

Implementation of Certainty Factor Method for Diagnose Pests in Eggplant Plants

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ABSTRACT

Eggplant crop cultivation is often influenced by various factors, factors that often occurs is pests and diseases. Lack of information and still rely on the experience of farmers to deal with pests and disease is a major cause. This problem is particularly serious because the can lead to crop failure. In this research, expert systems to diagnose pests and diseases eggplant created to help farmers cope with the problem a problem that occurs in terngnya garden and provide solutions and suggestions prevention caused by pests and diseases. Certainty factor method is suitable for expert systems to diagnose disease eggplant crop is because these methods produce results of the highest percentage of belief an expert.

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1. Introduction

Its limitations information system in the plantation sector, especially in the plantation media facilities eggplant because at least the consultation can be accessed by people who depend on the distance and time, a factor the ignorance of farmers will be problems - problems that occurred in the garden terungnya. This media is a link between the users (farmers eggplant) with experts to at least the information, with the expert system to be an alternative to be able to replace an expert as a source of information and solutions to overcome the problem - a problem that is well so that can be profitable for farmers to save time. The expert system will be able to help farmers in terms of disease and pest diagnose was happening to her garden for early treatment.

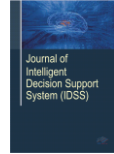
Limits - limits the problem of the expert system are:

- a. There are eight diseases that will be discussed in this expert system are: Damping-Semai, fruit rot, Fusarium wilt, Bacterial wilt, Antraknosa, Spotting Leaves, Stem Base Rot or neck Root and Leaf Rot or lodoh.
- b. There are 9 pests that attack plants indicated this eggplant among others: Leaf Beetle (*Epilachna* spp) Leaf lice (*Aphis gossypii* Glover), mites (*Tetranychus* spp), Silkworm Land (*Agrotis ipsilon* Hufn), armyworm (*Spodoptera litura* F.) , caterpillar Fruit (*Helicoverpa armigera* Hubn), peach Leaf lice (*Myzus persicae* Sulizet), Fruit fly (*Bactrocera* sp) and thrips.
- c. Table of trust at the level of experts diterpakan confidence in this expert system application is not (0) to certain (1).

The purpose of this research is done to create a web-based application system that is capable of diagnosing pests and diseases in plants equipped eggplant causes and prevention solutions to pests and diseases, as indicated by using certainty factor. The other purpose of this study is to provide information regarding the symptoms of diseases caused by pests on the plants of eggplant eggplant so farmers can find out the cause of pests and diseases that occur on plants eggplant quickly and save time.

2. Literature Review

Expert systems (expert systems) is a way to resolve particularly complex issue that can be solved by experts. Making the expert system is not to replace the expert itself but can be used as an experienced assistant[1], Diagnosis expert system of pests and diseases in tobacco plants in this study using certainty factor, which is where the determination of the percentage influenced by the value MB and MD values[2], The problem is the lack of knowledge of farmers in the event handler of plant diseases can cause harm to the income of farmers. Therefore, it is necessary to build a system that is practical and has the ability like an expert in detecting diseases in plants[3],



Some of the research journal that is used as a reference, the authors took the 15 journals of reference of which are 5 national journals and 10 international journals as a comparison. The first research journal that it can be concluded that the test results cat disease with certainty factor method is able to produce a calculation accuracy of up to 99% accurate[1], The second research journals can be concluded that the certainty factor method is applied to the goat disease diagnosis system using 25 training data with an accuracy level of 84% in the case of expert 1 whereas the second expert to produce the same number of cases by 80% accuracy[2], The third research journals can be concluded that the results of the testing method can be implemented certainty factor diagnosing diseases in plants[3], The fourth research journals can be concluded that the development of these applications not only web based but can also be based on Android[4], The fifth journal can be concluded that the application is able to run both functionally to diagnose diseases of acne on the face using certainty factor[5], Journal of the sixth can be concluded that the system is able to diagnose the disease in tomato plants. Android-based system that accurately shows the results for expert Identification[6], Journal seventh research expert diagnose system produces red chili, chili this system to diagnose disease[7], Journal of the eight research so the value of the accuracy of the results of the expert system on the expertise of acupuncture in treating patients with insomnia is 93.33%[8], Journal ninth generate research results an expert system that can identify foods that use formaldehyde and borax[9], Journal tenth produce research results an expert system that can identify diseases in animals catfish[10], Journal eleventh produce research results prevention system that can identify disease pests of plants using methods certainty factor[11], Journal of twelve research is the application of methods for early detection certainty factor based on Android[12], Journal thirteenth results of this study resulted in the analysis conducted for the application system design expert for damage to computer hardware[13], Fourteenth Journal research results obtained is a system created to diagnose technostress[14], Journal fifteenth research results obtained are megidentifikasi expert system for dental and oral diseases. Accuracy obtained expert system in this journal by 94.627%[15],

Based on previous studies, there are some drawbacks and limitations which, in the journal of reference only discuss about the disease and do not indicate the cause of the disease pests. Therefore, the authors wanted to create an expert system that is able to indicate at the same pest and disease symptoms - symptoms experienced by the plant eggplant.

3. Research methods

A. Data collection Technique

1) Literature review

Book study is an activity to collect information relevant to the topic or issue into an object. This library studies done by taking the data - data from books, journals associated with the appropriate issue to be able to have a theoretical basis and foundation can be accounted.

2) Interview

The interview that I did with Mr. Antoni Setiawan of the Ministry of Agriculture directorates-general horticulture.

B. Methods Certainty Factor (CF)

certainty factorexpressed confidence in an incident based on evidence of expert judgment (Turban, 2005). The certainty factor using an assumed value for the confidence level of an expert to the data that has the confidence of the concept was not sure until convinced that formulated the following formula:

As for some combination formula certainty factor in a variety of conditions such as:

a) *certainty Factor* in a single premise:

$$CF[GEJALA] = CF(USER) * CF[PAKAR]$$

b) *certainty Factor* from a combination of the same premise:

$$CFcombine = CF1 + CF2 * (1 - CF1)$$

c) Calculating the percentage of CF combine

$$Nilai\ persentase\ CF = Cfcombine * 100$$



C. Level of Accuracy

Testing the intended level of accuracy is to find the percentage of accuracy in classifying the data testing process tested. This level of accuracy is calculated using the formula below.[16]

$$akurasi = \frac{\sum match}{\sum tp} \times 100\%$$

$$\begin{aligned} \sum match &= \text{jumlah klasifikasi yang benar} \\ \sum tp &= \text{jumlah data testing} \end{aligned}$$

D. Confidence Level of Certainty Factor Method

Table 1.

Rules of value - the value of trust.

Uncertain Term	CF
Definitely not (definitely not)	-1.0
Almost certainty not (Almost not sure)	-0.8
Probably not (most likely not)	-0.6
Maybe not (probably not)	-0.4
Unkown (do not know)	-0.2 to 0.2
Maybe (probably)	0.4
Probably (most likely)	0.6
Almost certainly (almost certainly)	0.8
Definitely (definitely)	1.0

Table 1 is data rules - the rules of the trust value of the certainty factor method.[4]

E. Certainty Factor Method Flowchart

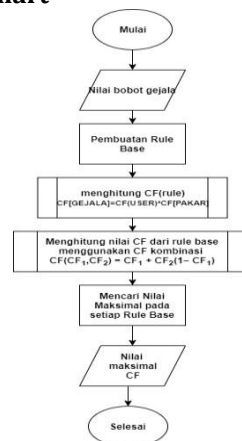


Fig 1. Certainty Factor Method Flowchart

In Figure 1 there is a flowchart method certainty factor in which the early stages of knowing the weights symptoms then go into the making of the rule base after a rule base is formed then further into the process of calculating the certainty factor, then the process of calculating the value cf of each using a combination of, the next step is to find the maximum value, the last is the result of the maximum value CF.

4. Results and Discussion

A. Process Certainty Factor

From the results of the data already in the 2 groups get the data that is data pest and disease data as well as data symptoms symptoms. Data that has been in this can be made into 3 tables include a table of pests and diseases, table of symptoms - symptoms and the decision table.

Table 2.

List of Pests and Diseases

Code	Name of Pests and Diseases
P01	anthracnose
P02	Leaf spotting



Code	Name of Pests and Diseases
P03	rotten Fruit
P04	Neck rot Root
P05	Bacterial wilt
P06	Damping-Semai
P07	foul leaves
P08	Fusarium wilt
P09	Leaf beetle
P10	lice leaves
P11	Mite
P12	Soil caterpillars
P13	armyworm
P14	caterpillar Fruit
P15	Peach Leaf Lice
P16	Fruit flies
P17	thrips

The table above is a data pests and diseases. The data consists of eight disease disease P01 - P08 and data consisting of 9 pest pests P09 - P17 which was given the code with P as a disease of eggplant crop.

Table 3.
List of Symptoms

Code	Name Symptoms
G01	In the fruit there are patches of irregular round shape.
G02	Surface blackish brown leaf curl and frizz shape
G03	Black stem rot and damp.
G04	The surface of old leaves are gray-brown spots or black spots so that the leaves wither and dry
G05	The leaves turn yellow and fall off
G06	Leaf spot during the rainy season will quickly spread throughout the plant
G07	Brown patches of wetness on the fruit so the fruit is rotten.
G08	Spotting wetness diameters of fruit then spread rapidly towards long sumbuh
G09	Fruit regardless of their sockets and into foul
G10	Brown stem rot and peeling skin
G11	Wilted arrived - arrived and eventually fall
G12	Brown color around the base of the stem
G13	All parts of the plant to wilt suddenly.
G14	Spotting - small yellowish green spots on young leaves
G15	Yellowish blotches on the leaves of old
G16	Overall yellowing leaves
G17	Soft and juicy stem
G18	Plants wither and die experience
G19	The young seedlings shrivel and die
G20	Fruit rot and softened
G21	- freckles brown and grooved on fruit
G22	The inside of the fruit drenched in brown irregular boundary
G23	Brown blotches covering the entire fruit
G24	There is a large brown spots covering the entire fruit
G25	Rotten fruit looks wet
G26	Young leaves wilt
G27	Exit milky slime when the stem is cut
G28	Fresh morning and wilt during the day
G29	plants droop
G30	Bone leaves whitish
G31	Brown root rot plants
G32	There are bite marks on the lower leaf surface
G33	The surface of the leaves so uneven
G34	Leaves a hole and the color is yellow and wither mennjadi
G35	Broken bones leaf leaves alone
G36	Young leaves will shrink and curly and coiled
G37	Stunted plant growth eventually dry up and die
G38	Many red ants shoots section
G39	The presence of red spots to brown or black on the leaf surface
G40	The leaves wither and perforated
G41	The base of the plant stem is damaged
G42	Fruit broken and perforated
G43	Eat the leaves, especially young leaves so hollow
G44	Plants become bald and stunted growth
G45	Loss of flowers and young fruit that failed to bear fruit



Code	Name Symptoms
G46	Leaf perforated - irregular holes
G47	Fruit rot and decay and eventually fall out
G48	Leaves become wrinkled yellow twisted
G49	Stunted plant growth so that it becomes stunted wither and die
G50	Fruit perforated black spot at the base
G51	Fruit rot and fall to the ground
G52	Surface silver colored leaf curling and wrinkles
G53	Leaves, shoots and buds rolled into and raised bumps
G54	Stunted plant growth and become stunted
G55	Infected leaves early - first raised patches - patches of green and white
G56	Spotting enlarged and changed into dry brown color
G57	Leaf surface there is a layer of gray

Table 3 is a table of symptoms symptoms obtained from experts and reinforced from the book - a book that consists of 57 types of symptoms of disease data 8 and 9 pests in eggplant plants. [17]

Table 4.
Decision

CODE	Disease name	number Symptoms
P01	anthracnose	G01, G02, G03, G20, G21
P02	Leaf spotting	G04, G05, G06
P03	rotten Fruit	G07, G08, G09, G22
P04	Neck rot Root	G10, G11, G12
P05	Bacterial wilt	G13, G14, G15, G16, G26, G27
P06	Damping-Semai	G17, G18, G19
P07	foul leaves	G55, G56, G57
P08	Fusarium wilt	G28, G29, G30, G31
P09	Leaf beetle	G32, G33, G34, G35
P10	lice leaves	G36, G37, G38
P11	Mite	G39, G40
P12	Soil caterpillars	G41, G42
P13	armyworm	G43, G44, G45
P14	caterpillar Fruit	G46, G47
P15	Peach Leaf Lice	G48, G49
P16	Fruit flies	G50, G51
P17	thrips	G52, G53, G54

Table 4 is a decision symptoms - symptoms that have been consulted to Mr. Antoni Setiawan.

B. Certainty Factor Calculation Methods Manual

Calculations using certainty factor method may be applied in one case with symptoms - symptoms as follows:

Table 5.
Sample case

Symptoms code	Symptoms - Symptoms	User confidence
G13	all parts of the plant to wilt suddenly.	Most likely
G14	Spotting - small yellowish green spots on young leaves	almost definitely
G22	The inside of the fruit drenched in brown irregular boundary	Most likely
G23	Brown blotches covering the entire fruit	Maybe
G28	fresh in the morning and withers at noon	almost definitely
G29	plants droop	Maybe
G30	Bone leaves whitish	Most likely

Table 5 is an example of a case of user input that is where the user input 7 symptoms.

The author here uses the combine where each data CF symptoms minimal user input is more than one, then the formula used is as follows:

$$CF_{combine} CF_{1,2} = CF_1 + CF_2 * [1 - CF_1] \text{Nilai persentase } CF = Cf_{combine} * 100$$

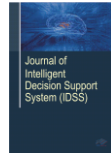
The system will know the certainty factor of disease or pests that attack plants eggplant user. The calculation of the value of certainty factor that may be suffered by the user are as follows:

a. Bacterial wilt

The results of the diagnosis is entered into the system by the user with the bacterial wilt, there are two symptoms are G13 and G14 then the following is the calculation certainty factor for bacterial wilt disease:

$$\begin{aligned} CF &= CF(G13) + [CF(G14) * (1 - (G13))] \\ &= 0.36 + 0.64 * (1 - 0,36) \\ &= 0.76,96 * 100 \\ &= 76,96\% \end{aligned}$$

So the result values CF of symptoms that fed the user to the bacterial wilt of 76.96%.



b. rotten Fruit

The results of the diagnosis is entered into the system by the user with the bacterial wilt, there are two symptoms are G22 and G23 so here is a certainty factor calculation for fruit rot disease:

$$\begin{aligned} CF &= CF(G22) + [CF(G23) * (1 - (G22))] \\ &= 0.6 + 0.24 * (1 - 0.6) \\ &= 0.696 * 100 \\ &= 69,9\% \end{aligned}$$

So the results of the symptoms of CF value is entered *user* for fruit rot disease amounted to 69.9%

c. Fusarium wilt

The results of the diagnosis is entered into the system by the user with the bacterial wilt, there are three symptoms, namely G28, G29 and G30 so here is a certainty factor calculation for fusarium wilt:

$$\begin{aligned} CF_{com1} &= CF(G28) + [CF(G29) * (1 - (G28))] \\ &= 0.32 + 0.32 * (1 - 0.32) \\ &= 0.5376 * 100 \\ &= 53,76\% \\ CF_{com2} &= CF(c1) + [CF(G30) * (1 - (CF(c1)))] \\ &= 0.5376 + 0.48 * (1 - 0.5376) \\ &= 0.759552 * 100 \\ &= 75.9552\% \end{aligned}$$

So the results of the CF value symptoms user input to fusarium wilt is 75.9552%

From the certainty factor calculation in three cases of the disease have a value above the maximum CF 0.7696 or 76.96% with bacterial wilt disease (P05). It was concluded that a diagnosis of symptoms - symptoms that are fed by the user is a bacterial wilt disease.

C. Use Case

Use case process flow diagram is a picture of interaction between actors with the system. In use case describes the structure of the process and the general functioning of the system which will involve actors.

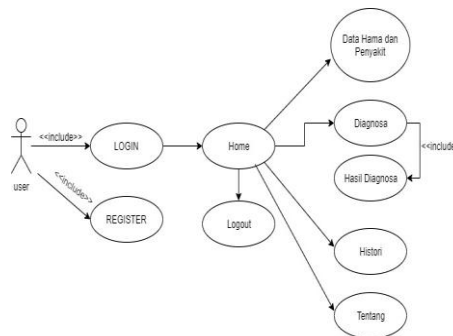


Fig 2, Use Case Diagram

In figure 2 is a use case diagram eggplant plant disease expert system, consists of one actor and has a groove login, register, home, logout, the data pests and diseases, diagnosis, diagnosis, history and about.

D. Activity Diagram

Activity process flow diagram is a picture of the interaction between the user with the system in the process of this diagnosis process diagnosa. Pada system will process the command from the user to display the instruction in accordance with the design done.

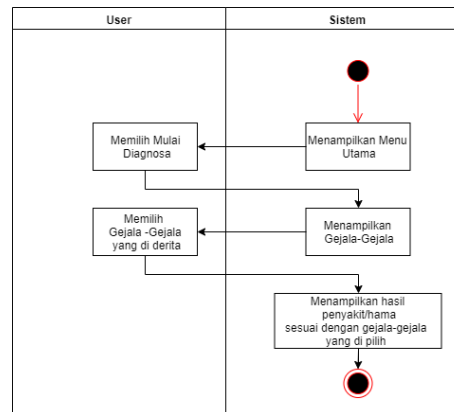
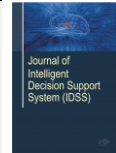


Fig 3, Activity Diagram

In figure 3 is an activity diagram that has two user activity and system, the first activity is the system displays the main menu and then the user selects a start for the diagnosis, then the system displays the symptoms - symptoms that exist, the user selects the symptoms - symptoms suffered by plants terungnya, and that the latter is the system displays the result of disease or pests according to the symptoms - symptoms that are selected by the user

E. Interface design

a. menu Home

Home menu is the main menu display that shows each part of the application system consists of a menu diagnosis, disease information, about, history.

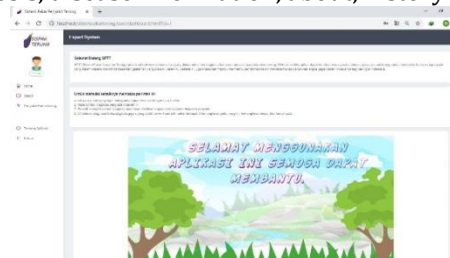


Fig 4. menu Home

b. Menu Diagnosis

Diagnosis menu is a menu displaying symptoms - symptoms that are available on application.

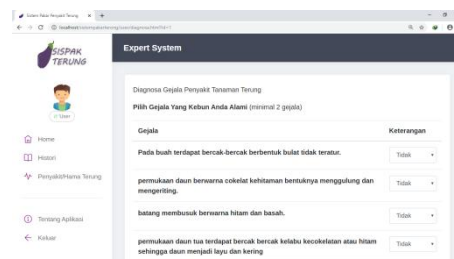


Fig 5. menu Diagnosis

c. Menu Results Diagnosis

Diagnosis Results menu is a menu that displays the results of dianosa entered by the user

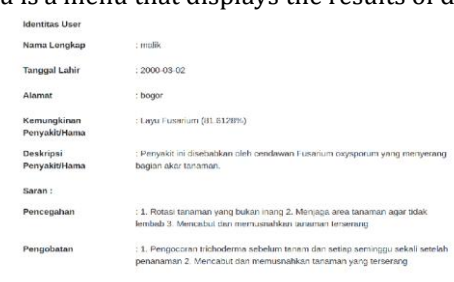


Fig 6. Menu Results Diagnosis

d. History menu



Menu This menu displays the data history - previous diagnosis results data of the account used for the history - a history of use of the system.

15	Nama Penyakit : Ulat Grayak (Spodoptera litura F.)	Nilai CF : 54.4 %	Tanggal Diagnosis : 2019-11-24
17	Nama Penyakit : Layu Fusarium	Nilai CF : 66.4 %	Tanggal Diagnosis : 2019-11-26
18	Nama Penyakit : Layu Fusarium	Nilai CF : 66.4 %	Tanggal Diagnosis : 2019-11-26
19	Nama Penyakit : Layu Bakteri	Nilai CF : 66 %	Tanggal Diagnosis : 2019-11-26
20	Nama Penyakit : Layu Bakteri	Nilai CF : 66 %	Tanggal Diagnosis : 2019-11-26
21	Nama Penyakit : Anthracnose	Nilai CF : 100 %	Tanggal Diagnosis : 2019-11-26

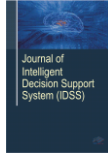
Fig 7. History menu

F. Testing Accuracy Level

Here is the test result data accuracy has been performed a total of 100 training data, below is a table of 100 training data:

Table 6. Training data number

No.	Symptoms are inputted	diagnosis Expert	Output from the System	Information
1	G01, G03, G20, G08, G23	Anthracnose (P01)	Anthracnose (98.56%) Rotten fruit (51.36%)	Right
2	G13, G14, G16, G34	Bacterial wilt (P05)	Bacterial wilt (97.21%) Leaf Beetles (Epilachna spp.) (48.32%)	Right
3	G10, G12, G11, G48, G49	Root rot Neck (P04)	Root rot Neck (87.2704%) Lice leaves peach (Myzus persicae Sulizet) (64.64%)	Right
4	G04, G05	Leaf spotting (P02)	Leaf spotting (92%)	Right
5	G17, G19, G46, G47	Damping-Semai (P06)	Damping seedlings (100%) Silkworm Fruit (Helicoverpa armigera Hubn) (66.72%)	Right
6	G50, G51	Fruit Fly (Bactrocera sp) (P16)	Fruit Fly (Bactrocera sp.) (89.6%)	Right
7	G55, G56, G57, G21, G02.	Leaf rot (P07)	Leaf rot (73.1264%) Antraknosa (48.32%)	Right
8	G36, G38, G13, G14, G21, G03.	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (92.8%) Bacterial wilt (60.48%) Antraknosa (54.4%)	Right
9	G28, G29, G30, G10, G11	Fusarium wilt (P08)	Fusarium wilt (95.104%) Neck Root Rot (64.64%)	Right
10	G39, G40	Mites (Tetranychus spp) (P11)	Mites (Tetranychus spp) (81.28%)	Right
11	G52, G54	Thrips (P17)	Thrips (89.6%)	Right
12	G41, G42, G18, G17.	Soil caterpillar (Agrotis ipsilon Hufn) (P12)	Soil caterpillar (Agrotis ipsilon Hufn) (92.8%) Damping Semai (42.24%)	Right
13	G43, G44	Armyworm (Spodoptera litura F.) (P13)	Armyworm (Spodoptera litura F.) (92.8%)	Right
14	G52, G53, G55, G56	Thrips (P17)	Thrips (100%) Rotten Leaves (42.24%)	Right
15	G22, G24	Fruit rot (P03)	Rotten fruit (92.8%)	Right
16	G26, G27, G22, G25	Fruit rot (P03)	Bacterial wilt (92.8%) Rotten Fruit (49.6%)	Incorrect
17	G05, G06	Leaf spotting (P02)	Leaf spotting (64.64%)	Right
18	G31, G30, G33, G35	Fusarium wilt (P08)	Fusarium (92.8%) Leaf Beetles (Epilachna spp.) (66.72%)	Right
19	G32, G35, G01, G03	Leaf beetle (Epilachna spp.) (P09)	Anthracnose (100%) Leaf Beetles (Epilachna spp.) (89.6%)	Incorrect
20	G37, G38	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (81.28%)	Right
21	G45, G44	Armyworm (Spodoptera litura F.) (P13)	Armyworm (Spodoptera litura F.) (85.6%)	Right
22	G39, G43	Armyworm (Spodoptera litura F.) (P13)	Armyworm (Spodoptera litura F.) (80%)	Right
23	G01, G02, G52, G53	Thrips (P17)	Thrips (96%)	Right
24	G21, G22, G32	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (60%)	Right
25	G30, G33, G34	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (54.4%)	Right
26	G11, G12, G14, G15	Bacterial wilt (P05)	Bacterial wilt (72.8%)	Right
27	G01, G02, G03, G42, G43	Anthracnose (P01)	Anthracnose (91.84%)	Right
28	G29, G30, G33	Fusarium wilt (P08)	Fusarium (75.52%)	Right
29	G41, G42, G45, G46	Soil caterpillar (Agrotis ipsilon Hufn) (P12)	Soil caterpillar (Agrotis ipsilon Hufn) (96%)	Right
30	G16, G17, G25, G26	Bacterial wilt (P05)	Bacterial wilt (64.64%)	Right
31	G17, G19, G22	Damping-Semai (P06)	Semai fall (87.2%)	Right
32	G27, G28	Bacterial wilt (P05)	Bacterial wilt (60%)	Right
33	G37, G38, G40	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (76.96%)	Right
34	G29, G30, G32	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (100%)	Right
35	G22, G23, G47, G48	Fruit rot (P03)	Rotten fruit (74.4%)	Right
36	G21, G24, G25	Fruit rot (P03)	Fruit rot (64.64%)	Right
37	G35, G46, G49	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (64%)	Right
38	G11, G12	Root rot Neck (P04)	Root rot Neck (51.36%)	Right
39	G07, G08, G11	Fruit rot (P03)	Rotten fruit (84%)	Right
40	G35, G36, G37	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (72.8%)	Right
41	G01, G02, G05	Anthracnose (P01)	Anthracnose (78.4%)	Right
42	G26, G29, G32	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (100%)	Right
43	G04, G05	Leaf spotting (P02)	Leaf spotting (60.48%)	Right
44	G38, G39, G42	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (80%)	Right
45	G16, G46	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (48%)	Right
46	G05, G06, G09	Leaf spotting (P02)	Leaf spotting (56.48%)	Right
47	G18, G20, G22	Damping-Semai (P06)	Seedling Damping (40%)	Right
48	G09, G11	Fruit rot (P03)	Rotten fruit (48%)	Right
49	G27, G28, G31	Bacterial wilt (P05)	Bacterial wilt (100%)	Right



No.	Symptoms are inputted	diagnosis Expert	Output from the System	Information
50	G04, G07	Fruit rot (P03)	Rotten fruit (100%)	Right
51	G01, G03	Anthracnose (P01)	Anthracnose (92%)	Right
52	G39, G40, G43	Mites (Tetranychus spp) (P11)	Mites (Tetranychus spp) (76.96%)	Right
53	G37, G40	Mites (Tetranychus spp) (P11)	Mites (Tetranychus spp) (64%)	Right
54	G10, G11, G12	Root rot Neck (P04)	Neck rot Root (90.208%)	Right
55	G42, G43, G46	Armyworm (Spodoptera litura F.) (P13)	Armyworm (Spodoptera litura F.) (64%)	Right
56	G54, G55, G46	Thrips (P17)	Thrips (48%)	Right
57	G10, G11	Root rot Neck (P04)	Root rot Neck (60.48%)	Right
58	G06, G07, G17, G18	Damping-Semai (P06)	Damping-Semai (56.48%)	Right
59	G34, G36	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (64%)	Right
60	G43, G44, G46	Armyworm (Spodoptera litura F.) (P13)	Armyworm (Spodoptera litura F.) (64.64%)	Right
61	G09, G12, G14	Bacterial wilt (P05)	Bacterial wilt (64%)	Right
62	G24, G26, G28	Bacterial wilt (P05)	Bacterial wilt (48%)	Right
63	G25, G27	Bacterial wilt (P05)	Bacterial wilt (60%)	Right
64	G02, G03, G04, G05	Anthracnose (P01)	Anthracnose (85.6%)	Right
65	G19, G20, G22	Anthracnose (P01)	Anthracnose (64%)	Right
66	G26, G28, G31	Fusarium wilt (P08)	Fusarium (84.8%)	Right
67	G47, G49, G53	Thrips (P17)	Thrips (80%)	Right
68	G31, G32, G39	Fusarium wilt (P08)	Fusarium (64%)	Right
69	G29, G30, G33	Fusarium wilt (P08)	Fusarium (81.28%)	Right
70	G04, G06, G08	Leaf spotting (P02)	Leaf spotting (60.48%)	Right
71	G34, G35	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (84.8%)	Right
72	G37, G38	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (48%)	Right
73	G13, G14, G17	Bacterial wilt (P05)	Bacterial wilt (81.28%)	Right
74	G48, G51, G50	Fruit Fly (Bactrocera sp) (P16)	Fruit Fly (Bactrocera sp.) (72.8%)	Right
75	G47, G44, G43	Armyworm (Spodoptera litura F.) (P13)	Armyworm (Spodoptera litura F.) (81.28%)	Right
76	G45, G47, G49	Armyworm (Spodoptera litura F.)	Armyworm (Spodoptera litura F.) (60%)	Right
77	G36, G37	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (60.48%)	Right
78	G12, G13, G14	Bacterial wilt (P05)	Bacterial wilt (72.96%)	Right
79	G17, G18, G21	Damping-Semai (P06)	Damping-Semai (51.36%)	Right
80	G39, G40	Mites (Tetranychus spp) (P11)	Mites (Tetranychus spp) (89.6%)	Right
81	G42, G41	Soil caterpillar (Agrotis ipsilon Hufn) (P12)	Soil caterpillar (Agrotis ipsilon Hufn) (92.8%)	Right
82	G48, G49	Peach leaf louse (Myzus persicae Sulizet) (P15)	Peach leaf louse (Myzus persicae Sulizet) (72.96%)	Right
83	G32, G33	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (87.2%)	Right
84	G10, G11	Root rot Neck (P04)	Root rot Neck (60.48%)	Right
85	G17, G18	Damping-Semai (P06)	Damping-Semai (64.64%)	Right
86	G04, G05, G06	Leaf spotting (P02)	Leaf spotting (80.6464%)	Right
87	G13, G14, G15	Bacterial wilt (P05)	Bacterial wilt (100%)	Right
88	G55, G56, G57	Leaf rot (P07)	Leaf rot (64.8576%)	Right
89	G23, G24, G25	Fruit rot (P03)	Fruit rot (82.4896%)	Right
90	G27, G28, G29	Bacterial wilt (P05)	Bacterial wilt (60%)	Right
91	G29, G30, G31	Fusarium wilt (P08)	Fusarium wilt (87.2704%)	Right
92	G33, G34, G35	Leaf beetle (Epilachna spp.) (P09)	Leaf beetle (Epilachna spp.) (81.3952%)	Right
93	G36, G37, G38	Lice Leaves (Aphis gossypii Glover) (P10)	Lice Leaves (Aphis gossypii Glover) (84.3328%)	Right
94	G01, G02, G03	Anthracnose (P01)	Anthracnose (95.84%)	Right
95	G30, G31, G32	Fusarium wilt (P08)	Fusarium (81.28%)	Right
96	G10, G11, G12	Root rot Neck (P04)	Root rot Neck (91.36%)	Right
97	G41, G42	Soil caterpillar (Agrotis ipsilon Hufn) (P12)	Soil caterpillar (Agrotis ipsilon Hufn) (89.6%)	Right
98	G48, G49	Peach leaf louse (Myzus persicae Sulizet) (P15)	Peach leaf louse (Myzus persicae Sulizet) (85.6%)	Right
99	G50, G51	Fruit Fly (Bactrocera sp) (P16)	Fruit Fly (Bactrocera sp.) (89.6%)	Right
100	G17, G18, G19, G33, G34	Damping-Semai (P06)	Damping-Semai (82.592%) Leaf Beetles (Epilachna spp.) (51.36%)	Right

In Table 6 and Table 7 are the results of testing 100 data that has been conducted there were 98 precise data. So if displayed with a graph the results will be as shown below:

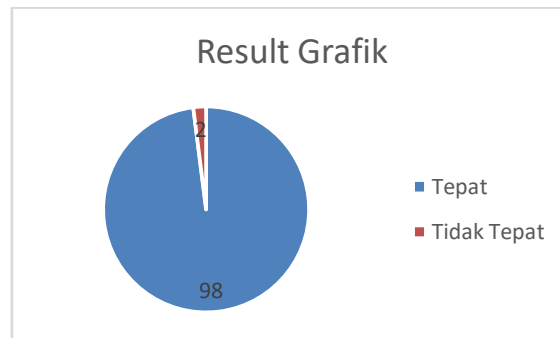
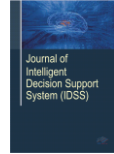


Fig 10. Pie Graph Models

In figure 10 is a graph of test results of 100 training data to training data that produces 98 tepat. Maka data showed the following:

$$\begin{aligned}\sum match &= 98 \text{ data klasifikasi yang benar} \\ \sum tp &= 100 \text{ data testing}\end{aligned}$$

So test the accuracy of the calculation results accuracy eggplant crop expert system is as follows:

$$akurasi = \frac{98}{100} \times 100\% = 98\%$$

Showed an accuracy of 98%, with this result the eggplant crop expert systems are considered fit for use by the user to diagnose pests and plant diseases eggplant.

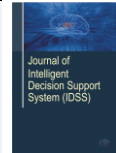
5. Conclusion

The results of the manufacturing plant disease expert system application eggplant berdasarkan system design, application design and testing done to diagnose pests and diseases in plants eggplant-based website can be summed up as follows:

- This expert system application can save farmers time, knowing pests and diseases suffered terungnya garden without having to ask kepakar and to directly addressing the symptoms - symptoms suffered an early stage. Eggplant disease expert system using certainty factor.
- Certainty factor method used in the application system produces an accuracy of 98% of the 100 training data and also discusses 8 and 9 of pests and diseases found 57 symptoms.
- output* of this application is in the form of advice and the results of the percentage likelihood of contracting disease or pests that occur on terungnya garden.

6. Reference

- [1] R. Ramadhan, I. F. Astuti, and D. Cahyadi, "Sistem Pakar Diagnosis Penyakit Kulit Pada Kucing Persia Menggunakan Metode Certainty Factor," *Pros. Semin. Ilmu Komput. dan Teknol. Inf.*, vol. 2, no. 1, pp. 263–269, 2017.
- [2] M. Arifin, S. Slamini, and W. E. Y. Retnani, "Penerapan Metode Certainty Factor Untuk Sistem Pakar Diagnosis Hama Dan Penyakit Pada Tanaman Tembakau," *Berk. Sainstek*, vol. 5, no. 1, p. 21, 2017.
- [3] H. Sulistiani and K. Muludi, "Penerapan Metode Certainty Factor Dalam Mendeteksi Penyakit Tanaman Karet," *J. Pendidik. Teknol. dan Kejur.*, vol. 15, no. 1, pp. 51–59, 2018.
- [4] Y. Permana, I. G. P. S. Wijaya, and F. Bimantoro, "Sistem Pakar Diagnosa Penyakit Mata Menggunakan Metode Certainty Factor Berbasis Android," *J. Comput. Sci. Informatics Eng.*, vol. 1, no. 1, p. 1, 2018.
- [5] I. M. A. Wirawan, "Sistem Pakar Diagnosis Penyakit Jerawat Di Wajah Dengan Metode Certainty Factor Jurnal Nasional Pendidikan Teknik Informatika | 97," *J. Nas. Pendidik. Tek. Inform.*, vol. 6, no. 2, pp. 96–106, 2017.
- [6] K. Muludi, R. Suharjo, A. Syarif, and F. Ramadhani, "Implementation of forward chaining and certainty factor method on android-based expert system of tomato diseases identification," *Int. J. Adv. Comput. Sci. Appl.*, vol. 9, no. 9, pp. 451–456, 2018.
- [7] F. Agus, H. E. Wulandari, and I. F. Astuti, "Expert System With Certainty Factor For Early Diagnosis Of Red Chili Peppers Diseases," *J. Appl. Intell. Syst.*, vol. 2, no. 2, pp. 52–66, 2018.
- [8] E. P. Gunawan and R. Wardoyo, "An Expert System Using Certainty Factor for Determining Insomnia Acupoint," *IJCCS (Indonesian J. Comput. Cybern. Syst.*, vol. 12, no. 2, p. 119, 2018.
- [9] D. Sudrajat *et al.*, "Expert system application for identifying formalin and borax in foods using the certainty factor method," *Eurasian J. Anal. Chem.*, vol. 13, no. 6, pp. 321–325, 2018.
- [10] I. Sumatorno, D. Arisandi, A. Putera, and U. Siahaan, "Expert System of Catfish Disease Determinants Using Certainty Factor Method," *Int. J. Recent Trends Eng. Res.*, vol. 3, no. 8, pp. 202–209, 2017.



- [11] R. Rahim *et al.*, "Pest Plant Disease Prevention and Identification System Using Certainty Factor Method," *Int. J. Eng. Technol.*, vol. 7, no. 3.2, p. 763, 2018.
- [12] L. Safira, B. Irawan, and C. Setiningsih, "Implementation of the Certainty Factor Method for Early Detection of Cirrhosis Based on Android," *J. Phys. Conf. Ser.*, vol. 1201, no. 1, 2019.
- [13] A. S. Sembiring *et al.*, "Implementation of Certainty Factor Method for Expert System," *J. Phys. Conf. Ser.*, vol. 1255, no. 1, 2019.
- [14] Mukhtar and Ismail, "The use of Certainty Factor (CF) in Technostress Diagnatation Expert System," *Int. J. Innov. Sci. Res. Tecnol.*, vol. 4, no. 5, 2019.
- [15] B. Ambara, D. Putra, and D. Rusjyanthi, "Fuzzy Expert System of Dental and Oral Disease with Certainty Factor," *Int. J. Comput. Sci. Issues*, vol. 14, no. 3, pp. 22-30, 2017.
- [16] C. M. Jamkhandi and J. I. Disouza, "Synthesis and antimicrobial evaluation of [(1H-benzotriazol-1-ylacetyl) amino] acetic acid derivatives," *Res. J. Pharm. Technol.*, vol. 5, no. 9, pp. 1197-1200, 2012.
- [17] Prianto Joko. 2016. Cara Gampang Usaha Dan Bisnis Terong. Depok : Villam media.