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Expert System for Diagnosing Pests and Diseases in Arabica Coffee Plants using the Certainty Factor Method

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ABSTRACT

Arabica coffee is coffee which is known to have the best quality among others, because it has a distinctive aroma and taste. However, arabica coffee is more susceptible to infection with pests and diseases, which causes farmers to experience difficulties in maintaining arabica coffee and lack of knowledge about how to control pests and diseases that attack arabica coffee. In handling pests and diseases, an agricultural consultant is needed to diagnose pests and diseases of arabica coffee plants. In this study, the expert system diagnosed pests and diseases in Arabica coffee plants was built to diagnose pests and diseases that attack arabica coffee plants, and provide solutions for pests and diseases. The method used in this expert system is the Certainty Factor method. Certainty Factor method is chosen because this method is suitable in the process of determining the identification of pests and diseases, and the results of applying this method are percentages. The percentage of expert system consultations was taken from the highest yield, as an alternative to pests and diseases that attacked arabica coffee plants. The expert system diagnoses pests and diseases of arabica coffee plants to make it easier for Arabica coffee farmers to find more detailed and accurate information about Arabica Coffee pests and diseases and their control.

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1. INTRODUCTION

Arabica coffee is the oldest type of coffee known and cultivated in the world, especially in Indonesia [1]. The Arabica coffee plant originated from the Ethiopian region and was then brought by Arab traders to Yemen [2] [3] [4]. The Arabs began to popularize Arabica coffee bean extract brewed with hot water as a refreshing drink. Arabica coffee is coffee that is known to have the best quality among others, because it has a distinctive aroma and different taste [5] [6] [7]. However, Arabica coffee is more sensitive to pests and diseases, which causes farmers to have difficulty in maintaining Arabica coffee and lack of knowledge about how to control pests and diseases that attack Arabica coffee [8] [9] [10].

Time and cost are obstacles for farmers to consult with experts or experts in the field of Arabica coffee about pests and diseases that attack Arabica coffee. Therefore, to overcome the problem of farmers, an expert system application is designed to diagnose pests and diseases of Arabica coffee plants where this system can diagnose pests and diseases of Arabica coffee using the certainty factor method.

The Certainty Factor method is used as a method in making expert system applications, this method is a method to prove the uncertainty of an expert's thinking, where to accommodate this one usually uses a certainty factor to describe the level of expert confidence in the problem at hand [11] [12] [13].

Research on expert systems to diagnose pests and diseases of Arabica coffee plants is expected to provide a solution to the problems faced by the Arabica coffee plantations, namely the problem of pests and diseases on Arabica coffee plants by using an expert system application with the certainty factor method. So that by implementing this application, it can help Arabica coffee farmers in determining the types of pests and diseases that attack Arabica coffee plants.

2. RESEARCH METHODS

2.1 Observation

This observation method is used to observe directly the object being studied. The object under study is an arabica coffee plantation located in Laesiboban Village, to find out the complaints of farmers about pests and diseases that attack arabica coffee, so they can continue a research.

2.2 Interview

Interviews were conducted directly by way of question and answer to coffee farmers, namely, Mr. Sadar Sinaga, one of the people who has an Arabica coffee plantation in the village of Lae Siboban. To obtain data and information about farmers' complaints about pests and diseases that attack Arabica coffee plants.

Interviews were conducted directly with those who are experts in the field of Arabica coffee, namely, Ms. Lisbet Munthe, S.Pt as a trusted expert in the plantation sector at the Dairi Regency Agriculture Office, North Sumatra Province, in order to obtain more accurate data and information about pests and diseases. Arabica coffee plant disease.

2.3 Study of literature

At this stage, data searches and information collection are carried out by reading and studying literature from reference books, online journals, and articles related to thesis writing that support this research.

2.4 Certainty Factor Method

The certainty factor method is used when facing a problem for which the answer is uncertain. This uncertainty can be a probability. This method was introduced by Shortlife Buchanan in the 1970s. He uses this method when diagnosing and treating meningitis and blood infections [14] [15].

The calculation steps in the certainty factor method to build an expert system for diagnosing pests and diseases on arabica coffee plants are as follows:

a. Determination of pest and disease data.
b. Determination of symptom data.
c. Determination of combined data, combined data here is a combined data between symptom data with pest and disease data.
d. The determination of the MB MD value is followed by the determination of the CF value.
e. Selection of symptom data by the user.
f. Calculation of CF value from user symptoms.
g. The results of the diagnosis of pests or diseases.

The results of the expert system diagnosis in the form of the percentage of the disease. The percentage of disease used for diagnosis results is the largest percentage. The percentage of disease is

obtained from the calculation of the certainty factor value based on the symptoms selected by the user. Calculation of certainty factor value as follows:

a. Calculating CF Value

$$CF[H,F] = MB[H,E] - MD[H,E] \quad \text{..... (1)}$$

Description :

CF(H,E) : certainty factor of hypothesis H which is influenced by evidence (evidence) E. The amount of CF ranges from -1 to 1. A value of -1 indicates absolute distrust, while a value of 1 indicates absolute confidence.

MB(H,E) : a measure of confidence (measure of increased belief) on the H hypothesis which is influenced by E symptoms.

MD(H,E) : a measure of increased disbelief in hypothesis H which is influenced by symptom E.

E : evidence (events or facts).

b. Calculating CFcombine Value

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

3. RESULTS AND DISCUSSION

3.1 Certainty Factor Method Analysis

Certainty Factor method is used 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 processing data and making decisions on the diagnosis of pests and diseases of arabica coffee plants Certainty Factor has a rule IF E THEN H is as follows:

CF[H,E] = MB[H,E] – MD[H,E]

CFcombineCF[H,E]1,2= CF[H,E]1 + CF[H,E]2 * [1 - CF[H,E]1]

CFcombineCF[H,E]old,3=CF[H,E]old +CF[H,E] 3 * (1-CF[H,E] old]

Description:

CF(H,E) : certainty factor of hypothesis H which is affected by symptoms (evidence) E.The magnitude of CF ranges from -1 to 1. A value of -1 indicates absolute distrust, while a value of 1 indicates absolute confidence.

MB(H,E) : a measure of confidence (measure of increased belief) on the H hypothesis which is influenced by E symptoms.

MD (H, E) : a measure of increased disbelief in hypothesis H which is influenced by symptom E.

E : evidence (events or facts).

3.2 Discussion

In designing an "Expert System to Diagnose Pests and Diseases in Arabica Coffee Plants Using the Certainty Factor Method", the author uses a program based on Vb.Net 2010 and uses Access 2010 as the database.

The inference mechanism with the Certainty Factor method for expert systems to diagnose pests and diseases of Arabica coffee has simple stages because it uses logical expressions in production rules using the following steps:

a. Step 1, ask the user a question
b. Step 2, accommodate input from the user as the premise of the rule in short term memory.
c. Step 3, check the rule based on the input that is accommodated in the short term memory, if found, repeat steps 1 to step 3. If not found then provide the default output.
b. Step 4, provide the results of the diagnosis.

4. CONCLUSION

From the results of the analysis and discussion that have been stated, it can be concluded several conclusions that; This research resulted in a new software on an expert system that is able to support decisions to diagnose pests and diseases of Arabica coffee plants by providing solutions from the results of the diagnosis. The expert system diagnoses pests and diseases of Arabica coffee plants in this study using a certainty factor to determine the level of certainty of a pest and disease based on the selected symptom data, then the data is processed, then the output is in the form of suggestions or controls given based on the input symptoms. The accuracy of the calculation process for the certainty factor method is influenced by the selection of symptom data on the consultation page.

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