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Expert System for Diagnosis of Pests and Diseases of Citrus Plants using the Certainty Factor Method (Case Study in Deram Village, Karo Regency)

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ABSTRACT

This research is an expert system for the diagnosis of disease pests in citrus plants using the Certainty Factor Method. The Certainty Factor method is used to diagnose existing pests in citrus plants, which can be seen from the value of the symptoms obtained from citrus plant experts. This expert system research was built with Visual Basic 2010 application as a tool to diagnose disease pests in citrus plants, especially sweet oranges in the village of Deram, Karo Regency and use Microsoft Access 2010 as a database. The diagnosis results from this expert system are in the form of control as a solution to overcome and eradicate pests in citrus in Deram Village and this expert system aims to help citrus farmers, especially sweet oranges and the community, to identify pests in citrus.

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1. INTRODUCTION

Citrus plants are fruit plants that contain a lot of vitamin C which are much in demand by people in Indonesia. Citrus plants are annual fruit plants originating from Asia which are widely planted in the tropics, citrus plants are now widely cultivated by farmers in Indonesia. Indonesia, because citrus plants can be grown in tropical areas in the lowlands and in the highlands in Indonesia [1].

Citrus plants are now widely developed in the tropics of Karo Regency, North Sumatra and one of them is in Deram Village, Merdeka District, Karo Regency, where most of the farmers in Deram Village are sweet orange farmers, because Deram Village has fertile soil for farming. so that sweet orange plants are very suitable to be planted in these cold areas. In addition to the tropics, sweet orange plants are also influenced by fertile soil and weather and maintenance that is protected from pests and diseases [2].

At present, there are still many farmers in Deram Village who do not recognize citrus pests and diseases because farmers still lack information about pests and diseases of sweet citrus and even farmers still need experts to diagnose citrus pests and diseases. Citrus plants in the village of Deram have been affected by many pests and diseases, so farmers have to find solutions to control these sweet citrus pests, but farmers must recognize the types of pests and diseases of sweet citrus. Karo district currently are Pests Brown, black and green aphids (Toxopetra citridicus, T.auranti and Myzuz

persicae), red mites (Panonycus citri) Thrips (Scritothrips citri), leaf caterpillars (Phylocnistis citriella), lice/shield ticks (Lepidosaphes beckii & Unaspis citri), Fruit fly (Bactrocera spp). Fruit borer (Citripestis sagitiferella), lice (Planococcus citri), snail/leaf snail pests (Helix aspera), leaf-eating beetles (Maleuterpes dentipes), citrus hopper (Diaphorina ciitri) [3] [4] [5]. And types of citrus diseases, including Blendok disease. (Phitoohthora nicotiana, P.citophthora and P.palmivora), Diolodia skin disease (Botryodiplodia theobromae), Black root rot (Armilariasp), Anthracnose disease (Colletotrichum gloeosporioides and gloeosporium limetticolum), Powdery mildew rot of stem base (Fusarium) tingitatinum), Peel fungus (Corticium salmonicolor), scurvy (corticium salmonicolor), green/blue mold (Penicillium spp) [6] [7] [8]. To identify pests and diseases of sweet citrus plants requires a diagnosis by an expert.

Diagnosis is determining the cause of malfunctions in complex situations based on the observed symptoms, including medical, electronic, mechanical and software [9]. Farmers in Deram village are currently very difficult to diagnose citrus pests and diseases and farmers still lack information about pests. and sweet orange disease.

For the types of pests and diseases of sweet orange, a farmer can seek information on pests and diseases of sweet orange through social media, books and an expert. With the rapid development of information technology, information from an expert can now be accessed via the internet, the system is called an expert system.

Expert systems are knowledge-based programs that provide expert-quality solutions to problems in a specific domain [10] [11] [12]. Expert systems are a branch of artificial intelligence and computer science that have emerged with the development of computer science today [13]. The method used in this expert system is Certainty Factor method, which expresses belief in an event (fact or hypothesis) based on evidence or expert judgment.

2. RESEARCH METHODS

The research method is basically a scientific way to obtain data with a specific purpose and use. In the research method, there are several methods made in the expert system research on the diagnosis of citrus pests, namely the method of Observation, Interview, and Literature Study. The following is an explanation of the three methods.

2.1 Data collection

a. Observation

Observation method, namely observation and recording of the phenomenon carefully. This method is one of the important tools for data collection that will require direct or indirect observations of the object of research carried out..

b. Interview

The interview method is the process of obtaining information for research purposes and direct conversations with sources or experts to obtain as clear-cut information as possible. The interviews conducted by the researchers were interviews with the Department of Agriculture in Karo Regency and interviews with sweet orange farmers in Deram Village.

c. Study of literature

Literature study is a method used to collect data or sources related to the topic raised in a study. Literature studies can be obtained from various sources such as journals, internet, and books.

2.2 Data analysis

To complete this research, researchers conducted research at the Office of Agriculture and Plantation Jl. Veteran No. 24, Kabanjahe Karo Regency, North Sumatra and citrus plants in Deram village. This agriculture and fishery office is the regional agriculture office of Karo district, North Sumatra Province.

This agricultural service functions to carry out the affairs of authority and assistance in the agricultural sector in the Karo district, North Sumatra. Deram village is a village located in the Merdeka sub-district, Karo district, some farmers in Deram village are sweet orange farmers and to obtain information on plant pest data Then, a direct inspection of citrus plants from farmers affected

by pests and diseases in citrus plantations in Deram village was conducted and an interview with one of the sweet orange farmers in Deram village was conducted.

2.3 Certainty Factor Method Analysis

The Certainty Factor method is a way of combining belief and distrust in a single number in certainty theory, qualitative data is represented as a degree of confidence. Certainty Factor shows a measure of certainty against a fact or rule.

Certainty Factor is used when facing a problem for which the answer is uncertain, this uncertainty can resemble Probability [14].

Certainty Factor introduces the concept of belief/belief and disbelif/unbelief. This concept is then formulated in the following basic formula [15] [16].

$$CF[H,E] = MB[H,E] - MD[H,E] \quad (1)$$

Description:

CF = *Certainty Factor hypothesis* in the hypothesis H which is influenced by the fact E

MB = *means of believe*, is the incremental value of the confidence hypothesis H is influenced by the fact E.

MD = m*reward of disbelieve*, is the increasing value of the distrust of hypothesis H influenced by fact E.

H = Hypothesis (alleged).

E = *Evidence* (events/facts)

Combining belief and disbelief in a single number has two uses, namely, first, the certainty factor is used to rank hypotheses in order of importance.

The original definition of Certainty Factor is:

$$CF = MB - MD \quad (2)$$

In 1997 the original definition was changed in MYCIN to:

$$CF = \frac{MB-MD}{1-\min(MB,MD)} \quad (3)$$

In the MYCIN method for combining facts in the antecedents of the rules, it can be seen in the following table:

Table 1. Combining Facts in Entities

Evidence E	antecedent uncertainty
E_1AND E_2	Min[CF(H,).CF(H,)E_1E_2 Max[CF(H,),CF(H,)E_1E_2
E_1 AND E_2 NOT E	-CF(H,E)

For example, we know a logical expression for concatenating evidence:

E = (E_1 AND AND) OR (AND NOT)$E_2E_3E_4E_5$

Evidence E will be calculated as follows:

E = max[min(E_1, E_2, E_3), min()]$E_{4,}-E_5$

If the value is known:

$E_1 = 0{,}9$ $E_2 = 0.8$ $E_3 = 0.3$

$E_4 = -0.5$ $E_5 = -0.4$

Then the result is:

E = max[min(0.9;0.8;0.3), min(-0.5;-0.4)]

= max[0.3;-0.5]

= 0.3

3. RESULTS AND DISCUSSION

3.1 Implementation

The implementation of this program system includes specifications for hardware requirements (hardware) and specifications for software (software).

a. Hardware and Software Specifications

This program is run using hardware that has the following specifications:

1). AMD E1-2500 APU Processor
2). Memory 4GB
3). Hard disk 320 GB
4). 11 inch LCD monitor
5). Keyboard and Mouse

The software used to run this application are:

1). Windows 8 operating system.
2). Visual Basic 2010
3). Microsoft Access 2010
4). Crystal report

b. Program Execution Results

Figure 1. Main Menu Form

The main menu is the first page that appears after logging in and when the user accesses the Pest and Disease expert system page. In the main part of this page there are main menus such as Master Data, Consultation and exit.

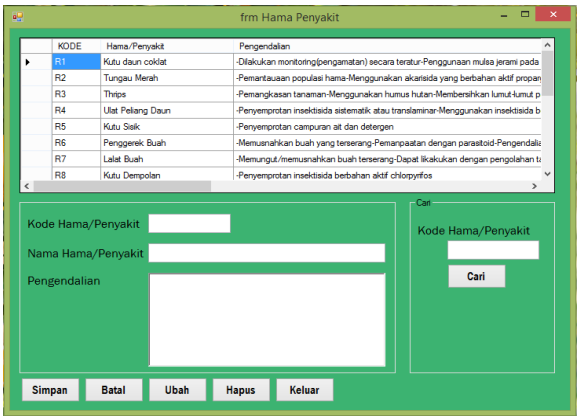


Figure 2. Pest Disease Data Form

Pest Disease Data form display form containing the type code Pest and Disease which displays all types of pests and diseases and their control with the type code of pests and diseases that

have been inputted. In the pest form, there is also a search for pests and diseases that serves to facilitate the search for types of pests and diseases.

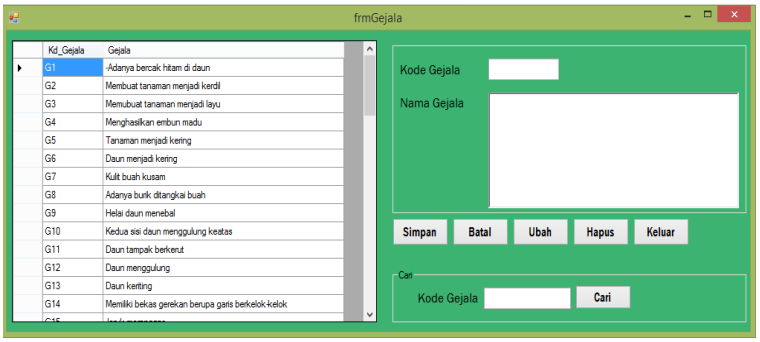


Figure 3. Symptom Data Form

The display of the Symptom data form is a display of the symptom code form along with the name of the symptoms that have been stored, there is also a search button to make it easier to search for symptoms of citrus pests.

3.2 Discussion

In designing the "Expert System for Diagnosis of Diseases of Citrus Pests, especially sweet oranges in Deram village using the Certinty Factor method", the author uses a program based on Vb.Net 2010 and uses Microsoft Access 2010 as the database.

Inference mechanism with Certainty Factor method for expert system Diagnosis of sweet orange pests using the following steps;

a. Step 1, Fill in the Registration data

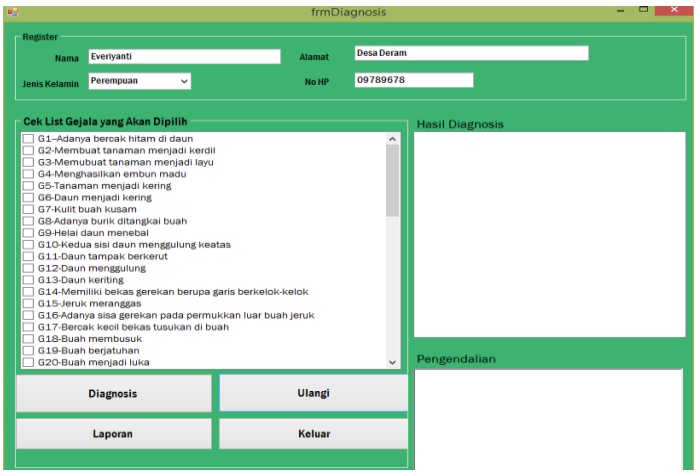


Figure 4. Register

The first step, after entering the consultation data, is that there is a register display at the top of the consultation. This registration section functions to input the farmer's personal data, which contains the farmer's full name, gender, farmer's address and farmer's cellphone number.

b. Step 2 Select Symptoms by checking the available View list check pad.

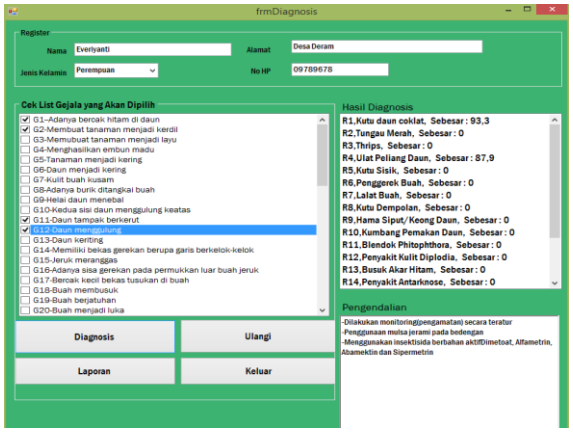
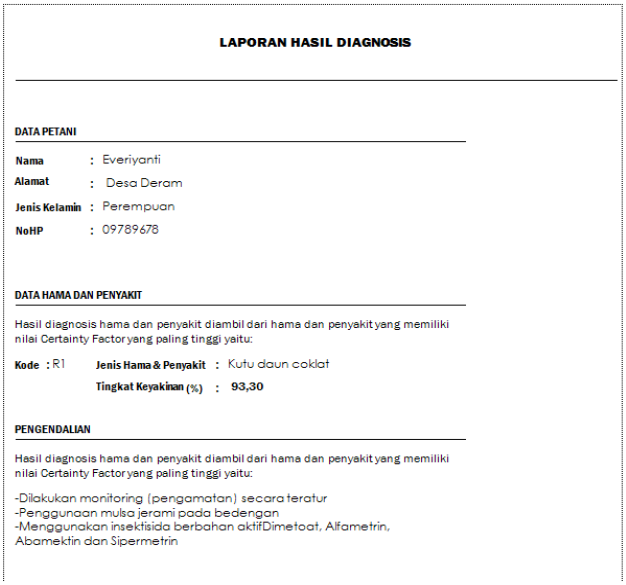


Figure 5. Choose Symptoms and Diagnosis

Step 2 select the symptoms listed under registration, these symptoms are selected by checking the list of symptoms to be selected then clicking the diagnosis button to find out the results of the symptoms that have been checked and if there is an error or lack of data that has been made, you can click the repeat button to repeat data entry or select symptom data.

c. Step 3 Displaying the Diagnostic Result Report



LAPORAN HASIL DIAGNOSIS

DATA PETANI

Nama : Everiyanti
Alamat : Desa Deram
Jenis Kelamin : Perempuan
NoHP : 09789678

DATA HAMA DAN PENYAKIT

Hasil diagnosis hama dan penyakit diambil dari hama dan penyakit yang memiliki nilai Certainty Factor yang paling tinggi yaitu:

Kode : R1 **Jenis Hama & Penyakit** : Kutu daun coklat
Tingkat Keyakinan (%) : **93,30**

PENGENDALIAN

Hasil diagnosis hama dan penyakit diambil dari hama dan penyakit yang memiliki nilai Certainty Factor yang paling tinggi yaitu:

-Dilakukan monitoring (pengamatan) secara teratur
-Penggunaan mulsa jerami pada bedengan
-Menggunakan insektisida berbahan aktifDimetoat, Alfametrin, Abamektin dan Sipermetrin

Figure 6. Diagnostic Report Results

Step 3 is the display of the diagnosis results which contains reports on the results of farmer's personal data, symptoms of pests and diseases, the results of diagnosis and control in the results of this diagnosis can be printed.

4. CONCLUSION

From the results of the analysis and discussion that have been put forward, it can be concluded that several conclusions are as follows:

The Certainty Factor method is applied in diagnosing these citrus plant pests by inputting the symptoms of existing pests and determining the value of the symptoms, namely the MB and MD values. the calculation process is carried out by the Certainty Factor calculation. The calculation process of the Certainty Factor method is influenced by the weight value of the pest symptoms

resulting from the Certainty Factor calculation in the form of a control solution for sweet orange plant pests in Deram village.

This expert system is built with Visual Basic 2010 application using Microsoft Access 2010 as database. This system was built with the UML design which consists of the design of Use Case Diagrams, Activity Diagrams and Class Diagrams in this system application made to facilitate the community, especially farmers, to be able to know the types of citrus plant pests and their control. without the need to look for experts and this expert system is used as a means of consulting citrus pests and diseases.

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