ANALYSIS OF PLANT *FRAGARIA XANANASSA* DISEASE DIAGNOSES USING PRODUCTION RULES BASE ON EXPERT SYSTEM

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Abstract— Errors that occur in solving problems in strawberry plants (Fragaria Xananassa) such as the presence of leaf patches, fruit rot, perforated leaves, and insect pests can be the cause of not maximum in harvest time. The farmers and the general public who planted strawberry (Fragaria Xananassa) need to know the proper treatment of diseases and pests so that future yields as expected. Therefore, it takes an application as a solution in the delivery of information related to the problems that are often encountered in strawberry plants (Fragaria Xananassa). Methods of production rules can be used to diagnose the disease strawberry (Fragaria Xananassa) based on signs or symptoms that occur in the parts of plants and strawberry, the results of diagnosis using this method are the same as we do Consultation on experts. The purpose of this study was to determine the early diagnosis of disease in strawberry plants (Fragaria Xananassa) based on signs or symptoms that occur in the plant and fruit parts. The results of the analysis of this study showed that the validation of disease and symptom data in strawberry plants (Fragaria Xananassa) reached 99%, meaning that between the data of symptoms and disease understudy the accuracy was guaranteed with the experts.

Keywords: Production Rules, disease identification, Strawberry, Fragaria Xananassa

Abstrak—*Kesalahan yang terjadi dalam mengatasi masalah pada tanaman strawberry (fragaria xananassa) seperti adanya bercak daun, buah membusuk, daun berlubang, dan hama serangga dapat menjadi penyebab tidak maksimalnya di waktu panen. Para petani dan masyarakat umum yang menanam strawberry (fragaria xananassa) perlu mengetahui penanganan penyakit dan hama yang tepat agar kelak mendapatkan hasil panen sesuai yang diharapkan. Untuk itu diperlukan sebuah aplikasi sebagai solusi dalam penyampaian informasi terkait masalah-masalah yang sering dijumpai pada tanaman strawberry (fragaria xananassa). Metode kaidah produksi dapat digunakan untuk mendiagnosa penyakit strawberry (fragaria xananassa) berdasarkan tanda atau gejala yang terjadi pada bagian tanaman dan buah strawberry, hasil diagnosa menggunakan metode ini adalah sama dengan kita melakukan konsultasi pada ahli . Tujuan dari penelitian ini adalah mengetahui diagnose secara dini penyakit pada tanaman strawberry (fragaria xananassa) berdasarkan tanda atau gejala yang terjadi pada bagian tanaman dan buah. Hasil analisis dari penelitian ini diperoleh bahwa validasi data penyakit dan gejala pada tanaman strawberry (fragaria xananassa) mencapai 99%, artinya antara data gejala dan penyakit yang diteliti terjamin keakuratannya dengan ahlinya.*

***Kata Kunci**: Kaidah Produksi, Diagnosa penyakit, Tanaman Strawberry, Fragaria Xananassa*

INTRODUCTION

Although the development of Strawberry (Fragaria Xananassa) in Indonesia continues to experience increased (Kumar, Sharma, Sharma, Sharma, & Bansal, 2018), When compared with foreign countries, strawberry Business (Fragaria Xananassa) in Indonesia has not been done optimally. Most farmers still use their conventional cultivation practices. (Zolnoori, Zarandi, & Moin, 2012). The Weakness of unintegrated land processing can cause crop vulnerability to pests and diseases and can reduce the quantity and quality of his(Basiroh, Kurniasih, et al., 2018; Kishore & Thomas, 2016). In addition, sometimes in a conventional way, the cost of production used is not comparable to the profits gained (Kumar et al., 2018; Siler & Buckley, 2004)(Basiroh, Kurniasih, et al., 2018). Diseases of the Strawberry plant (Fragaria Xananassa) can be caused by fungi,

bacteria, microplasma-like organisms, and viruses (Manzke et al., 2010). Fatal pest attack on strawberry plants (Fragaria Xananassa) can also cause crop failure (Xu, 2006). Therefore, to overcome the necessary precautions by recognizing the characteristics and symptoms in advance (Beck & Deuser, 1994). Thus, the control is done on the target (Huang, Liu, Chu, & Cheng, 2005).

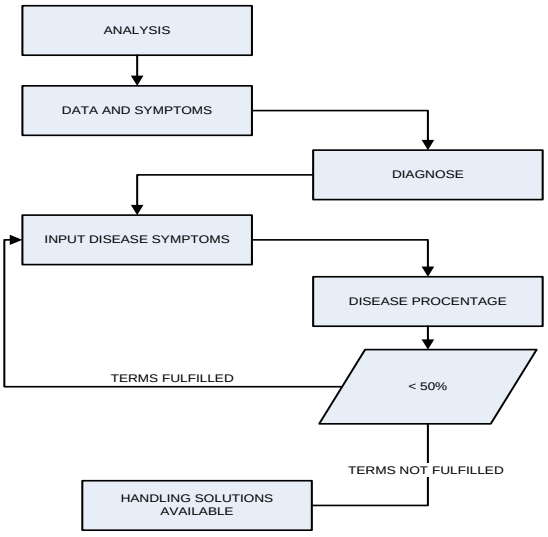
Technological advances capable of adopting human processes and ways of thinking are Artificial Intelligence technology (Graf & Schindler, 2014) or artificial intelligence. One of artificial intelligence technology is an expert system (Chuanlei, Shanwen, Jucheng, Yancui, & Jia, 2017) Which is a computer program that can mimic the process of thinking and expert knowledge to solve a problem that specifications (Jalalian et al., 2017).

One form of knowledge representation in the expert system is the rules of production (Risnawati, 2018)(Badnjevic, Gurbeta, & Custovic, 2018). The method of production rules is written in if-then (if-then). The IF-then rule connects the antecedent to the consequences of it (Jalalian et al., 2017; Mahmoodi, Mirzaie, & Mahmoudi, 2016). This rule consists of two parts of a premise (IF) containing things or information that is deemed correct and part of the conclusion (THEN) which contains the conclusions or results of the interconnected premise (Kusrini & Luthfi, 2009). The purpose of this research is to know the early diagnose of diseases in strawberry plants (Fragaria Xananassa) based on signs or symptoms that occur in parts of plants and fruit and can know that with the method of production rules can be applied to detect the disease.

MATERIALS AND METHODS

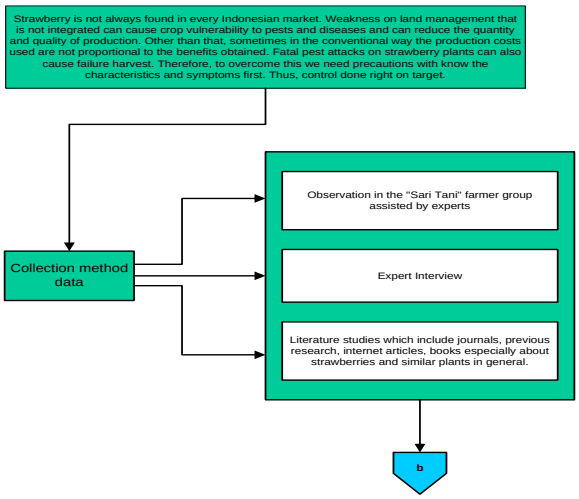
The Research was conducted on the farmer group "Sari Tani". Farmer groups, especially in the strawberry is managed by the local people who are in the preside by Mr. Ngadirin. Based on its purpose, authors use descriptive research methods (descriptive research), Where the research is aimed at describing an existing situation or phenomenon(Basiroh, Hilal, & Handayani, 2018), Current or past. In this case, researchers do not manipulate or give specific treatment to the research object (Kadir, 2014), All activities or research runs as-is.

1) Identifying the problem of researchers looking for problems that often occur in the surrounding community.
2) Formulating problems of various problems at the identification stage, the authors determine the problems that will be discussed and take the discussion about the cultivation and diagnosis of disease in strawberry.
3) Collecting Data Researchers visit the location of farmer group "Sari Tani" to conduct interviews with the experts and observe directly in the garden to know the real situation.
4) Designing the final stage system after conducting the analysis, designing the system starts from the design of the initial display, or commonly called a mockup. This design is used before the work or view is actually applied.



Sources: (Basiroh & Lestari, 2019)

Figure 1. Plot framework



Sources: (Basiroh & Lestari, 2019)

Figure 2. Plot outline Research Thinking

Method of representation using methods of production rules (Yuanita, Zulnaidi, & Zakaria, 2018). In the rules of production will be written in some form of command if-then (IF-THEN). Both parts of the premise (IF) containing the terms of information that are deemed correct and part of

the conclusion (THEN) deemed to contain the conclusions or results of the interconnected premise

RESULTS AND DISCUSSION

The result of need analysis is an analysis of the overall data needed to build the system. If there is new data, later on, the user will need to update the application. Based on the data collected at the data collection stage, analysis needs the following data:

A) Data on cultivation is data on the cultivation of strawberry.
There are 4 different table types available in the system, including the following:

Table 1. Cultivation Data

No	Title
1	The planting system in
2	A Vertical system with a sack
3	Covered land with Green House
4	Vertical Level Rack System

Sources: (Basiroh & Lestari, 2019)

Sources: (Basiroh & Lestari, 2019)
Figure 2. Plastic Planting system with

Table 2. Disease and Pest Data

Disease Code	Name of illness
P1	Lice disease
P2	Mites
P3	Flower drilling beetles/roots/stems
P4	White Lice (Pseudococcus sp.)
P5	Nematoda (Aphelencoides fragariae atau A. Ritzemabosi)
P6	Wilted verticillium
P7	Powdery mildew (powdery mildew)
P8	Red Spot (Red spot)
P9	Foul Rhizopus
P10	Wilt bacteria
P11	Leaf spotting
P12	Hawar Daun (rot leaves)
P13	Virus-induced diseases

Sources: (Basiroh & Lestari, 2019)

Sources: (Basiroh & Lestari, 2019)
Figure 3. Leaf Lice

Tabel 3. Data Gejala

Symptom code	Name of illness
G1	Wrinkled leaves
G2	Curly leaves
G3	Stunted Flower formation
G4	Stunted fruit formation
G5	Leaves with yellow to brown patches
G6	Leaves dry out
G7	Autumn Leaves
G8	Plant parts are flour
G9	The leaves are still rolled white flour
G10	There is an abnormal part because of white flour
G11	Thin leaf stalk
G12	Less hairy
G13	The plant becomes wither then dies
G!5	Flowers Dries and Fall
G16	The round spot leaves are irregular and dark purple.
G17	Egg round spot Diameter between 1-5 mm
G18	Purplish red spots on the body
G19	Rotten Fruit
G20	Juicy Fruit and light brown
G21	Light brown Fruit
G22	When the fruit is pressed, it will emit cloudily
G23	White-covered fruit mushrooms and spores black
G24	The network of xylem in young plants is damaged
G25	There are xylem cavity on the stem

Sources: (Basiroh & Lestari, 2019)

Sources: (Basiroh & Lestari, 2019)

Figure 4. Rotten leaves

B) The decision Data is a knowledge base analysis data used as a reference in making the decision tree. Based on the analysis of disease problems and symptoms above, the knowledge base can be seen in the following table:

Table 4. Decision Data

Symptom code	Disease												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
G1	√												
G2	√	√											
G3	√												
G4													
G5		√				√							
G6		√											
G7		√											
G8			√										
G9				√									
G10				√									
G11					√								
G12					√								
G13													
G!5							√						
G16								√					
G17								√					
G18								√					
G19									√				
G20									√				
G21									√				
G22													
G23										√			
G24										√			
G25										√			

Sources: (Basiroh & Lestari, 2019)

The knowledge representation used in this study is to use forward chaining reasoning methods i.e. a decision-making strategy that starts from the premise (fact) to the (Kusrini & Luthfi, 2009).

Examples of reasoning are as follows:

IF Pucuk/Leaf Wrinkles AND
Curly leaves AND
The formation of stunted flowers AND
Stunted fruit formation
THEN
Leaf Lice (Chaetosiphon Fragaefolii).

For the system to reach the conclusion, users should choose the symptoms of wrinkles/leaves, kinky leaves, stunted flower formation, and the formation of stunted fruit. Later, the system will issue a conclusion that the disease or pests suffered from strawberry plants caused by lice leaves (Chaetosiphon Fragaefolii).

Sources: (Basiroh & Lestari, 2019)

Figure 5 Drill Lice

Characteristics: Anthonomus Ruby attacked the flower, a very small size, which is only 0.25 mm long. The body is brown in freedom. Otiorhyncus Rugostriatus attacked the leaves, the beetle is greyish-brown, about 5 mm in size. In the larva stadium, the beetle attacks the roots. Stem drilling beetles damage the inside of the stem, the affected plant becomes dry and then dies.
Symptoms: The part of the plant is herniated by flour.
Treatment: Infected plants sprayed with insecticide, Decis 2.5 EC, Perfekthion 400 EC, or Curacron 500 EC

C) Rule base

The Diagnosis of the strawberry disease requires the creation of a knowledge base and a complete rule base so that the inference process can run properly. The knowledgebase can be viewed in Table 4.4 table. The rule base is fetched from an existing knowledge base, then compiled in the rule form. The rule can be seen in the following table:

Tabel 5. Rule base

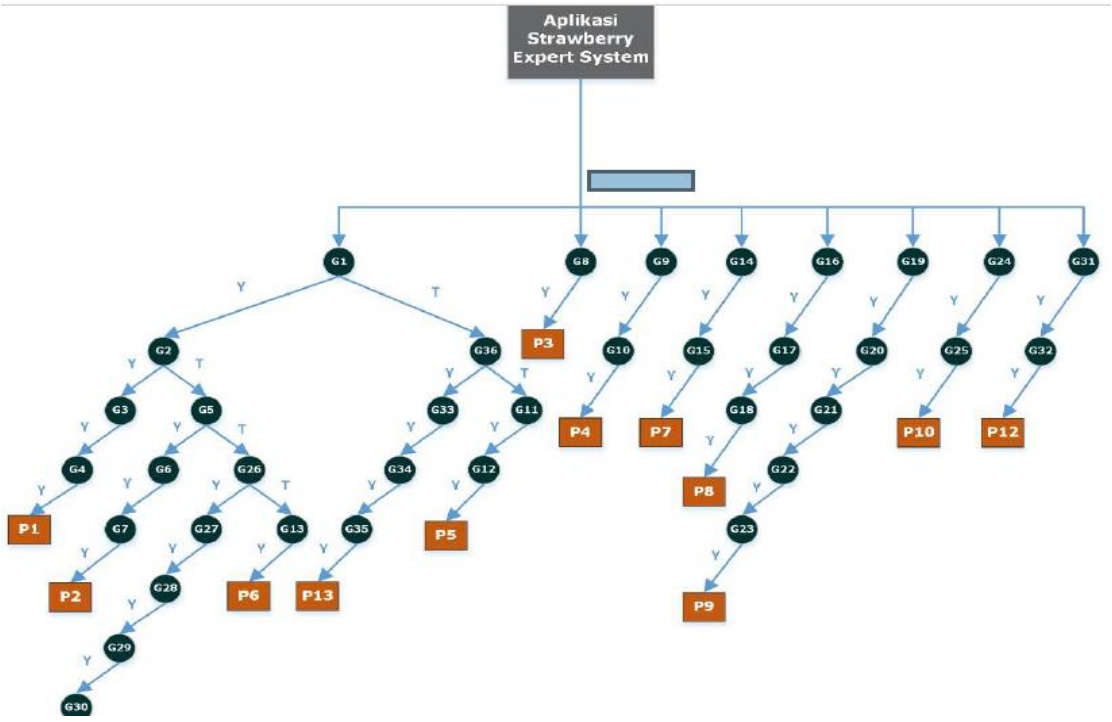
Rules	Production rules (AND)	
R1	IF	G1 G2 G3 G4
	THEN	P1
R2	IF	G2 G5 G6 G7
	THEN	P2
R3	IF	G8
	THEN	P3
R4	IF	G9 G10
	THEN	P4
R5	IF	G11 G12
	THEN	P5
R6	IF	G5 G15
	THEN	P 6
R7	IF	G14 G15
	THEN	P7
R8	IF	G16 G17 G18
	THEN	P8
R9	IF	G19 G20 G21 G22 G23
	THEN	P9
R10		G24 G25 P10

Sources: (Basiroh & Lestari, 2019)

Sources: (Basiroh & Lestari, 2019)
Figure 6. White Lice *(Pseudococcus sp.)*

Characteristics: White lice have a length of about 2 mm. The Body is closed wax so like cotton. Symptom: A white ticks attack causes the chlorosis points on the leaves that are still rolled. The plants that are covered with white lice will

Become abnormal.
Treatment: Using the insecticide 400 EC or Decis 2.5 EC corresponds to the recommended dose. From the base of the rules that have been on table 5, a decision tree is formed. The decision tree consists of symptoms and diseases that show the relationship between objects. Here are the decision trees that formed:



Sources: (Basiroh & Lestari, 2019)

Figure 6. The decision Tree

Description:
: Disease Symptoms

Expert Data validation

Validation is content by experts, in this case, it is a way to determine the level of accuracy of the system when compared to the calculations by experts. The attached data validation form. The following data validation test calculation results to find the accuracy level.

Data in accordance X = 13
Data not matched Y = 0
Total Z = 13

$Akurasi = \frac{x-y}{z}$ x 100% ..... (1)
(Basiroh, 2019)

$Akurasi = \frac{13-0}{13}$ x 100%

Based on the results of the test, it can be concluded that the accuracy of the data validation test is 100%

CONCLUSION

Based on the results of the analysis that has been done can be taken several conclusions, including the following: The data validation of the symptoms and diseases of the strawberry (Fragaria Xananassa) in the system reaches 100%. That is, the data raised is assured of accuracy. The index value that can be at the reception test stage has a percentage of 81.6%. Then it can be concluded that the Strawberry analysis (Fragaria Xananassa) Expert System is very good used as a guideline in cultivation as well as disease handling in Strawberry plants (Fragaria Xananassa). It is known that the method of production rules can be applied to diagnose the disease strawberry (Fragaria Xananassa) based on the signs or symptoms that occur in the parts of plants and strawberries (Fragaria Xananassa). The results of the diagnosis are the same as consulting the experts.

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