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Expert System To Diagnose Stem Border In Sugarcane Plant With Certainty Factor Method

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Abstract:

Sugarcane (Saccharum Officanarum L) is an annual plantation crop, which has its own characteristics, because it contains sugar in its stems. Sugarcane belongs to the grass family (graminae) like rice, reeds, corn, bamboo and others. One of the problems that exist in sugarcane plantations at PT Perkebunan Nusantara II is stem borer pests. Losses due to borer attacks can be in the form of a decrease in sugarcane weight, yield and quality of the sap obtained. pests on sugarcane plants cause a decrease in sugar production of about 10%. There are three types of stem borer pests found in PT Perkebunan Nusantara II, namely shoot borer pests, striped stem borer pests, and giant stem borer pests. Meanwhile, biological control is by spreading natural predators of pests which will suppress the population of widespread distribution and breeding of pests which are commonly called parasitoids. Parasitoids will become predators of their respective hosts, so appropriate diagnostic therapy for stem borer pests is needed so that the spread of stem borer pests does not become more widespread and the parasitoids to be spread operate effectively. By using the Certainty Factor method, you can find out the types of pests that are attacking sugarcane plants. Based on manual calculations, the dipole yield was 79% on one of the selected pest types based on the symptoms induced in the sugarcane plant.

Keywords: *Certainty Factor, Mysql, PHP, Sugarcane*

1. Introduction

Sugarcane (Saccharum Officanarum L) is an annual plantation crop, which has its own characteristics, because the sugar is contained in the stem. Sugarcane belongs to the grass family (graminae) such as rice, reeds, corn, bamboo and others . Biological control with parasitoids can suppress pest populations. There are three types of stem borer pests found at PT Perkebunan Nusantara II, namely shoot borer pests, striped stem borer pests, and giant stem borer pests. These three types of pests become destructive commodities to sugarcane stalks in plantations which are characterized by damage to sugarcane stalks at a young age until they are ready for harvest.

Sugar cane pest control is usually done in several ways, namely by biological control and pesticides. The biological control is by spreading the pest's natural predators which will suppress the population of widespread distribution and breeding of pests which are commonly called parasitoids. Because biological control will minimize the excessive use of pesticides. Although plantations continue to use pesticides, parasitoids are very helpful in controlling the destructive stem borer pests as well as reducing the amount of yield on stems naturally. widespread and the parasitoid to be spread does its job effectively. At PT Perkebunan Nusantara II there are several types of parasitoids for biological control, one of which is Xanthocampoplex sp, Apanteles sp, Sturmiopsis inferens. This parasitoid was developed in Sei Semayang sugarcane and tobacco RISBANG with a relatively low success rate.The expert system will make it easier for farmers to quickly diagnose stem borer pests without having to wait for field observers to check them. Because if the pest is handled slowly, the pest will continue to lay eggs and reproduce in the sugar cane garden.

2. Literatur

According to research [2] the Certainty Factor method was chosen because this system will analyze based on existing symptom data entered by the user so that a result of disease identification in sugar cane is obtained in the form of disease names, accuracy level and how to handle

it. By calculating the Certainty Factor method from one sugarcane plant disease, a confidence value can be obtained from the diagnosis results with an accuracy rate of 94.6%. In this study the included pest variables were not found in pest variables at PTPN II Sei Semayang. According to research [3] the system for determining the types of diseases in cucumbers was analyzed based on the existing symptoms through calculations using the Certainty Factor method with the result that there were 2 diseases, namely powdery mildew and rotten fruit with a confidence presentation of 0.6, a value of 60%. The system can detect more than one disease with 2 possibilities of the same percentage based on the symptoms present.

According to research [4] in this system researchers can present a possible level of disease with a value of 94.12% using the Certainty Factor Method. Based on the symptoms and level of probability agreed by an expert, the disease can be detected at a relatively young age in sugarcane so it doesn't spread to other plants.

2.1. Certainty Factor

The Certainty Factor theory is to accommodate the uncertainty of an expert's thought proposed by shortlife from Buchanan in 1975. An expert (eg a doctor) often analyzes existing information with expressions of uncertainty, to accommodate this we use a certainty factor to describe the level of expert confidence in the problem being faced [4]

2.2. Expert system

An expert system, also known as a Knowledge-Based System, is a computer application designed to assist decision-making or solving problems in a specific field. This system works by using knowledge and analysis methods that are defined in advance by experts in accordance with their areas of expertise. This system is called an expert system because its functions and roles are the same as an expert who must have knowledge and experience in solving a problem. The system usually functions as an important key that will help a decision support system or executive support system [5].

The characteristics of an expert system are as research, including:

1) Limited to a certain domain of expertise
2) Can provide reasoning on uncertain data.
3) Can put forward a series of reasons given in a way that can be understood.
4) Based on certain rules or rules.
5) Designed to be developed in stages
6) Knowledge and inference mechanisms are clearly separate.
7) The output is recommended.
8) The system can activate rules in the appropriate direction guided by dialogue with the user

2.3. XAMPP

XAMPP is software (software) which is a kind of application package in which there are several other software that are supported in processing websites or web-based applications [6].

2.4. Website

The website is a medium that has many linked pages (hyperlinks), where the website has the function of providing information in the form of text, images, video, sound and animation or a combination of all of them. Websites at this time are generally dynamic, but static websites are rare or even almost non-existent. The main characteristic of the website is that the pages are connected to each other, and are equipped with a domain as an address (URL) or the world wide web (www) and also hosting as a data storage medium. The website can be accessed via the internet network with a platform called a browser, such as Chrome, Mozilla Firefox, Internet Explorer (IE), Opera and so on [6].

2.5. Understanding PHP

PHP has become a website programming language that is widely used to create dynamic web pages. In this case, it is reinforced by Solichin (2016) which states that PHP is one of the languages used for website development. PHP was originally developed at the end of 1994 by Rasmus Lerdorf, but is now taken up by the PHP Group. PHP is a language that is an interpreter, in the sense of reading every instruction and syntax (coding) by reading one by one or line by line of program code [6].

2.6. Sugarcane Plant

Sugarcane (Saccharum Officanarum L) is an annual plantation crop, which has its own characteristics, because the sugar is contained in the stem. Sugarcane belongs to the grass family (graminae) such as rice, reeds, corn, bamboo and others [7], [8], [9].

3. Results And Discussion

The purpose of this research is to create a system that can detect types of pests in sugar cane based on existing symptoms and to determine the level of accuracy in diagnosing sugarcane diseases and solutions to overcome these problems.

3.1. Application of the Method

The certainty factor method uses a value to assume an expert's level of confidence in a data. This method will make it easier to calculate the certainty of stem borer diagnosis of the indications of symptoms that appear.

Table 1: Sugarcane Stem Borer Pests

No.	Id Pest	Types of Sugarcane Stem Borer Pests
1	H01	Shoot Borer
2	H02	Striped Stem Borer
3	H03	Giant Stem Borer

Table 2: Table of Symptoms and Sugarcane Stem Borer Pests

No.	Symptom Id	Symptom Name	H01	H02	H03
1	G01	Rotting of young stems (navel death)	✓	✓	✓
2	G02	Buds and leaves dry up	✓	✓	✓
3	G03	Hollow leaves	✓		
4	G04	Brownish red streaks on the stems	✓		
5	G05	Holes in the knuckles (cane bones)	✓		
6	G06	New shoots appear on sugarcane bones (siwilan)	✓	✓	✓
7	G07	Stems tergerek from the shoots to the bottom	✓		✓
8	G08	Hoist in a straight rod	✓		✓
9	G09	Hollow rod with movement upwards		✓	
10	G10	Transparent spots on irregular leaves		✓	✓
11	G11	Irregular twist in rods		✓	
12	G12	Holes in leaf sheaths		✓	✓
13	G13	The middle of the cane rots and breaks		✓	✓
14	G14	Dwarf plant	✓	✓	✓

The following is the Certainty Factor value:

Table 3: Table of Certainty Factor Values of Experts and Users

Uncertainty Tram	CF
No	0
Don't know	0.2
Little Sure	0.4
Sure enough	0.6
Certain	0.8
Very confident	1

3.2. Case Study

In one block of sugarcane plantations at PTPN II Sei Semayang there are symptoms on one of the sugarcane trees with a User weight value, for example the User chooses the following answer:

1. Young stem rot (navel death) = sure enough
2. Buds and leaves dry up = very sure
3. The stem moves from the top down = a little sure
4. Holes in knuckles (cane bones) = Little Sure
5. Hollow leaves = a little sure

Table 4: Table of Symptoms and Pests

No.	Symptom	Types of Pests	CF Expert	CF users
1	Rotting of young stems (navel death)		0.6	0.6
2	Buds and leaves dry up		0.4	1
3	Stems tergerek from the shoots to the bottom	Shoot Borer	0.2	0.4
4	Holes in the knuckles (cane bones)		0.4	0.6
5	Hollow leaves		0.6	0.4
6	Rotting of young stems (navel death)		0.6	0.6
7	Buds and leaves dry up	Stem Borer	0.4	1
8	Stems tergerek from the shoots to the bottom	Striped	0	0.4
9	Holes in the knuckles (cane bones)		0	0.6
10	Hollow leaves		0	0.4
11	Rotting of young stems (navel death)		0.6	0.6
12	Buds and leaves dry up		0.4	1
13	Stems tergerek from the shoots to the bottom	Stem Borer	0.2	0.4
14	Holes in the knuckles (cane bones)	Giant	0	0.6
15	Hollow leaves		0	0.4

Then calculate the CF value by multiplying it by CFuser :

To calculate the value of CF on shoot stem borer

CF[H,E]1= CF[H]1* CF[E]1
= 0.6 * 0.6
= 0.36
CF[H,E]2= CF[H]2* CF[E]2
= 0.4 * 1
= 0.4
CF[H,E]3= CF[H]3* CF[E]3
= 0.2 * 0.4
= 0.08
CF[H,E]4= CF[H]4* CF[E]4
= 0.4 * 0.6
= 0.24
CF[H,E]5= CF[H]5* CF[E]5
= 0.6 * 0.4
= 0.24

Combined CF values on shoot stem borer

For the calculation of CF[H,E]1,2 :

CF[H,E]1,2= CF[H,E]1+ CF[H,E]2+ (1-CF[H,E]1)
= 0.36+ 0.4 (1-0.36)
= 0.61
CF[H,E]3= CF[H,E]2+ CF[H,E]3+ (1-CF[H,E]2)
= 0.61 + 0.16 (1-0.61)
= 0.64
CF[H,E]4= CF[H,E]3+ CF[H,E]4+ (1-CF[H,E]3)
= 0.64+ 0.24 (1-0.64)
= 0.73
CF[H,E]5= CF[H,E]4+ CF[H,E]5+ (1-CF[H,E]4)
= 0.73 + 0.16 (1-0.73)
= 0.79

So, the CF confidence value of the Stem Shoot Borer Pest is

Confidence percentage = CF * 100%
= 0.79 * 100%
= 79%

To calculate the CF value of the Striped Stem Borer

CF[H,E]1= CF[H]1* CF[E]1
= 0.6 * 0.6
= 0.36
CF[H,E]2= CF[H]2* CF[E]2
= 0.4 * 1

= 0.4
CF[H,E]3= CF[H]3* CF[E]3
= 0 * 0.4
= 0
CF[H,E]4= CF[H]4* CF[E]4
= 0 * 0.6
= 0
CF[H,E]5= CF[H]5* CF[E]5
= 0 * 0.4
= 0
Combined CF values on the Striped Stem Borer
For the calculation of CF[H,E]1,2 :
CF[H,E]1,2= CF[H,E]1+ CF[H,E]2+ (1-CF[H,E]1)
= 0.36 + 0.4 (1-0.36)
= 0.61
CF[H,E]3= CF[H,E]2+ CF[H,E]3+ (1-CF[H,E]2)
= 0.61 + 0 (1-0.61)
= 0.61
CF[H,E]4= CF[H,E]3+ CF[H,E]4+ (1-CF[H,E]3)
= 0.61 + 0 (1-0.61)
= 0.61
CF[H,E]5= CF[H,E]4+ CF[H,E]5+ (1-CF[H,E]4)
= 0.61 + 0 (1-0.61)
= 0.61
So, the CF confidence value of the Striped Stem Borer is
Confidence percentage = CF * 100%
= 0.61 * 100%
= 61%

To calculate the value of CF on the Giant Stem Borer

CF[H,E]1= CF[H]1* CF[E]1
= 0.6 * 0.6
= 0.36
CF[H,E]2= CF[H]2* CF[E]2
= 0.4 * 1
= 0.4
CF[H,E]3= CF[H]3* CF[E]3
= 0.2 * 0.4
= 0.08
CF[H,E]4= CF[H]4* CF[E]4
= 0 * 0.6
= 0
CF[H,E]5= CF[H]5* CF[E]5
= 0* 0.4
= 0
Combined CF values on the Striped Stem Borer
For the calculation of CF[H,E]1,2 :
CF[H,E]1,2= CF[H,E]1+ CF[H,E]2+ (1-CF[H,E]1)
= 0.36 + 0.4 (1-0.63)
= 0.61
CF[H,E]3= CF[H,E]2+ CF[H,E]3+ (1-CF[H,E]2)
= 0.61 + 0.08 (1-0.61)
= 0.64
CF[H,E]4= CF[H,E]3+ CF[H,E]4+ (1-CF[H,E]3)
= 0.64 + 0 (1-0.64)
= 0.64
CF[H,E]5= CF[H,E]4+ CF[H,E]5+ (1-CF[H,E]4)
= 0.64 + 0 (1-0.64)
= 0.64
So, the CF confidence value of the Giant Stem Borer is
Confidence percentage = CF * 100%
= 0.64 * 100%
= 64%

Based on the CF results, the highest confidence value is found in shoot stem borer with a confidence value of 0.79 or 79%. From the results obtained, the system will diagnose that the pest is affected. The solution to be given to the plant is:

1. Sow parasitoid Xanthocampoplex Sp.
2. Sowing of Xanthocampoplex Sp. This is done by sprinkling 10 pias/Ha on the garden/block that is attacked by the pest.
3. Sowing is done before 10 am (according to climatic conditions)
4. You can also sow Tricogamma Sp to eradicate borer eggs that are attacking the garden at the beginning of sugarcane planting.

4. Conclusion

Based on the results of the analysis that has been carried out in this study, it can be concluded that by using the Certainty Factor method it can solve problems regarding stem borer pests based on symptoms detected on sugarcane plants by manual calculation results from case data in chapter III diagnoses obtained by the Certainty method Factor is a shoot borer with the highest percentage value of 79%. With this, conclusions can be drawn in extracting existing information with a value of uncertainty between the user and an admin or expert.

5. Suggestion

From the results of expert system research to diagnose sugarcane stem borer pests using the Certainty Factor method. The suggestions that can be given for the development process are as follows:

1. Diagnosis of stem borer using certainty factor method only uses several variables of stem borer. For the next maybe it can be developed even better.
2. For the use of the method, it is expected to use other methods to compare.
3. Add symptoms and diseases and use expert values and user values in more detail to get better information

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