

# Applying certainty factor method to identify diseases in rice plants

Bangkit Indarmawan Nugroho<sup>1</sup>, Ahmad Miftakhuddin<sup>2</sup>, Syefudin Syefudin<sup>3</sup>, Gunawan Gunawan<sup>4</sup>

<sup>1</sup>Information System, STMIK YMI Tegal, Indonesia  
<sup>2,3,4</sup>Informatics Engineering, STMIK YMI Tegal, Indonesia

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## ABSTRACT

Rice (*Oryza Sativa* L) is the most important food crop in the world after wheat and corn, as well as the main source of protein for most of the world's population, especially in Asia. The Save Swamps for Prosperous Farmers (Serasi) program in Central Java Territory cannot run well considering the tall capacity of existing rice agriculturists to bargain with bugs and maladies of the rice they plant, so it is essential to make a device within the frame of an master framework for diagnosing rice plant infections. For this reason, it is very important to be aware of the factors that influence production levels. Disease is one of the most detrimental factors in rice production, where many losses are caused by disease. Each of these diseases generally shows symptoms of the disease suffered before it reaches a more severe and widespread stage, these symptoms can be recognized by carrying out a diagnosis first. This can be done using an expert system. In this research, an expert system was utilized which was made utilizing the certainty figure strategy, with a test of 25 ranchers within the West Tegal Area, Tegal City. From the comes about of the inquire about carried out, it was concluded that with this framework the level of exactness obtained using the posttest contains a esteem of 100%, in other words the framework encompasses a decently tall level of accuracy.

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### Corresponding Author:

Ahmad Miftakhuddin,  
Informatics Engineering,  
STMIK YMI Tegal,  
Jl. Pendidikan No.1 Pesurungan Lor, Margadana, Tegal City 52147, Central Java, Indonesia.  
Email: ahmadmifta66@gmail.com

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## 1. INTRODUCTION

Padi (*Oryza Sativa* L), is a very important crop because rice is still used as a commodity for most of the Indonesian population, also the world to this day (Sutardi et al., 2023). Even rice has been a strategic commodity (Rozi et al., 2023) because rice has a huge influence on economic and political stability (Mardiharini et al., 2023). Over the past five to ten years, rice production trends in Central Java have shown fluctuations influenced by various factors such as crop size, weather conditions, and agricultural policies. Overall, despite an increase in the use of technology and supporting policies, external factors such as weather remain a major challenge in increasing rice production in Central Java. With proper management, including mitigation of the impact of climate change, rice production is expected to be more stable in the future.

Moreover, uncertain seasonal changes, as well as poor farmers' ability to cope with pest attacks can eventually lead to lower rice productivity, so governments have to import rice to meet national needs (Sarkar et al., 2022). This situation is aggravated by the economic crisis that affects farmers' purchasing power for means of production, especially fertilizers, pesticides, and medicines

(Pu & Zhong, 2020). Central Java is one of the Central Government's Compatibility Programmes (Save the Farmers' Welfare) (Ariyani & Fauzi, 2023), farmers can be well-off when there is an increase in grain production in addition to the increase in the population's food needs (Lowder et al., 2021).

The Central Java province is considered a potential because it has almost 80% of the existing land (Safitri et al., 2021). Based on data from the Food Plant and Horticulture Department of Central Java Province, the implementation of the Serasi program reached 250,000 hectares spread across the district/city (Nasikh et al., 2021). An increase in productivity would not be possible without paying attention to the attacks of beetroot diseases, because plant diseases in beetroots could change the lives of humans from food enough as a result of increased productivity into starvation and even death. In the 1940s, about two million people in Bangladesh died of starvation due to the cultivation of peanut crops infected by the fungus *Helminthosporium oryzae* (Bhunjun et al., 2021). As for the attacks, they can be caused by infection at the time of filling, fertilization, growth, or even during harvest. There are still many farmers in Central Java who are unable or inadequate to cope with the attacks of pests and plagues (Khairullah et al., 2024). If this is not repeated, then the plan of Central Java to become a national shelter will be difficult to (Lines et al., 2022).

According to the data provided by the Chief of the Food Plant and Horticulture Department of Tegal, at present, the tungro virus not only attacked the newly lucky farmers but has now spread to other species, namely West Tegal Prefecture, East Tegal prefecture as well as Margadana Prefectures, also in South Tegal Prefecture based on BPP Perfection data (Wahyono & Huda, 2024). In 2020, there were 1,487 tons of grain produced as a result of the pest attack and the disease of the grain (Refaai et al., 2023), there was a decrease in the harvest of 1.487 tonnes (8.20 percent) compared to 2023 (Yadav et al., 2021).

## 2. RESEARCH METHOD

### Factors of certainty (Certainty Factor)

According to John McCarthy, Artificial Intelligence (AI) is to know and model human thinking processes and design machines to mimic human behavior, also defined as the intelligence of scientific entities (McCarty, 2024). Systems like this are generally considered computers (Diederich et al., 2022). That is, intelligence is created and inserted into computers so that they can do the work that humans do (Verganti et al., 2020).

An expert is a person who has expertise in a particular field, i.e. an expert who has special abilities that others do not know or are capable of in the field they possess (Bereczki & Kárpáti, 2021). Certainty Factor (CF) is a method proposed by Shortliffe and Buchanan in 1975 to accommodate an expert's inexact reasoning (Zhao et al., 2021). An expert often analyzes information in terms of "possible", "most likely", or "nearly certain". So, the existence of the Certainty Factor method can describe the degree of confidence of an expert in a problem (Rendall, 2022).

Certain Factor is part of the certainty theory, which was first introduced by Shortliffe Buchanan in the creation of the MYCIN (an early expert system application designed to identify bacteria that cause severe infections) notes that experts often analyze the information available in terms such as those mentioned above: (Unknown, A Little Confident, Quite Sure) (Omar et al., 2021). To oblige this, the MYCIN group employs the certainty factor (CF) to depict the level of expert certainty within the issue (Kovas et al., 2023).

CF or the factor of certainty is additionally valuable to overcome instability in deciding disease that has the same indications (evidence) (Burgel et al., 2024). CF too utilized the concept of Measures of Belief (MB) and Measures of Disbelief (MD) (Ajenaghughrure et al., 2020). In providing MB, MD, and CF measurements, MYCIN provides parameters to indicate the size of trust.

The table of CF Trust Value Rules is shown in table 1 as follows:

**Table 1.** CF trust value rules

Trust	CF
Unknown	-1,0 to -0,79
A little confident	-0,8 to -0,59
Quite sure	-0,6 to -0,39
Sure	-0,4 to -0,19
Very sure	-0,2 to 0,2

Table of interpretation values for MB and MD is shown in table 2 as follows:

**Table 2.** Interpretation values for MB and MD

Trust	CF
I don't know	0 - 0,29
Maybe	0,3 - 0,49
Big probability	0,5 - 0,69
Almost	0,7 - 0,89
Must be	0,9 - 1,0

The Certainty Factor uses a measure of confidence (MB) and an unbelief measure (MD) in combining several evidence to determine the CF value of a hypothesis. This concept was then formulated into formula 1:

$$CF [h,e] = MB [h,e] – MD [h,e] \dots\dots\dots(1)$$

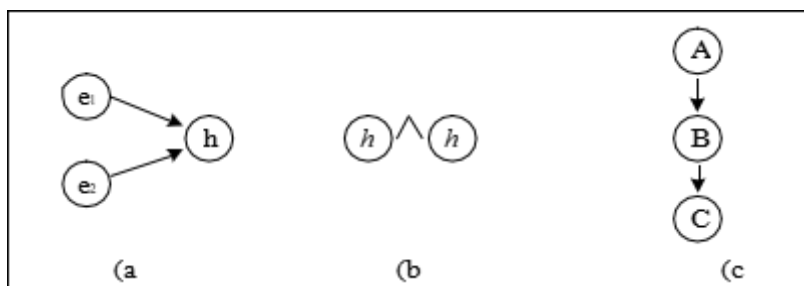
Description:

CF [h,e] = the certainty factor of the hypothesis h influenced by evidence e. The magnitude of CF ranges from -1 to 1. A value of -1 indicates absolute unbelief while a value of 1 shows absolute belief.

MB [h,e] = measure of confidence against hypothesis h, if given evidence e (antara 0 dan 1)

MD [h,e] = measure of unbelief in the hypothesis h, if given evidence e (antara 0 dan 1)

Next, on certainty factor there are several possible combinations of uncertainty rules that can occur. Picture The combination of uncertainty rules can be shown in figure 1 as follows:



**Figure 1.** Combination of uncertainty rules

1. Some evidence is combined to determine the CF of a hypothesis as seen in figure 1 (a). If e1 and e2 are symptoms, then formula 2:

$$\begin{aligned}
 MB[h, e1 \wedge e2] &= \{MB[h, e1] + MB[h, e2].(1 - MB[h, e1])\} \dots\dots\dots \\
 MD[h, e1 \wedge e2] &= \{MD[h, e1] + MD[h, e2].(1 - MD[h, e1])\} \dots\dots\dots(2)
 \end{aligned}$$

2. CF is calculated from a combination of several hypotheses as seen in figure 1 (b) If h1 and h2 our hypothesis then formula 3:

$$\begin{aligned}
 MB[h_1 \square h_2, e] &= \min(MB[h_1, e], MB[h_2, e]) \\
 MB[h_1 \vee h_2, e] &= \max(MB[h_1, e], MB[h_2, e]) \\
 MD[h_1 \square h_2, e] &= \min(MD[h_1, e], MD[h_2, e]) \\
 MD[h_1 \vee h_2, e] &= \max(MD[h_1, e], MD[h_2, e]) \dots \dots \dots (3)
 \end{aligned}$$

3. Some rules overlap, the uncertainty of one rule becomes input for another rule as seen in figure 1 (c) then formula 4:

$$MB[h, s] = MB[h, s] * \max(0, CF[s, e]) \dots \dots \dots (4)$$

With MB' [h, s] is a measure of confidence h based on full confidence in validation s. The Value table is shown in table 3 as follows:

Table 3. Value Table

Range Value	Weight Value	Font Value	Category
81-100	4	A	Special
71-80	3,5	AB	Well once
66-70	3	B	Good
61-65	2,5	BC	Good enough
55-60	2	C	Enough
41-54	1	D	Less
0-40	0	E	Less than once

Judgment here is the ability of a person to make consideration of a condition, value, or idea, assuming if a person is faced with several choices then he will be able to choose one option best according to the standards or criteria existing.

**3. RESULTS AND DISCUSSIONS**

Some of the main views of the built-in system, presented in figure 2, 3, and 4. The consultation menu form on figure 2 serves to choose side effects that have been checked by the user to proceed the method to the conclusion outcome, to continue to the demonstrative result tap the method button underneath the side effect choice table. The consultation menu is shown in figure 2 as follows:

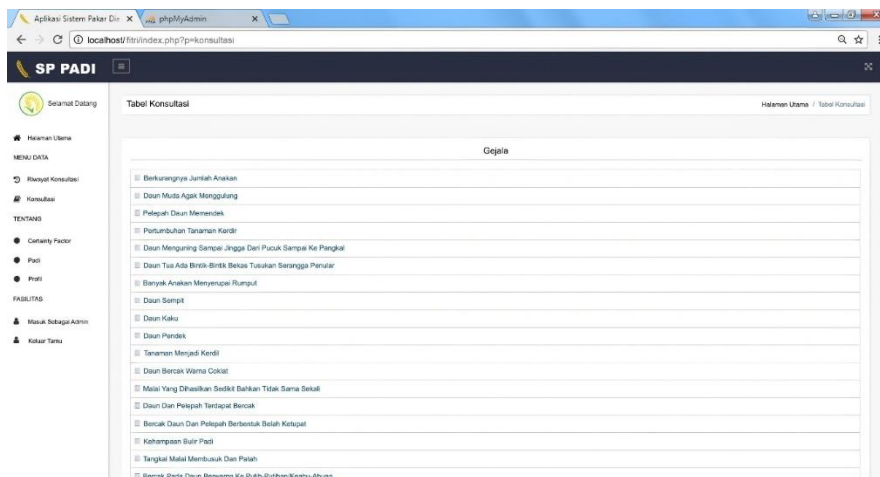


Figure 2. Form consultation menu

The user symptomatic result frame in figure 3 serves to show the comes about of the determination that the client has performed after a past side effect choice, in this shape comprises of the result of the choice of indications, the results of the malady that have been depicted by the side effect, the certainty calculate esteem, and the consultation.

Image of User Diagnosis Results Form is shown in figure 3 as follows:

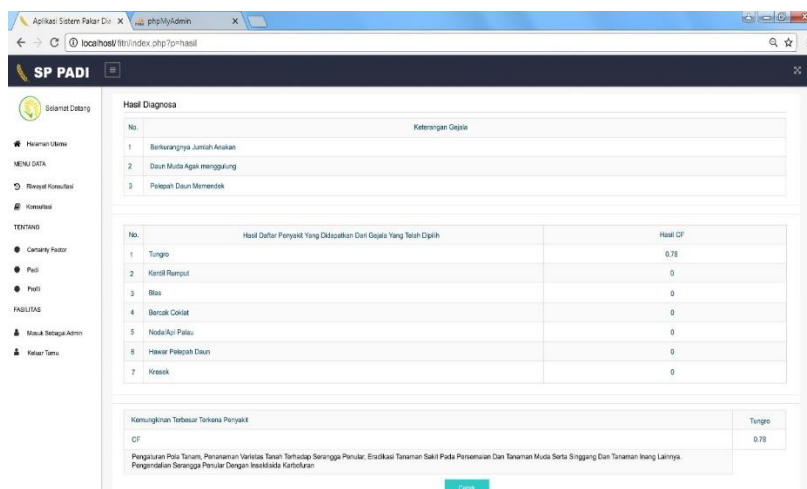


Figure 3. User diagnosis result form

Print form results on image 4 diagnosis function printing results of diagnosis performed by the user. Diagnosis results are shown in figure 4 as follows:

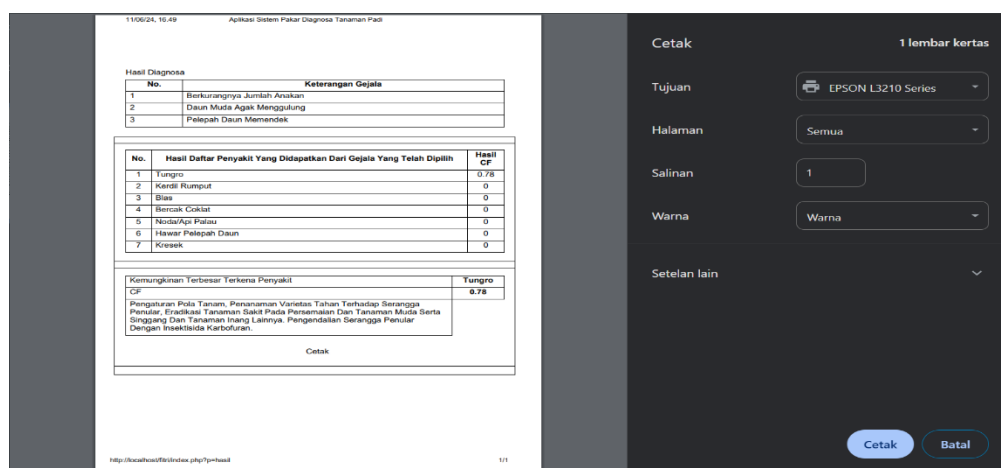


Figure 4. Form print diagnosis results

On table 4 is one showing comparison of diseases of plants that are diagnosed using specialized systems with Certainty Factor methods that are compared with the diagnoses of specialists. The Posttest Test Results table is shown in table 4 as follows:

**Table 4.** Posttest results

Symptoms	Expert Diagnosis	Application Diagnosis	Description
Spotted on the rod Small round-shaped young spots of dark brown	Chocolate Spots	Chocolate Spots	Suitable
Spotted on the oval-shaped leaves The leaves and leaves are spotted	Blas	Blas	Suitable
Leaf stains and squid-shaped leaves The emptiness of the rice plant Generally affects young rice plants (1-2 weeks) Attacks occur on the edges of the wounded leaf in the form	Crash	Crash	Suitable

Symptoms	Expert Diagnosis	Application Diagnosis	Description
of spotted lines of the leaf			
There's a lot of grass The leaves are narrow Hard leaves	Grass Dwarf	Grass Dwarf	Suitable
Old leaves have stains of infectious insect stains. Growth of dwarf plants	Tungro	Tungro	Suitable
Gray-green spotted color. Attacked leaves slightly rolling, drying grey color whitening	Crash	Crash	Suitable
Attacked leaves drying from the ends.	Leaf Blowing Hawar	Leaf Blowing Hawar	Suitable
Spotted marks on leaves and strands of leaves The gasket is not full / empty The plants are starting to crumble	Leaf Blowing Hawar	Leaf Blowing Hawar	Suitable
One malai is just a few grains attacked.	Fake node/fire	Fake node/fire	Suitable
The color of the spore balls is yellow-green/green On the skin of black spots. The size of the spots can reach 1 cm.	Chocolate Spots	Chocolate Spots	Suitable
Small round-shaped young spots of dark brown. Spotted on the rod.	Chocolate Spots	Chocolate Spots	Suitable
The stake is rotten And broken.	Blas	Blas	Suitable
Spotted on blank-white-gray coloured leaves			
Malai produced a little even not at all. Brown spotted leaves. Growth of dwarf plants. Leaf blossoms shrink.	Grass Dwarf	Grass Dwarf	Suitable
The emptiness of the padi. The stake is rotten and broken.	Tungro	Tungro	Suitable
Malai and padi filled With spores.	Blas	Blas	Suitable
Malai and padi filled With spores.	Fake node/fire.	Fake node/fire.	Suitable
One malai is just a few Grains attacked Leaf blossoms shrink The leaves are yellowed to the thighs from the shoots to the gray-green spotted color.	Tungro	Tungro	Suitable
Attacks occur on the edges of the wounded leaf in the form of spotted lines of the leaf.	Crash	Crash	Suitable
The gasket is not full/empty. Spotted marks on leaves and strands.	Leaf Blowing Hawar	Leaf Blowing Hawar	Suitable
Plants become dwarves. Hard leaves.	Tungro	Tungro	Suitable
One malai is just a few grains attacked. Malai and padi filled with spores.	Fake node/fire	Fake node/fire	Suitable
Decreased number of offspring. Growth of dwarf plants.	Tungro	Tungro	Suitable
Small round-shaped young spots of dark brown. On the skin of black spots	Chocolate Spots	Chocolate Spots	Suitable

Symptoms	Expert Diagnosis	Application Diagnosis	Description
Leaf stains and squid-shaped leaves. The stake is rotten and broken.	Blas	Blas	Suitable
The leaves are narrow. Brown spotted leaves	Grass Dwarf	Grass Dwarf	Suitable

Current research has successfully filled the gaps found in previous research by offering a more sustainable and environmentally friendly solution for pest control in rice crops. The Integrated Pest Control (PHT) approach shows more positive results in the long term than conventional methods that rely solely on chemical pesticides.

The results of the expert system diagnosis in table 4 show that the entire sample of the diagnosis is the same as the expert's opinion, so it can be said that the specialist system with the certainty factor method has a high accuracy rate of 100% for the amount of data tested as much as 25 data.

#### 4. CONCLUSION

Provide a statement that what is expected, as stated in the "Introduction" chapter can ultimately result in the "Results and Discussion" chapter, so there is compatibility. Moreover, it can also be added the prospect of the development of research results and application prospects of further studies into the next (based on results and discussion), With the existence of this system, it can be used as a tool to support the activities of Save the Farmers' Welfare Rawa (Sharat) which is a Central Government program located in Central Java Province, and As for the suggested system, it could be tested in other areas in Central Java Province, or developed with an Android-based system.

This research in reducing the impact of pests and diseases on rice crops has made some significant contributions to the field of science: environmentally friendly approach: This research introduces and develops Integrated Pest Control (PHT) methods that reduce dependence on chemical pesticides and promote the use of natural enemies, which are safer for the environment, modern Agricultural Technology: Introducing the use of advanced technology and routine monitoring methods for early detection and pest management, improving efficiency and efficiency in agricultural practice, practical knowledge: Providing practical guidance to farmers and other stakeholders on more effective and sustainable pest control techniques, agricultural sustainability: Helps create more sustainable agricultural systems, which can maintain long-term productivity without damaging ecosystems. Thus, this research not only fills the gaps in existing knowledge but also encourages more sustainable and environmentally friendly farming practices.

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