Application of forwardchaining method to diagnosis of onion plant diseases

Delima Sitanggang, Saut D. Siregar, Suryani M. F. Situmeang, Evta Indra, Ayu R. Sagala, Oloan Sihombing, Marlince Nababan, Hendra Pasaribu, Rudolf R. Damani, Mardi Turnip, Rijois I. E. Saragih

1Faculty of Technology and Computer Science, Universitas Prima Indonesia, Indonesia
2Poltekkes Kemenkes Department of Health Analyst, Indonesia
3Methodist University of Indonesia, Indonesia

Abstract. Red Onion is a tuber plant that is widely used by the people of Indonesia, both as herbs and herbal medicines. Onion farmers have limitations in identifying diseases that attack their crops. This disease can cause crop failure against the onion. This design begins with the creation of a knowledge base up to input-output design with forward chaining method. The results of this design can assist farmers in identifying their plant diseases. Based on diagnostic results of several methods that have been done testing can diagnose diseases contained in onion plants. With symptoms data that has been determined by the expert with the value of each symptom is different. As for the symptoms that have been determined that the leaves contain patches with a value of 0.3, White leaf spots value 0.4, Leaf spots form a purple zone if it is severe 0.5, Leaf tip of 0.2, Tubers rot 0.4. Based on the above diagnostic results then get the value of diagnosis 67% forward chaining with trotol disease type, Purple spotting.

1.Introduction
Horticulture is a potential agricultural commodity to be developed in Indonesia and has a bright prospect in the future as well as a source of foreign exchange for Indonesia. Horticulture crops are widely cultivated in Indonesia, but when viewed from the results still not satisfactory. This is due to various factors, among them is the cultivation technique, environmental conditions as well as pests and diseases. Pests and diseases are major constraints in the cultivation of agricultural crops that can reduce production by up to 40% [1]. Limitations of an expert sometimes become an obstacle for farmers who will consult to solve a problem to get the best solution. In this case an expert system for the diagnosis of pests and diseases of horticultural crops made to serve as a means for consultation, a means of learning in an Agency of Agriculture or Agricultural laboratory and can be used as a tool for an expert in diagnosing and socializing the types of pests and diseases. With the application of expert systems also a Farmers Group can easily help farmers who are experiencing problems about pests and diseases of horticultural plants and the best solution to be taken without relying entirely on an expert and can share information or knowledge among farmers based on the system. Comparative techniques of forward and backward chaining in applied because the data and facts in conducting the research process has been obtained, and from the data or facts can be made a system that will provide a
conclusion or solution based on a collection of data and facts. Using this inference technique the chances of getting a more specific conclusion can easily be obtained [2].

By using the rule-based reasoning method that has an if-then pattern on the knowledge base in the application of this expert system's diagnosis, then the experts with their performance can solve the problem sequentially [3]. With this approach method, the rules that have been generated can be reviewed by experts to be improved or modified in order to get better results. Besides that, this method is also used whenever an explanation of traces (steps) in obtaining an achievement of a solution or steps regarding the achievement of the results of a diagnosis of pests and diseases of horticultural crops. Expert Systems are applied in several areas of life, for example in the diagnosis of rice disease. In this research an expert system developed on the agricultural area, explains the design and development of the rule base in the expert system using the ESTA shell (Expert System for Text Animation). This research produces a system that integrates a structured knowledge base along with solutions to the problem. The resulting system has been tested between an existing dataset and an expert in the field of plant disease [4].

Earlier researchers used expert systems to diagnose eye disease [5]. The CLIPS language of this research is used as a tool for designing expert systems. Based on research results, it was found that the performance of frame-based was more reliable than rule-based in terms of the speed of the diagnosis process [7]. In this study expert system using demster Shafer method. The resulting diagnosis of coronary heart disease is positively accepted by the user [6]. Expert systems are used for detection and early treatment of cow disease. In this research expert system is implemented by using mobile based applications. However, with limited computing resources on mobile devices. In this research diagnosed coronary heart disease [8]. Then researchers use expert systems in diagnosing skin diseases. This expert system was built using the backward chaining method for decision making [9].

2. Methodology
Expert systems in [6-10], the expert system is a computer program designed to simulate - expert human problem solving in a narrow or disciplined domain. Expert systems usually consist of a knowledge base (information, ituristics, etc.), machine conclusion (basic knowledge analysis), and end user interface (receiving input, generating output). [11-15]. Forward Chaining is a search technique that begins with known facts, then match those facts with the IF part of the IF-THEN rules. If any facts match the IF section, then the rule is executed. When a rule is executed, then a new fact (part THEN) is added to the database. Each time to match, starting from the top rule. Each rule can only be executed once. The matching process stops when there are no more executable rules. The search method used is Depth-First Search (DFS), Breadth-First Search (BFS) or Best First Search. The approach in tracking starts from the input information and then tries to illustrate the conclusion, future tracking of facts that match the IF section of the IF-THEN rules. With the forward chaining method of the approach and the rules that have been produced can be reviewed by experts to be improved or modified to obtain better results [16-17].

As shown in figure 2. Disease diagnosis process on shallot plant will start from checking G5 symptom, where there are three types of diseases that have symptoms of G5, namely disease P1, P2 and P6. After that, the next symptom check will be done. If G1 symptoms are detected then the likelihood of the disease is P1. Meanwhile, if detected symptoms of G7, then the possibility of the disease is P2. Finally, if G29 symptoms are detected, then the possibility of the disease is P6.
Block diagram is used to find out the working order of expert systems to reach a decision and made to model work processes on a computer for easy understanding. The following is a description of the block diagram of the forward chaining expert system:

![Decision Tree Diagram](image)

**Figure 1.** The decision tree of forward chaining method.

The search process will start from the process of reading the data characteristics of the database. After that, the system will wait for the user's response to the features displayed by the system. If the data entered by the user in accordance with the characteristics of certain onion diseases, then the system will take the next characteristic of the onion fruit disease in question and request a response from the user again. If not, then the system will take the characteristics of other onion diseases and ask for the response from the user. Workflow from the data search process can be seen in Figure 3 as follows:

![Block Diagram](image)

**Figure 2.** Block diagram of diagnosis of onion diagnosis expert system.
If the system has obtained an onion disease solution or any list of features has been asked, then the system will display the conclusions obtained. The following data of symptoms used in this onion disease expert system amounted to 16 symptoms. The data of these symptoms can be seen in table 1 below.

Table 1. Data on onion disease symptoms.

| Codes | Symptom name                                      | Weight Value |
|-------|--------------------------------------------------|--------------|
| G1    | Leaves contain spotted curves                    | 0.3          |
| G2    | White leaf spots                                 | 0.4          |
| G3    | Leaf spots form a purple zone if it is severe    | 0.5          |
| G4    | Leaf tips dry                                    | 0.6          |
| G5    | Tubers rot                                       | 0.4          |
| G6    | Tuber tissue dries                               | 0.1          |
| G7    | Leaf tips are pale green spots                   | 0.4          |

Figure 3. Structure of data search algorithm.
There are mycelium and spores on the leaf spot 0.7

dwarf plant 0.4
user wrinkled 0.6
brownish tubers 0.3
he tuber parts look dry and pale 0.2
Spotted leaf round and elongated 0.5
brown leaf spot 0.3
the largest number of spots on the tip of the leaf 0.2
tissue on dead leaf spot 0.5

The number of diseases processed in this onion disease expert system are 9 kinds of diseases. The data of this disease can be seen in table 2.

Table 2. Onion disease.

| Codes | Symptoms                                      | Symptom name                               |
|-------|-----------------------------------------------|--------------------------------------------|
| P1    | Tramples, purple blots                       |                                            |
| P2    | Fake flour                                   |                                            |
| P3    | Leaf spots cercospora                        |                                            |
| P4    | Automatic, anthracnose                       |                                            |
| P5    | Leaf spots cercospora                        |                                            |
| P6    | Dead shoots                                  |                                            |
| P7    | Penicillium reeds                            |                                            |
| P8    | Yellow dwarf virus, mosaic virus              |                                            |
| P9    | Nematodes root cultivation                   |                                            |

3. Results and Discussion
In Figure 4 describes the process done on this system application where when this application is run then that appear first is the login menu when the login menu appears if the user and password is true then go to the main page of the application if wrong then appear your password message wrong. When you enter there are some menus that contain some links to certain pages for example on the menu of symptoms then this menu displays the form of selection of symptoms when it has been selected symptoms into the final diagnosis. Figure 4. Login Process Go to Main menu and Selection of Symptoms.
Figure 4. Login process go to main menu and selection of symptoms.

In table 3 it shows the results of onion diagnosis with forward chaining.

Table 3. Report on the diagnosis of onion disease.

| Date            | Disease                  | Solution                                                                 |
|-----------------|--------------------------|--------------------------------------------------------------------------|
| 2017-11-29:15:15:60 | Moler or Fusarium Lumber (P5) | 1. Planting resistant varieties, such as philippine and sumenep varieties, long rotation of plants, adding organic fertilizer in the field of 5-10 tons /ha, planting healthy tuber seeds, avoiding the cultivation of bulbs either at planting or harvesting, immediately revoking and destroying affected plants and seed treatment with recommended functions (100kg of seedlings + 100 g of functionalis).
   |                           | 2. Effective soil dyeing and treatment registered and legalized by the Minister of Agriculture such as Anaconda 50 WP and Saco P |

4. Conclusions

Based on the diagnostic results of several methods that have been done testing can diagnose the disease contained in shallot plants. With symptoms data that has been determined by the expert with the value of each symptom is different. As for the symptoms that have been determined that Leaves contain spotted curve with a value of 0.3, White leaf spots value 0.4, Leaf spots form a purple zone if it is severe 0.5, Dry leaf tip 0.2, Tubers rot 0.4. Based on the diagnostic results above then get a value of 67% forward chaining diagnosis results with trotol disease type, Chugging.
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