Jurnal Teknik Informatika C.I.T Medicom, Vol. 13 No. 1, Marc (2021) p-ISSN 2337-8646 e-ISSN 2721-561X
Contents lists available at Publisher Institute of Computer Science (IOCSCIENCE)
Jurnal Teknik Informatika C.I.T Medicom
journal homepage: www.medikom.iocspublisher.org/index.php/JTI

Accuracy in Identifying Rice Plant Diseases Using Method Fuzzy

Sri Handayani[1,*], Gunadi Widi Nurcahyo[2], Sumijan[3]

[1,2,3] Pasca Sarjana UPI-YPTK Padang, Jl. Raya Lubuk Begalung, Lubuk Begalung Nan XX, Kec. Lubuk Begalung, Kota Padang, Sumatera Barat 25145

Email : *srihandayani111218@gmail.com

ARTICLE INFO

Article history:

Received: 05/03/2021
Revised: 10/ 03/2021
Accepted: 22/03/2021
Available online: 30/03/2021

Keywords:

Rice Plants;
Rice Plant Diseases ;
Fuzzy Tsukamoto;
Identification.

ABSTRACT

Rice is one of the most favored crops by the Indonesian people, because of its many benefits, especially as a staple food for Indonesians, and is also used as a raw material for the feed and food industry. In particular, rice is processed to produce rice which contains high carbohydrates, so that rice is widely used and used as a human staple food. Some things that often happen at this time by rice farmers, many losses caused by rice plant diseases that are too late to be identified, causing crop failure. In this case, this rice plant disease is still in a mild stage, but many farmers ignore it, so that a bigger and wider problem arises and it is too late to control. The purpose of this study is to assist rice farmers in identifying rice plant diseases, which will use the Tsukamoto fuzzy method and implement it into the system, so that farmers do not feel overwhelmed again in identifying rice plant diseases. In general, Fuzzy can be referred to as uncertain logic but its advantage is that it is capable of the punishment process so that its design does not require complex mathematical equations. There are various fields that can be used by fuzzy logic, one of which is to identify rice plant diseases. The results of this study were in the form of rice plant disease types based on visible symptom characteristics and provided solutions to the treatment of these rice plant diseases.

1. Introduction

During the last few decades, rice plants are highly recognized as one of the strong sources of energy for resource production. Rice plants are cultivated in five regions of the world, namely Asia, Africa, America, Europe, and Oceania [1]. Rice is one of the most popular crops by the Indonesian state, because rice contains a very high carbohydrate content, so that rice is used as a raw material for the feed and food industry and as a staple food in several regions in Indonesia. Rice is crucial for humans, especially Indonesians. Most of the Indonesian population works in the agricultural sector, generally rice [2]. Some of the problems that attack rice plants that cause crop failure are the lack of knowledge of farmers in dealing with rice pest problems including rat pests, stem borer pests, brown leafhoppers, green leafhoppers, golden snail pests, fake white pests, ganjur pests [3].

Plant disease is one of the causes of decreased quality and quantity of agricultural products [4]. Diseases that attack the leaves of rice plants can reduce the amount of rice production [5]. During the cultivation process, many rice plants are susceptible to disease and pest attacks, including: leaf blight, tongguo grass, rice bursts, and dwarf grass[20]. In general, when rice plants are attacked by diseases and pests, farmers use pesticides directly or by means of countermeasures which are sometimes not suitable for diseases and pests that are infected by rice plants [6].

One of the diseases in rice plants is a disturbance in the leaves. The types of diseases on the leaves of rice plants are very diverse, the types of diseases are well recognized by experts after the type of disease is identified, a solution can be given to overcome it [16][17]. However, the type of disease on the leaves of the rice plant is sometimes not identified by ordinary people, so it will result in errors in identifying the type of disease and its handling[18]. Even experts can make misidentification if they are tired or in unsupportive conditions. To overcome this problem, identification with computer vision can be done. Computer vision has been widely used in identifying plant disease types [5].

The method used to identify rice plant diseases is the Fuzzy Tsukamoto method because this method has the accuracy to detect pests through digital images [7]. Themethod Fuzzy Tsukamoto consists of three calculation steps: Fuzzification, Engine Inference, and Defuzzification [8]. Inmethod Tsukamoto's, each rule takes the form of a causal or input-output relationship in which antecedents and consequences must be related [9]. System concept Fuzzy can also be interpreted as an approximate reasoning.model is Fuzzy based on inference composition rules, starting with the introduction ofideas and rules fuzzy other [10]. Fuzzy logic is widely used because it tolerates incorrect or uncertain data [11]. The advantage of the Tsukamoto method is that it is intuitive and can provide responses based on information that is qualitative, inaccurate, and ambiguous [12]. Fuzzy set theory is used as a mathematical framework for dealing with the problem of uncertainty, uncertainty or it can be used for information deficiency [15].

2. Research methods

In identifying rice plant diseases with Fuzzy, it takes stages of data processing that are formed in the research methodology [19]. The research methodology to be applied is as follows:

a. Collection of Literature Studies,
   is done by reading references from several books of rice plant experts, and collecting several national computer informatics journals to find out rice plant studies that have been done by previous researchers, so that they serve as a reference for the author.
b. Analysis
   In analyzing this rice plant disease, a method is needed for data processing. The method used is themethod *Tsukamoto fuzzy*. As for the symptoms that become the basic reference for the knowledge base, obtained from references to expert system journals and rice plant books, namely 34 symptoms with 9 rice plant diseases.
c. Design
   Design is a phased process that focuses on the design of the system to be built including data flow diagram design, database design, display or I/O design and devices [13].
d. Program Making
   As for making programs using Microsoft Visual Basic 2008 programming language software with mysql database.
e. Testing
   Testing is done by trying a decision support system software application that has been made [14].

3. Results and Discussion

3.1 Analysis of rice plant diseases with Fuzzy Tsukamoto

Case example of diagnosing rice plant disease is in terms of analyzing data processing using themethod *Tsukamoto*. The categories of rice plant disease can be seen in the following table:

Table 1
Category Of Padi Disease

No	Name of Disease
1	Tungro
2	Dwarf Grass
3	Empty Dwarf
4	Blast
5	Brown Spot
6	Frond Blight
7	Bacterial Blight
8	Orange Leaves
9	Yellow Dwarf

The stages in analyzing the diagnosis of rice plants are: method *Tsukamoto's* is as follows:

a. Fuzzyfication of the degree of membership of the linguistic value of the input variable The mathematical equation is as follows:

$$\mu\ light(x) = \begin{cases} 0; & x \leq 0 \\ 1; & 0 < x \leq b \\ \frac{c-x}{c-b}; & b < x \leq c \\ 0; & x > c \end{cases} \quad (1)$$

$$\mu\ medium(x) = \begin{cases} 0; & x \leq 1 \\ \frac{c-x}{c-a} & a < x \leq c \\ \frac{e-x}{e-c}; & c < x \leq e \\ 0; & x > e \end{cases} \quad (2)$$

$$\mu\, high(x) = \begin{cases} 0; & x \le c \\ \frac{e-x}{e-c}; & c < x \le e \\ 1 & x > e \end{cases} \tag{3}$$

The graph of the degree of membership function can be seen in Figure as follows:

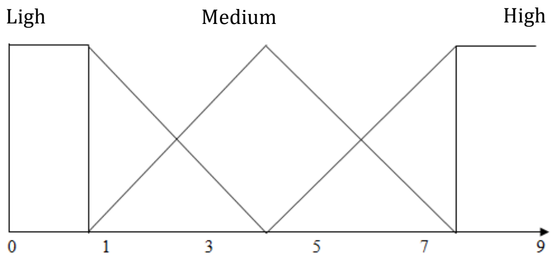

Fig 1. Graph of Membership Degree Function

There is an inference process, there are rules to control input in the form of linguistic variables. The inference method used in this study uses the max-min inferencing method.

b. The first rule base for Knowledge of Rice Disease Symptoms.
The first rules bases table of knowledge to diagnose rice plant disease using the IF rules Symptoms of THEN Disease name can be seen in the table category of rice disease knowledge rule base as follows:

Table 2.
Category Of Rice Disease Knowledge Rule Base

No	[redacted]	Symptoms	[redacted]	disease
1	IF	Dwarf plants	THEN	Tungro
2	IF	Tillers are reduced / a little	THEN	Tungro
3	IF	The leaves turn yellow to orange from shoot to base	THEN	Tungro
4	IF	Young leaves look like mottles	THEN	Tungro
5	IF	Old leaves like brown spots from prickling	THEN	Tungro
6	IF	Brown spots	THEN	Dwarf Grass
7	IF	The leaves are short and narrow	THEN	Dwarf Grass
8	IF	The leaves are pale green / yellowish in color	THEN	Dwarf Grass
9	IF	The spots attack the leaves	THEN	Dwarf Grass
10	IF	Grow upright	THEN	Dwarf Grass
11	IF	Leaves circular like twisted	THEN	Empty Dwarf
12	IF	The edges of the leaf blade are serrated	THEN	Empty Dwarf
13	IF	Flag leaves are torn / wavy - waves along the vessels	THEN	Empty Dwarf
14	IF	The leaves are dark green	THEN	Empty Dwarf
15	IF	The resulting grain is empty / empty	THEN	Empty Dwarf
16	IF	Pannel out	THEN	Empty Dwarf
17	IF	Patches are oval or elliptical	THEN	Blast
18	IF	The spots attack the leaves	THEN	Blast
19	IF	Gray / whitish spots	THEN	Blast
20	IF	The spots are circled in brown / red-brown color	THEN	Blast
21	IF	The base of the neck is grayish brown in color	THEN	Blast
22	IF	The area near the panicle neck is brown	THEN	Blast
23	IF	Black / brown spots on grain skin	THEN	Brown Spot
24	IF	Spot on the lower leaf midrib	THEN	Frond Blight
25	IF	Patches are gray-green / grayish green	THEN	Frond Blight
26	IF	The edge of the wound leaves is a line of wet spots	THEN	Bacterial Blight
27	IF	Leaves wrinkled and wilted like scalded	THEN	Bacterial Blight
28	IF	The leaves curl and dry up	THEN	Bacterial Blight
29	IF	Leaves whitish gray	THEN	Bacterial Blight
30	IF	Normal old leaves, young leaves pale chlorosis	THEN	Bacterial Blight
31	IF	Orange leaves	THEN	Orange Leaves
32	IF	Fewer plant roots	THEN	Orange Leaves
33	IF	The leaves are pale green or pale yellow	THEN	Yellow Dwarf
34	IF	The sapling grows limp	THEN	Yellow Dwarf

c. Input values of membership degrees
As for fuzzy reasoning Linguistics that are described numerically can be seen in the table as follows:

Table 3
Linguistic Fuzzy Reasoning

No	Linguistic Fuzzy Reasoning	Numeric value
1	Symptoms of the disease are few	1
2	There are very few visible symptoms of the disease	2
3	There are very few visible symptoms of the disease	3
4	Symptoms of the disease appear moderate	4
5	Symptoms of the disease appear moderate	5
6	The symptoms of the disease are very moderate	6
7	Symptoms of the disease look a little high	7
8	Symptoms of the disease appear high	8
9	Symptoms of the disease appear very high	9
10	Symptoms of the disease are very high	10

As for the input of data on rice plant disease symptoms experienced by a farmer, input with fuzzy linguistic reasoning which is described numerically, for example, it can be seen in the table as follows:

Table 4
Input Data Of Symptoms Of Rice Plant Disease

CODE	SYMPTOMS	SCORE
G01	Dwarf plants	7
G02	Tillers are reduced / a little	6
G03	The leaves turn yellow to orange from shoot to base	7
G04	Young leaves look like mottles	6
G05	Old leaves like brown spots from prickling	7
G06	Brown spots	8
G07	The leaves are short and narrow	3
G08	The leaves are pale green / yellowish in color	5
G09	The spots attack the leaves	6
G10	Grow upright	2
G11	Leaves circular like twisted	5
G12	The edges of the leaf blade are serrated	1
G13	Flag leaves are torn / wavy - waves along the vessels	6
G14	The leaves are dark green	7
G15	The resulting grain is empty / empty	8
G16	Pannel out	6
G17	Patches are oval or elliptical	5
G18	The spots attack the leaves	3
G19	Gray / whitish spots	4
G20	The spots are circled in brown / red-brown color	6
G21	The base of the neck is grayish brown in color	5
G22	The area near the panicle neck is brown	8
G23	Black / brown spots on grain skin	4
G24	Spot on the lower leaf midrib	7
G25	Patches are gray-green / grayish green	1
G26	The edge of the wound leaves is a line of wet spots	2
G27	Leaves wrinkled and wilted like scalded	4
G28	The leaves curl and dry up	3
G29	Leaves whitish gray	5
G30	Normal old leaves, young leaves pale chlorosis	6
G31	Orange leaves	5
G32	Fewer plant roots	7
G33	The leaves are pale green or pale yellow	6
G34	The sapling grows limp	3

The calculation method for finding the value of Miu (μ) for each symptom experienced by farmers is as follows:

1) G01 Dwarf plants = 7

$$\mu\ Ligh(x) = \begin{cases} 0; & x \leq 0 \\ 1; & 0 < x \leq 3 \\ \frac{5-x}{5-3}; & 3 < x \leq 5 \\ 0; & x > 5 \end{cases}$$

$$\mu\ Medium\ (x) = \begin{cases} 0; & x \leq 1 \\ \frac{5-x}{5-1} & 1 < x \leq 5 \\ \frac{9-x}{5-1}; & 5 < x \leq 9 \\ 0; & x > 9 \end{cases}$$

$$\mu\ High(x) = \begin{cases} 0; & x \leq 5 \\ \frac{9-x}{9-5}; & 5 < x \leq 9 \\ 1 & x > 9 \end{cases}$$

μ ligh(x) = (5-x)/2 = (5-7)/2 = 0
μ medium(x) = (9-x)/4 = (9-7)/4 = 0,5
μ high(x) = (9-x)/4= (9-7)/4 = 0,5

The computation result μ (miu) for each symptom can be seen in the table as follows:

Table 5
Computation Result μ (MIU) For Every Symptom

SYMPTOMS	Input	μ light (x)	μ medium (x)	μ high (x)
G01	7	0	0,5	0,5
G02	6	0	0,75	0,75
G03	7	0	0,5	0,5
G04	6	0	0,75	0,75
G05	7	0	0,5	0,5
G06	8	0	0,25	0,25
G07	3	0,5	0,25	0
G08	5	0	0	0
G09	6	0	0,75	0,75
G10	2	1	0,75	0
G11	5	0	0	0
G12	1	1	0	0
G13	6	0	0,75	0,75
G14	7	0	0,5	0,5
G15	8	0	0,25	0,25
G16	6	0	0,75	0,75
G17	5	0	0	0
G18	3	0,5	0,25	0
G19	4	0,5	0,25	0
G20	6	0	0,75	0,75
G21	5	0	0	0
G22	8	0	0,25	0,25
G23	4	0,5	0,25	0
G24	7	0	0,5	0,5
G25	1	1	0	0
G26	2	1	0,75	0
G27	4	0,5	0,25	0
G28	3	0,5	0,25	0
G29	5	0	0	0
G30	6	0	0,75	0,75
G31	5	0	0	0
G32	7	0	0,5	0,5
G33	6	0	0,75	0,75
G34	3	0,5	0,25	0

d. Formation of Rules

Based on the results of the calculation miu (μ) can be adjusted to The*rules bases*that have been combined into a system inference engine can be seen in the following table:

Table 6
Knowledge Base For Inference Machines

No	Disease	Knowledge Base
1	Tungro	IF G01 = LOW. G02 = LOW. G03 = LOW. G04 = LOW. G05 = HIGH THEN TUNGRO
2	Tungro	IF G01 = LOW. G02 = MEDIUM. G03 = MEDIUM. G04 = MEDIUM. G05 = HIGH THEN TUNGRO
3	Tungro	IF G01 = MEDIUM. G02 = MEDIUM. G03 = HIGH. G04 = HIGH. G05 = HIGH THEN TUNGRO
4	Tungro	IF G01 = MEDIUM. G02 = HIGH. G03 = HIGH. G04 = HIGH. G05 = HIGH THEN TUNGRO
5	Tungro	IF G01 = HIGH. G02 = HIGH. G03 = HIGH. G04 = HIGH. G05 = HIGH THEN TUNGRO
6	Dwarf Grass	IF G06 = LOW. G07 = LOW. G08 = LOW. G09 = LOW. G10 = HIGH THEN Dwarf Grass
7	Dwarf Grass	IF G06 = LOW. G07 = MEDIUM. G08 = MEDIUM. G09 = MEDIUM. G10 = HIGH THEN Dwarf Grass
8	Dwarf Grass	IF G06 = MEDIUM. G07 = MEDIUM. G08 = HIGH. G09 = HIGH. G10 = HIGH THEN Dwarf Grass

No	Disease	Knowledge Base
9	Dwarf Grass	IF G06 = MEDIUM. G07 = HIGH. G08 = HIGH. G09 = HIGH. G10 = HIGH THEN Dwarf Grass
10	Dwarf Grass	IF G06 = HIGH. G07 = HIGH. G08 = HIGH. G09 = HIGH. G10 = HIGH THEN Dwarf Grass
11	hollow dwarf	IF G11 = LOW. G12 = LOW. G13 = LOW. G14 = LOW. G15 = LOW. G16 = HIGH THEN Dwarf HAMPA
12	hollow dwarf	IF G11 = LOW. G12 = LOW. G13 = LOW. G14 = MEDIUM. G15 = MEDIUM. G16 = HIGH THEN Dwarf HAMPA
13	hollow dwarf	IF G11 = LOW. G12 = LOW. G13 = MEDIUM. G14 = MEDIUM. G15 = HIGH. G16 = HIGH THEN Dwarf HAMPA
14	hollow dwarf	IF G11 = MEDIUM. G12 = MEDIUM. G13 = MEDIUM. G14 = MEDIUM. G15 = HIGH. G16 = HIGH THEN Dwarf HAMPA
15	hollow dwarf	IF G11 = MEDIUM. G12 = MEDIUM. G13 = HIGH. G14 = HIGH. G15 = HIGH. G16 = HIGH THEN Dwarf HAMPA
16	hollow dwarf	IF G11 = HIGH. G12 = HIGH. G13 = HIGH. G14 = HIGH. G15 = HIGH. G16 = HIGH THEN Dwarf HAMPA
17	Blast	IF G17 = LOW. G18 = LOW. G19 = LOW. G20 = LOW. G21 = LOW. G22 = HIGH THEN BLAST
18	Blast	IF G17 = LOW. G18 = LOW. G19 = LOW. G20 = MEDIUM. G21 = MEDIUM. G22 = HIGH THEN BLAST
19	Blast	IF G17 = LOW. G18 = LOW. G19 = MEDIUM. G20 = MEDIUM. G21 = HIGH. G22 = HIGH THEN BLAST
20	Blast	IF G17 = MEDIUM. G18 = MEDIUM. G19 = MEDIUM. G20 = MEDIUM. G21 = HIGH. G22 = HIGH THEN BLAST
21	Blast	IF G17 = MEDIUM. G18 = MEDIUM. G19 = HIGH. G20 = HIGH. G21 = HIGH. G22 = HIGH THEN BLAST
22	Blast	IF G17 = HIGH. G18 = HIGH. G19 = HIGH. G20 = HIGH. G21 = HIGH. G22 = HIGH THEN BLAST
23	Brown Spot	IF G23 = LOW THEN SPOTS BROWN
24	Frond Blight	IF G24 = LOW. G25 = HIGH THEN FRESH BREAD
25	Frond Blight	IF G24 = HIGH. G25 = HIGH THEN FRESH BREAD
26	Bacterial Blight	IF G26 = LOW. G27 = LOW. G28 = LOW. G29 = LOW. G30 = HIGH THEN Bacterial Blight
27	Bacterial Blight	IF G26 = LOW. G27 = MEDIUM. G28 = MEDIUM. G29 = MEDIUM. G30 = HIGH THEN Bacterial Blight
28	Bacterial Blight	IF G26 = MEDIUM. G27 = MEDIUM. G28 = HIGH. G29 = HIGH. G30 = HIGH THEN Bacterial Blight
29	Bacterial Blight	IF G26 = MEDIUM. G27 = HIGH. G28 = HIGH. G29 = HIGH. G30 = HIGH THEN Bacterial Blight
30	Bacterial Blight	IF G26 = HIGH. G27 = HIGH. G28 = HIGH. G29 = HIGH. G30 = HIGH THEN Bacterial Blight
31	Orange Leaves	IF G31 = LOW. G32 = HIGH THEN Orange Leaves
32	Orange Leaves	IF G31 = HIGH. G32 = HIGH THEN Orange Leaves
33	Yellow Dwarf	IF G33 = LOW. G34 = HIGH THEN Yellow Dwarf
34	Yellow Dwarf	IF G33 = HIGH. G34 = HIGH THEN Yellow Dwarf

The process of Defuzification inference engine is in accordance with the knowledge base rules above using the formula and the computation is as follows:
To calculate each z use the formula:

$$\frac{5 - z_n}{2} = \propto - setiap\ predikat$$

$$z = \frac{\propto_1 z_1 + \propto_2 z_2 + \cdots + \propto_m z_m}{\propto_1 + \propto_2 + \cdots + \propto_m}$$

1) TUNGRO
[R1] IF G01 = LIGH . G02 = LIGH. G03= LIGH. G04= LIGH. G05=HIGH THEN TUNGRO.
α – Predikat = $\mu_{LIGH} \cap \mu_{LIGH} \cap \mu_{LIGH} \cap \mu_{LIGH} \cap \mu_{HIGH}$
= min (μ_{LIGH}[0], μ_{LIGH}[0], μ_{LIGH} [0], μ_{LIGH}[0], μ_{HIGHI}[0,5]
= min(0;0;0;0;0.5)
= 0
(5 - z) / 2 = 0
-z = 0 – 5
z= 5
The defuzzification process is to convert the fuzzy output obtained from the inference engine into a firm value using the appropriate membership function when fuzzyfication is performed.
a) TUNGRO
Calculating the TUNGRO defuzzification is as follows

$$z = \frac{0\ x\ 5 + 0\ x\ 5 + 0{,}5\ x\ 4{,}5 + \ 0{,}5\ x\ 4{,}5 + \ 0{,}5\ x\ 4{,}5}{0 + 0 + 0{,}5 + 0{,}5 + 0{,}5}$$
$$z = \frac{0\ + 0 + 2.25 + 2.25 + 2.25}{1{,}5}$$
$$z = 4{,}5$$

b) GRASS GRASS

Calculating the defuzzification of GRASS GRASS is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5 + 0\ x\ 5 + \ 0\ x\ 5 + \ 0\ x\ 5}{0 + 0 + 0 + 0 + 0}$$
$$z = NaN$$

c) KERDIL HAMPA

Calculating the defuzzification of KERDIL HAMPA is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5 + 0\ x\ 5 + \ 0\ x\ 5 + \ 0\ x\ 5}{0 + 0 + 0 + 0 + 0}$$
$$z = NaN$$

d) BLAST

Calculating the BLAST defuzzification is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5 + 0\ x\ 5 + \ 0\ x\ 5 + \ 0\ x\ 5 + 0\ x\ 5}{0 + 0 + 0 + 0 + 0 + 0}$$
$$z = NaN$$

e) CHOCOLATE SPOTS

Calculating CHOCOLATE SPOT defuzzification is as follows:
$$z = \frac{0{,}5\ x\ 4{,}5}{0{,}5}$$
$$z = 4{,}5$$

f) BREEDING FRESH

Calculating the FRUIT BEAUTIFUL defuzzification is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5 + 0\ x\ 5 + \ 0\ x\ 5 + \ 0\ x\ 5}{0 + 0 + 0 + 0 + 0}$$
$$z = NaN$$

g) BACTERIA BACTERIA

Calculating the defuzzification of BACTERIA BACTERIA is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5 + 0\ x\ 5 + \ 0\ x\ 5 + \ 0\ x\ 5}{0 + 0 + 0 + 0 + 0}$$

Z= 4,625

h) ALSO LEAVES

Calculating the defuzzification of ALSO LEAVES foul is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5}{0 + 0}$$
$$z = NaN$$

i) YELLOW Dwarf

Calculating the yellow dwarf defuzzification is as follows
$$z = \frac{0\ x\ 5 + 0\ x\ 5}{0 + 0}$$
$$z = NaN$$

e. Results of Defuzification in Identifying Rice Plant Diseases

The defuzification results of the diagnosis of rice plant disease can be seen in the following table:

Table 7

Defuzzification Results From The Identification Of Rice Plant Diseases

Symptoms	Input	µ Ligh(x)	µ Medium(x)	µ Highx)	Disease	Defuzifikasi
G01	7	0	0,5	0,5		
G02	6	0	0,75	0,75		
G03	7	0	0,5	0,5	Tungro	4,5
G04	6	0	0,75	0,75		
G05	7	0	0,5	0,5		
G06	8	0	0,25	0,25	Dwarf	NaN
G07	3	0,5	0,25	0	Grass	

Symptoms	Input	µ Ligh(x)	µ Medium(x)	µ Highx)	Disease	Defuzifikasi
G08	5	0	0	0		
G09	6	0	0,75	0,75		
G10	2	1	0,75	0		
G11	5	0	0	0		
G12	1	1	0	0		
G13	6	0	0,75	0,75	Dwarf	
G14	7	0	0,5	0,5	Grass	NaN
G15	8	0	0,25	0,25		
G16	6	0	0,75	0,75		
G17	5	0	0	0		
G18	3	0,5	0,25	0		
G19	4	0,5	0,25	0	Blast	NaN
G20	6	0	0,75	0,75		
G21	5	0	0	0		
G22	8	0	0,25	0,25		
G23	4	0,5	0,25	0	Spotting Chocolate	4,5
G24	7	0	0,5	0,5	Blight	NaN
G25	1	1	0	0	Midrib	
G26	2	1	0,75	0		
G27	4	0,5	0,25	0	Blight	
G28	3	1	0,5	0	Bacteria	4,625
G29	5	0	0	0		
G30	6	0	0,75	0,75		
G31	5	0	0	0	Leaf	NaN
G32	7	0	0,5	0,5	Orange	
G33	6	0	0,75	0,75	Little	NaN
G34	3	0,5	0,25	0	Yellow	

Information NaN = infinite result

4. Conclusion

From the discussion above, the conclusions of this study can be drawn as follows: a). The degree of membership in the symptoms of rice plant disease that appears is described linguistically to numerical values with a value range between 1-10, the greater the input value, the higher the level. frequent symptoms of the disease. b). The value of the equation for defuzification for each symptom uses the LIGHT membership degree equation with equation (5 - x) / 2 to find the smallest risk of each diagnosis, with a measured disease diagnosis level range between 3 to 5 values, the rest is NaN (infinity). c). The results of the data that have been inputted are the results of the diagnosis of rice plant diseases, namely; TUNGRO disease = 4,5, disease, grass stunt = NaN, empty dwarf = NaN, Blast = NaN, Brown spots = 4.5, Frond Blight = NaN, Bacterial Blight = 4.625, Orange Leaves = NaN, Yellow Dwarf = NaN. The highest risk level for diagnosing rice plant disease is the presence of leaf blight, tungro and brown spots.

5. References

[1] P. K. Sethy, N. K. Barpanda, A. K. Rath, and S. K. Behera, "Image Processing Techniques for Diagnosing Rice Plant Disease: A Survey," *Procedia Comput. Sci.*, vol. 167, no. 2019, pp. 516–530, 2020, doi: 10.1016/j.procs.2020.03.308.

[2] W. Febrianto, A. Yudha Suryatama, N. Afrianto, I. Mualana, P. Nur Hidayat, and J. Ipmawati, "Analisis Sistem Pakar Untuk Mengidentifikasi Penyakit Dan Hama Pada Tanaman Padi Dengan Metode Bayes," *Smart Comp Jurnalnya Orang Pint. Komput.*, vol. 8, no. 1, pp. 11–16, 2019, doi: 10.30591/smartcomp.v8i1.1311.

[3] O. Nurdiawan, "Penerapan Sistem Pakar Menggunakan Metode Fuzzy Sugeno Identifikasi Hama Tanaman Padi," *JATISI (Jurnal Tek. Inform. dan Sist. Informasi)*, vol. 5, no. 1, pp. 45–59, 2018, doi: 10.35957/jatisi.v5i1.112.

[4] H. B. Prajapati, J. P. Shah, and V. K. Dabhi, "Detection and classification of rice plant diseases," *Intell. Decis. Technol.*, vol. 11, no. 3, pp. 357–373, 2017, doi: 10.3233/IDT-170301.

[5] R. N. Whidhiasih and I. Ekawati, "Identifikasi Jenis Penyakit Daun Padi Menggunakan Adaptif Neuro Fuzzy Inferene System (ANFIS)," *Semin. Nas. Energi Dan Teknol.*, pp. 131–140, 2019.

[6] Y. Wendra and D. Aldo, "Metode Case Based Reasoning Untuk Identifikasi Penyakit Tanaman Padi," *Jursima*, vol. 8, no. 2, pp. 103–110, 2020.

[7] D. A. Puryono, "Sistem Informasi Pendeteksi Hama Penyakit Tanaman Padi Menggunakan Metode Fuzzy Tsukamoto Berbasis Android," vol. 10, no. 2, pp. 63–69, 2018, doi: 10.31219/osf.io/hpk5s.

[8] E. Nugraha, A. P. Wibawa, M. L. Hakim, U. Kholifah, R. H. Dini, and M. R. Irwanto, "Implementation of fuzzy tsukamoto method in decision support system of journal acceptance," *J. Phys. Conf. Ser.*, vol. 1280, no. 2, 2019, doi: 10.1088/1742-6596/1280/2/022031.

[9] S. Hardi, A. Triwiyono, and Amalia, "Expert System for Diagnosing Osteoarthritis with Fuzzy Tsukamoto Method," *J. Phys. Conf. Ser.*, vol. 1641, p. 012107, 2020, doi: 10.1088/1742-6596/1641/1/012107.

[10] D. Sitanggang *et al.*, "Diagnosing chicken diseases using fuzzy Tsukamoto web-based expert system," *IOP Conf. Ser.*

Mater. Sci. Eng., vol. 505, no. 1, 2019, doi: 10.1088/1757-899X/505/1/012086.
[11] J. Jufriadi, G. W. Nurcahyo, and S. Sumijan, "Logika Fuzzy dengan Metode Mamdani dalam Menentukan Tingkat Peminatan Tipe Motor Honda," *J. Inform. Ekon. Bisnis*, vol. 3, pp. 7–11, 2020, doi: 10.37034/infeb.v3i1.60.
[12] W. Febriani, G. W. Nurcahyo, and S. Sumijan, "Diagnosa Penyakit Rubella Menggunakan Metode Fuzzy Tsukamoto," *J. Sistim Inf. dan Teknol.*, vol. 1, no. 3, pp. 12–17, 2019, doi: 10.35134/jsisfotek.v1i3.4.
[13] R. R. Putra, H. Hamdani, S. Aryza, and N. A. Manik, "Sistem Penjadwalan Bel Sekolah Otomatis Berbasis RTC Menggunakan Mikrokontroler," *J. Media Inform. Budidarma*, vol. 4, no. 2, p. 386, 2020, doi: 10.30865/mib.v4i2.1957.
[14] N. Musyaffa and M. Ryansyah, "Implementation of VPN Using Router MikroTik at Al-Basyariah Education Foundation Bogor," vol. 12, no. 2, pp. 49–55, 2020.
[15] A. Setiawan, B. Yanto, and K. Yasdomi, *LOGIKA FUZZY Dengan MATLAB (Contoh Kasus Penelitian Penyakit Bayi dengan Fuzzy Tsukamoto)*, vol. 1, no. March. 2018.
[16] Kaur, S., Pandey, S., & Goel, S. (2019). Plants disease identification and classification through leaf images: A survey. Archives of Computational Methods in Engineering, 26(2), 507-530.
[17] Barbedo, J. G. A. (2019). Plant disease identification from individual lesions and spots using deep learning. Biosystems Engineering, 180, 96-107.
[18] Hang, J., Zhang, D., Chen, P., Zhang, J., & Wang, B. (2019). Classification of plant leaf diseases based on improved convolutional neural network. Sensors, 19(19), 4161
[19] Bera, T., Das, A., Sil, J., & Das, A. K. (2019). A survey on rice plant disease identification using image processing and data mining techniques. In Emerging Technologies in Data Mining and Information Security (pp. 365-376). Springer, Singapore.
[20] Khan, N., Bano, A., Ali, S., & Babar, M. A. (2020). Crosstalk amongst phytohormones from planta and PGPR under biotic and abiotic stresses. Plant Growth Regulation, 90(2), 189-203.