

Forward Chaining Method for Diagnosing Diseases and Pests in Melon Plants

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ABSTRACT

There are many problems encountered in the field of agriculture, for example problems about diseases and pests in melon plants. Experts or experts in the field of agriculture rarely need to build a system that is able to adopt human processes and ways of thinking in the form of an expert system. The purpose of this study is to build an expert system to diagnose diseases and pests in melon plants using the forward chaining method. A reasoning that starts from facts first to test the correctness of a hypothesis. The system was tested using the black box testing method which was tested on experts and melon farmers. Based on the results of testing using the black box testing method tested on experts and farmers, the results of the assessment were obtained that the expert system for diagnosing diseases in melon plants was proven to run well as expected with 100% validation. The end result of this expert system is to make it easier for users to carry out the consultation process by providing a list of indication of diseases and pests experienced. Then the control of the type of disease and pest will be displayed according to the selected indication. In addition, this expert system also makes it easier for admins to update data such as disease data, indication and control. This expert system application program is also not only beneficial for experts but can also be useful for farmers that ordinary people who do not understand a little about melon plant diseases and pests.

Keywords: expert system; forward chaining; melon;

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1. INTRODUCTION

There are many problems encountered in the field of agriculture, for example problems with diseases and pests in melon plants. These diseases and pests greatly affect the production of melon plants. To be able to overcome this problem, an expert who is an expert in his field is needed, namely agriculture. The rarity of experts in agriculture, especially melon plants, results in a lack of time given by experts to the community or melon farmers to consult about melon plants, so that people or melon farmers who want to know about melon plant diseases and pests find their own solutions, which sometimes result in crop failure.

Therefore, it is necessary to build a system or application, namely an expert system that can help in diagnosing melon plant diseases and pests. An expert system is a computer-based system that uses knowledge,

facts, and reasoning techniques in solving problems that can usually only be solved by an expert in the field[1][2][3]. An expert system is a computer-based system that uses knowledge, facts, and reasoning techniques in solving problems that can usually only be solved by an expert in the field[4][5].

Solving these problems can be solved using reasoning called an inference engine. An inference machine is a computer program that provides a methodology for reasoning about information that exists in the knowledge base and in the workplace, and to formulate conclusions. There are two approaches to controlling inference in a rule-based expert system, namely forward chaining and backward chaining. The forward chaining method is Pancarian method or forward tracking technique that starts with existing information and incorporation of rules to produce a conclusion or goal [6][7]. While the backward chaining method is the opposite of forward chaining, in which the problem-solving technique starts from the desired goal or result[8].

In this study, an expert system application will be created to provide information about diseases and pests and be able to diagnose the indication of plant diseases, especially in melon plants, as well as provide solutions on how to deal with them, which can later be used to reduce or minimize the risk of crop damage that results in crop failure or decreased crop yields [9]. An expert system built by applying the forward chaining method. It is hoped that with this expert system, the community, especially in this case, farmers, can be helped in solving the problems they face.

2. RESEARCH METHOD

2.1. Data Collection Methods

The data or information obtained is directly from an expert/expert, in this case PPL in Belitang Mulya District. This data collection technique is as follows:

a. Observation Methods

In this observation method, the necessary observations and data collection were carried out in 2 villages in Belitang Mulya District, in this case Sriwangi and Purwodadi villages. The observation data is used as a reference for the representation of knowledge in the system.

b. Interview methods

To obtain information about various diseases and pests, indication and control, the author conducted a direct interview with the resource person, namely Supriyanto, S.P. as the First Agricultural Extension Officer at the P3K Office of Belitang Mulya District. The data from interviews with the interviewees was used as data from the representation of knowledge and the basis of rules in the built system. These interviews help in verifying the information obtained from the literature as well as providing an important clinical perspective in the design of the rulebase used for the case studies raised [10].

c. Literature Study Methods

The author searches for reference sources from books and journals found on the internet that are related to the problem being studied, namely about melon diseases and pests. The data is in addition to the data entered into the system to make the consultation process more accurate.

2.2. Inferences Methods

The reasoning method used in this expert system is the forward chaining method. Method *Forward Chaining* or what is often called forward is a search technique that starts with known facts, then matches those facts with the IF part of the IF-THEN rule[11][12]. This search begins with the facts provided by the user first to be tested using the rules (*rule*) which ends in a conclusion based on existing facts [13]. The final conclusion can be an objective, a hypothesis, an explanation or a diagnosis[14].

The following figure shows how the forward chaining inference method works [15] [16]

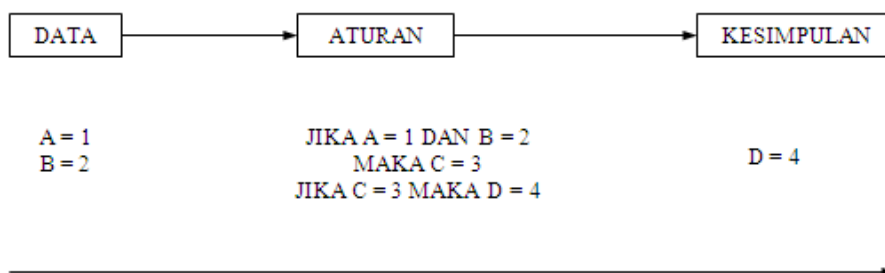


Figure 1. Inference Forward Chaining

The forward track inference method is suitable for handling control problems (*controlling*) and forecasting (*prognosis*). Here's an example of inference using forward inference [17]:

IF sufferers with idiopathic epilepsy with CF between 0.4 to 0.6
 THEN administer carbamazepine

Process *forward chaining* Starting with providing questions in the form of facts/indication that have been stored in the system in the form of a knowledge base[16]. The answers given by users will be processed so as to produce conclusions about the type of disease in melon plants. The system can also provide appropriate advice for the control of the disease.

This expert system for diagnosing diseases and pests in melon plants requires a knowledge base and an inference engine. This knowledge base contains the facts needed by the system, while the inference engine is used to analyze the facts entered by the user until a conclusion can be found[7]. Meanwhile, the knowledge to make a diagnosis and provide suggestions for improvement is represented in the form of production rules[17].

The knowledge base required by the system consists of rules for the types of diseases and pests, indication, and control methods. The data that becomes an input to the system is indication data, then the data is used by the system to determine the type of disease or pest experienced. The creation of indication rules is specified in table 1 below:

Table 1. Indication Rules

No	Disease Indication Rules
1	IF Rotten seedlings before or after emerging from the soil AND The plant grows into a dwarf plant AND the leaves look pale AND The top of the leaves looks wilted AND The plant withers and dies THEN Fusarium wilts
2	IF The underside of the leaf has slightly rounded whitish patches AND The size and number of whitish patches increase and are interconnected AND The Powdery Disease section on the leaves has whitish round patches AND The entire leaf appears to be coated with white flour THEN Powdery dew
3	IF Leaves look pale AND The top of the leaves has yellow patches AND In humid weather, the underside of the spots has purplish or grayish hairy fungi AND Leaves look shrunken THEN Rotten leaves
4	IF Leaves have light brown patches AND Leaves have reddish-dark brown patches AND Reddish dark brown patches on leaves are widespread, interconnected until the leaves dry out AND Stems or petioles have narrow elongated, wet, settling spots yellow or brown THEN Antraknos
5	IF Leaves have light brown spots AND Leaves have small yellow spots with angles, at the bottom they emit brown exudate AND Spots on hollow leaves AND On the fruit there is decay that enters the pulp THEN Angled leaf spots
6	IF In young fruits there are spots that curl (settle) into the AND the center line can reach 1 cm AND On the edges of the fruit release a dry liquid like rubber AND In older fruits there is brown scabs that are corked THEN scabs
7	IF the melon fruit rots AND the melon fruit changes color THEN Fruit Fly
8	IF curly leaves AND wavy leaves AND suffer from drought THEN Aphids
9	IF curved leaves AND wavy leaves AND melon fruit discolored AND experiencing drought THEN Trips
10	IF dwarf plants AND plants do not grow well THEN Cucumber Mosaic Virus (CMV)
11	IF mosaic on AND leaves brown or black spots appear on leaves, stems and fruits THEN Watermelon Mosaic Virus (WMV)

2.3. System Testing

The testing stage is carried out after the completion of running the application or program can be seen whether there are errors or not. At this stage, testing is carried out using the black box method. Testing by providing a validation assessment sheet to check whether the system can be run in accordance with the design and analysis that has been made. In this study, the test was carried out on Agricultural Extension Officers, namely Mr. Supriyanto, S.P and melon farmers in Belitang Mulya District.

3. RESULTS AND DISCUSSION

This stage is carried out after going through the planning stage with the aim that at the implementation stage it can easily describe the software design that is made. The expert system for diagnosing diseases in melon plants has several important parts, either used for a user or an expert. The parts of it are as follows:

a. Login

Figure 2. Login Form

This login form functions to provide security with access rights for users. On the login form, there are two options, namely Expert and User. If the user logs in with the User menu, then there is no need to enter the name and password. The user selects/clicks Login, then the main user menu will be displayed. On the other hand, if the user logs in with the Expert menu, they must first enter their name and password before clicking Login. If the name and password entered are correct, it will enter the main menu of the expert, but if it is incorrect, an error message will be displayed.

- b. Main Form. On the main menu form, several menus will be displayed. First, the File menu which contains the Consult and Close menus; Knowledge containing Disease, Indication, and Control menus; Rules containing the Indication Rules and Control Rules menus; Help and Profile menu. If you want to select a menu by clicking on one of the menus, it will display the form according to the selected menu.



Figure 3. Expert Lead Form

- c. *The Disease Form* contains 5 menus, namely Add, Edit, Delete, Save and Close. To add data, just click the Add button, the code will automatically be filled in with the last data plus one then type the disease data and description. To save the data, just click the Save button. To edit the data, the first step is to select one of the data in the list, then change the Disease data then click Edit. The way to delete the data is to select one of the data in the list then click Delete. To exit the form click the Close button

Kode	Penyakit	Deskripsi
J001	Layu fusarium	Penyakit ini disebabkan oleh jamur Fusarium oxysporum yang masuk
J002	Embun Tepung	Penyakit ini disebabkan oleh jamur Erysiphe cichoracearum
J003	Busuk Daun	Penyakit ini disebabkan oleh jamur Pseudo Peronospora Cubensis (f
J004	Bercak Daun Bersudut	Penyakit ini disebabkan oleh bakteri Pseudomonas Lachrymans Cars
J005	Antraknos	Penyakit ini disebabkan oleh jamur Colletotrichum lagenarium. Gejala
J006	Kudis	Penyakit ini disebabkan oleh jamur Cladosporium Cucumerinum Ell.
J007	Lalat Buah	Lalat buah merupakan serangga kecil berukuran sekitar 7-8 mm yan
J008	Kutu Daun	Kutu daun merupakan serangga kecil yang berukuran sekitar 2-4 mm
J009	Trips	Trips merupakan serangga kecil berukuran sekitar 1-2 mm yang mer
J010	Cucumber Mosaic Virus (CMV)	CMV adalah virus yang menyerang melon dan tanaman lain seperti r
J011	Watermelon Mosaic Virus (WMV)	WMV adalah virus yang menyerang melon dan tanaman musim lain

Jumlah Penyakit : 11

Figure 4. Disease Data Form

- d. *The indication form* contains 5 menus, namely Add, Edit, Delete, Save and Close. To add data, just click the Add button, the code will automatically be filled in with the last data plus one, then type in the indication data. To save the data, just click the Save button. To edit the data, the first step is to select one of the data in the list, then change the indication data then click Edit. The way to delete data is to select one of the data in the list and then click Delete. To exit *the form* click the Close button.

Kode	Gejala Penyakit
G001	Semai busuk sebelum atau sesudah muncul dari tanah
G002	Tanaman tumbuh menjadi tanaman kerdil
G003	Daun terlihat pucat
G004	Bagian atas daun terlihat layu
G005	Tanaman layu dan mati
G006	Bagian bawah daun terdapat bercak agak bulat keputihan
G007	Ukuran dan jumlahnya bercak keputihan bertambah dan saling berhubungan
G008	Bagian atas daun terdapat bercak bulat keputihan
G009	Seluruh daun tampak dilapisi tepung putih
G010	Bagian atas daun terdapat bercak kuning
G011	Pada cuaca lembab, sisi bawah bercak terdapat jamur berbulu berwarna keunguan atau ke
G012	Daun terlihat mengerut
G013	Daun terdapat bercak berwarna coklat muda
G014	Daun terdapat bercak berwarna coklat tua kemerahan
G015	Bercak coklat tua kemerahan pada daun meluas, saling berhubungan sehingga daun meng

Jumlah Gejala : 32

Figure 5. Indication Data Form

- e. *The control form* contains 5 menus, namely Add, Edit, Delete, Save and Close. To add data, click the Add button, the code will automatically be filled with the last data plus one, then type the control data. To save the data click the save menu. To edit data, the first step is to select one of the data in the list, then change the data then click Edit. The way to delete data is to select one of the data in the list and then click Delete. To exit *the form* click the Close button.

SISTEM PAKAR UNTUK MENDIAGNOSA PENYAKIT PADA TANAMAN MELON - [Data Pengendalian Pen...]

Login Pengetahuan Aturan Konsultasi Petunjuk Profil Keluar

Kode Cari

Pengendalian

Tambah Edit Hapus Simpan Tutup

Daftar Pengendalian Penyakit	
Kode	Pengendalian Penyakit
P001	Semprot tanaman yang sudah terserang parah dengan Anvil 50 EC
P002	Beyleton 250 EC
P003	Dab benlate sesuai dosis anjuran
P004	Ditebang
P005	Dibakar
P006	Tanaman yang belum terserang juga disemprot dengan fungisida
P007	Kurangi kelembapan kebun dengan cara mengatur/mengurangi naungan
P008	Pemangkasan bagian tanaman kopi yang sudah tidak produktif
P009	Penjarangan bibit
P010	Memperbaiki drainase (membuat parit untuk membuat air hujan)
P011	Menanam yang lebih tahan terhadap bunga bintang
P012	Pengaturan naungan
P013	Pemangkasan yang baik terutama menghadapi musim hujan
P014	Bongkar pohon kopi hingga akarnya yang menunjukkan gejala terserang
P015	Singkirkan

Jumlah Pengendalian : 39

Figure 6. Control Data Form

- f. *The Instruction Form* is used to provide an explanation of filling in knowledge data, both disease data, indication and control. In addition, this *form* is also used to provide an explanation of filling in rule data, both indication rules and control rules.

SISTEM PAKAR UNTUK MENDIAGNOSA PENYAKIT PADA TANAMAN MELON - [Petunjuk]

Login Pengetahuan Aturan Konsultasi Petunjuk Profil Keluar

PETUNJUK PENGISIAN

Petunjuk ini digunakan untuk melakukan pengolahan data basis pengetahuan (data gejala, data penyakit dan data pengendalian) dan basis aturan (aturan gejala dan aturan pengendalian) mengenai penyakit pada tanaman melon. Adapun petunjuknya adalah sebagai berikut ini:

Pengisian Data Basis Pengetahuan

Untuk semua proses pengisian data basis pengetahuan (data gejala, data penyakit dan data pengendalian) memiliki langkah yang sama seperti berikut ini.

- Proses pengisian data
 - Tekan tombol **tambah** untuk menambah data.
 - Setelah pengetikan data selesai, kemudian tekan tombol **simpan**.
- Proses mengubah data
 - Pilih data yang akan diubah pada daftar.
 - Ganti data yang ingin di ubah, setelah selesai mengetik data, kemudian tekan tombol **edit**.
- Proses penghapusan data
 - Pilih data yang akan dihapus pada daftar.
 - Kemudian tekan tombol **hapus**.
 - Setelah itu akan muncul pesan.
 - Tekan tombol **Yes** untuk proses menghapus data dan tekan tombol **No** untuk membatalkan penghapusan data pengetahuan.
- Proses pencarian data
 - Ketikkan kata kunci di kotak kode atau nama data pengetahuan, lalu tekan tombol **cari** untuk melakukan proses pencarian.
 - Silahkan anda operasikan sesuai kebutuhan.
- Untuk mengakhiri tekan tombol **tutup**.

Pengisian Data Basis Aturan

Figure 7. Instruction Form

- g. *The indication rule form* contains the relationship between the disease and the indication or causes of the disease that occurs. The steps are to choose the disease that will be associated with the indication first. After selecting the disease, continue by selecting the indication, then select the Select indication button which is the rule of the relationship between the disease and the indication then click save. To delete the rule data, the first step is to select the diseases and indication to be deleted and then click the Delete button. The Clean button is used to cancel the selection. Close button to exit *the form*.

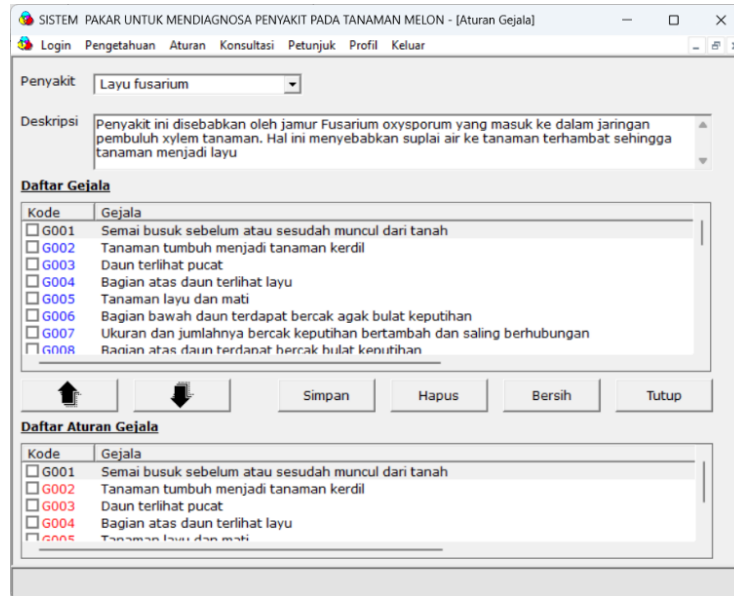


Figure 8. Indication Rule Form

- h. *The control rule form contains the relationship between the disease and the control of the disease that occurs. The steps are to choose the disease that will be associated with control first. After selecting the disease, proceed by selecting the control, then select the Select control button which is the rule of the relationship between the disease and its control and then click Save. To delete the rule data, the first step is to select the disease and control to be deleted and then click the Delete button. The Clean button is used to cancel the selection. Close button to exit the form.*

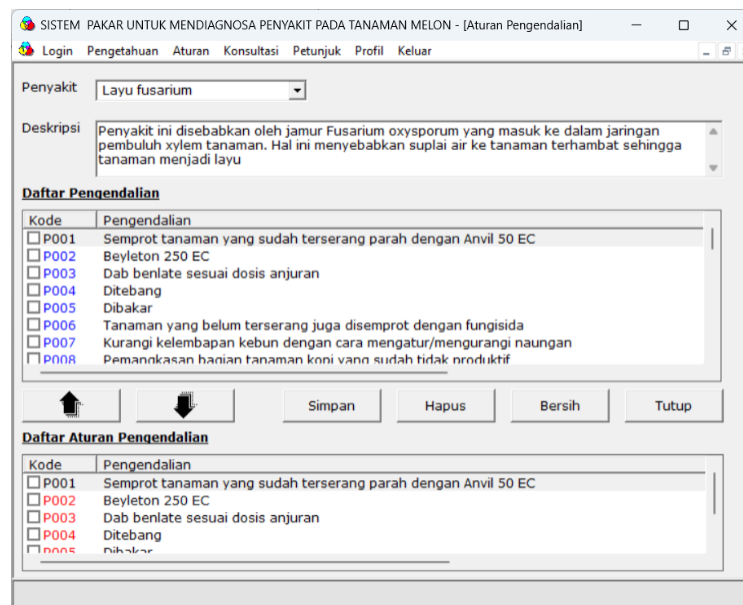


Figure 9. Control Rule Form

- i. If the Consultation menu is clicked, it will display *the Consultation form*. To conduct a consultation, the first step carried out by the system is to display a list of all indication used as a reference in the rulebase data. Users only need to select the indication of the disease that occur in the List, after being selected then click the Select button. After the user selects the indication, the system will proceed to the diagnosis process to determine the type of disease, namely by clicking the Diagnose button. To cancel the selected data of the selected disease indication, the User only needs to click the Clean button. To exit by clicking the Close button.

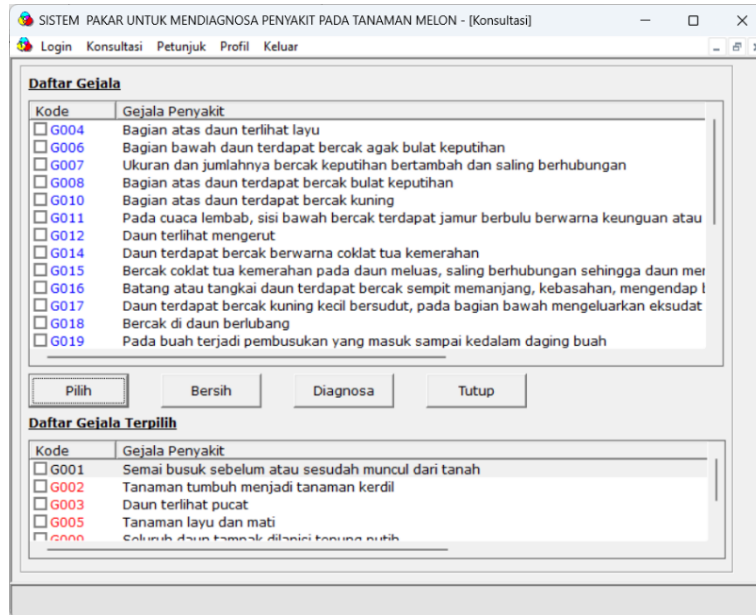


Figure 10. Consultation Form – Indication experienced

- j. The indication data selected by the user is used as a reference to determine the possible indication of the type of melon disease. The next process will be to trace the advice on how to control the type of disease.

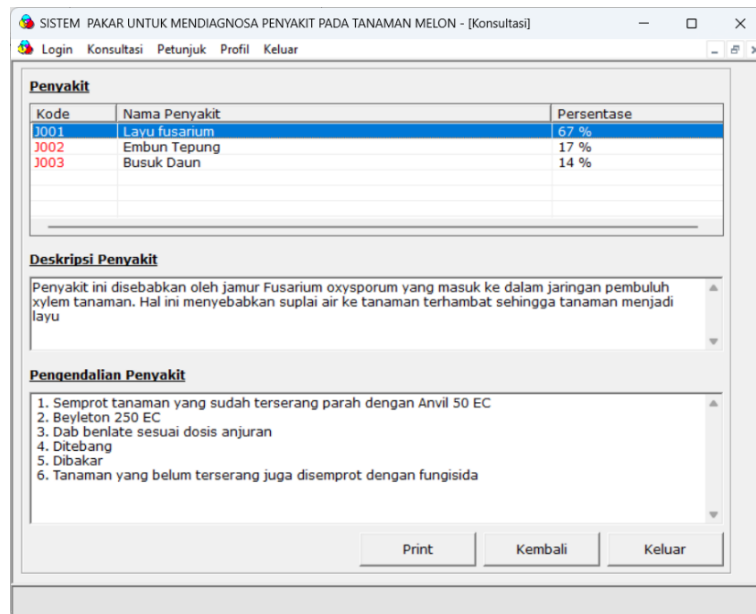


Figure 11. Consultation Form – Diagnosis and Control Results

Once the application of this expert system is built, the next step is to conduct a test of the system. System testing is carried out using the black box testing method. The system was tested by an expert, namely Mr. Supriyanto, S.P and melon farmers in Belitang Mulya District. Testing is carried out to find out whether the system is in accordance with the science and expertise of an expert, such as information about all types of diseases, disease indication, and disease control. The results of the system tests carried out by experts and farmers, it can be concluded that all tests on the expert system application are running well as expected with 100% validation. The expert system application built is able to provide information about all diseases, disease indication, and control that occur in melon plants.

During the system testing process, the author found several points of advantages and disadvantages that this expert system has. The advantage of the development of the expert system is that the expert system is made to make it easier for users to consult the process to diagnose diseases in melon plants. Besides the advantages, there is a weakness of the application that is built, namely that this system can only diagnose diseases based on indication that have been stored in the system.

4. CONCLUSION

Based on the results of the research, it can be concluded that the application built is another alternative for users, both the general public or people who are having problems with melon diseases that can be used as a guide as a step to find control of the disease experienced. The acquisition of knowledge from an expert system to diagnose diseases and pests in melon plants using the forward chaining method is sourced from experts and from the internet. In terms of data security, the expert system for diagnosing diseases and pests on melon plants using the forward chaining method is only given expert login access for the knowledge base and the rule base. The representation of knowledge from the expert system to diagnose diseases and pests in melon plants using the forward chaining method uses the type of production rules (IF THEN).

Based on the results of the system tests conducted by experts and farmers, it can be concluded that all tests on the expert system application are running well as expected with 100% validation. The expert system application built is able to provide information about all diseases, disease indication, and control that occur in melon plants.

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