 3 (P3)
NO SYMPTOMS MEET FOR DISEASE 3 = 0%
CF Disease 4 (P4)
Weight : P4G1 ([0.90],[0.05])

CF[HE]4,1B = CF[H,E]old0B + (CF[H,E]4 * (1-CF[H,E]old0B))
= 0 + (0.90 * (1 – 0.00))
= 0.90

CF[HE]4,1D = CF[H,E]old0D + (CF[H,E]4 * (1-CF[H,E]old0D))
= 0 + (0.05 * (1 – 0.00))
= 0.05

CF = CF[HE]2,1B - CF[HE]2,1D
= 0.90 – 0.05
= 0.85
= 85 %
Conclusion: P1 = 94%
: P2 = 88%
: P3 = 0%
: P4 = 85%
So, plants diagnosed with disease [P1] with a 94% probability rate [P1] is the disease "White Root Fungus (JAP)"

4. Conclusion

Based on the results obtained and the analysis carried out for the diagnosis of Arabica coffee plant diseases, the following conclusions can be drawn:

1. This expert system is able to diagnose Arabica coffee plant diseases along with how to control the disease, making it easier for coffee farmers to find out what diseases can attack coffee plants, and how to control these diseases.
2. This Expert System can be used online and offline, making it easier for users to diagnose Tanman Kopi disease when offline.

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