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Impact of Using Automatic Smart Control Technology Using UV Rays on Hydroponic Chili Plants

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Abstract—Development and human population that is so solid also has an impact on increasingly narrow agricultural land. Therefore, a new farming model called the hydroponic system is designed to minimize agricultural land. The most potential plants to be planted using this system are chili plants because of the culture of the people who like to consume chilies. The problem that occurs in conventional chili farmers is still not optimal in producing crops. The method used in this study is field observation and designing an automatic smart hydroponic system control device, then supporting components using several sensors including EC sensors, ph sensors, RTC sensors, and ultraviolet lamps. Preliminary studies regarding the potential benefits to be obtained by partners or chili farmers based on field test results that this technology can maximize harvest time efficiency from manual hydroponic cultivation which was originally 90 days to 70-80 days. Therefore, a smart automatic plant control system using UV lamps has a harvest speed of 70-80 days, while the manual method can reach 90 days. Thus, it was concluded that the use of this technology would have an impact on increasing the economy of chili farmers if an automatic smart crop control system was used.

Keywords: Automatic Intelligent Control, Hydroponic Chili, UV Lamp

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1. Introduction

Indonesia is an agricultural country that has abundant natural wealth and most of the population in Indonesia are farmers. The food crisis and energy crisis have forced the world community to accelerate technological developments [1], [2]. A farmer works in managing the land with the aim of growing and maintaining plants in order to obtain maximum results which can later be used alone or sold to others. However, over time the land needed by farmers has decreased due to the many constructions of houses and roads which have resulted in less and less land needed by farmers [3]. Hydroponics is a solution for cultivating plants without using soil, because hydroponics does not require soil as a medium but instead requires water as a substitute for soil [4],[5]. Hydroponic plants Chili is a type of vegetable that has many benefits as well as a basic necessity typical of Indonesian cuisine because chili is widely used as a spice and flavoring for food.[6]. Chili is also a vegetable that has a selling price which sometimes increases during major holidays such as New Years, Eid al-Adha and other holidays. In addition, chili is also one of the plants that is very easily attacked by pests, especially chili plants that are grown hydroponically, pests that attack hydroponic chili plants are armyworm pests.[7], [8], [9]. Therefore, this is what makes farmers have to be extra careful to get maximum chili fruit yields. The initial study in this research was to visit people who work as Micro, Small and Medium Enterprises for hydroponic cultivation located on Jl. Lorong Amal No.11, Tegal

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Sari III, Medan City, North Sumatra found problems with farmers in yield productivity from hydroponic chili plants which were still not optimal. Hydroponic cultivators, especially chili plants, experience many crop failures due to pests that continue to attack hydroponic chili plants, resulting in losses for these hydroponic cultivators. There are many strategies to increase crop yields in hydroponic chili plants, especially keeping the pH stable, it is recommended for chili plants, namely 6.0-6.5 and also nutrients for the early growth of hydroponic chili using nutrients as much as 600 to 700 ppm [10]–[12]. Furthermore, in order for hydroponic chili cultivation to produce good quality and hygiene, there must be a pest protection process with an automatic control system for spraying pesticides, automatic control of pH and nutrition and UV lamps which function to repel pests and replace photosynthesis at night.

The determining strategy so that hydroponic chili cultivators can produce optimal harvests using appropriate technology. Better response using a smart approach and handling more complex systems in the integration of automatic controls and direct implementation of hydroponic equipment plants [13]–[15]. a tool was designed with automatic smart control technology using a UV lamp. The UV lamp functions as a substitute for sunlight at night, thanks to the UV lamp the nutrients needed by hydroponic chili plants are maintained and get enough light for 24 hours straight. In terms of quality, plants using a hydroponic system with UV light technology have lighter leaf colors, white roots and fresh chilies. This is an indicator that the chili plants are growing healthily. With a stable irrigation system and lighting with this UV lamp, hydroponic chilies can be harvested in just 70-80 days, where chili plants can generally be harvested at the age of 80-90 days if not using a UV lamp. These results show that automatic smart control technology using UV lamps can maintain pH stability, nutrition and sufficient lighting to maintain quality and increase yields of hydroponic chili plants.

2. Method

The activity begins with conducting case studies and also literature studies, then a problem or obstacle is found that must be resolved, namely how to optimize the productivity of hydroponic chili crops so that they can produce quality crops in a fast time and avoid pests. After conducting a survey, it was later found that there was a problem with the performance of manual hydroponic chili cultivation not being able to work optimally which resulted in many pests attacking the plants so that many chilies failed to be harvested. Utilization of hydroponic cultivation manually with a low success rate of harvest and performance problems of manual chili hydroponic cultivation cannot work optimally which results in many pests attacking the plants so that many chilies fail to be harvested. Based on figure 1, it can be seen that the use of conventional hydroponic methods and the harvest success rate is still low.



Figure 1. Chilli hydroponic plants with conventional method

Based on the findings in the field, there are several steps that must be taken so that hydroponic plants can be more optimal in the cultivation of chili plants. The first step taken was to design a smart plant control automatic tool, then use several sensors to support optimal hydroponic technology performance, such as EC sensors, ph sensors, RTC sensors, and ultraviolet lamps. To see the initial

design of sensor integration with automatic smart plant control technology, it can be seen in figure 2 below.

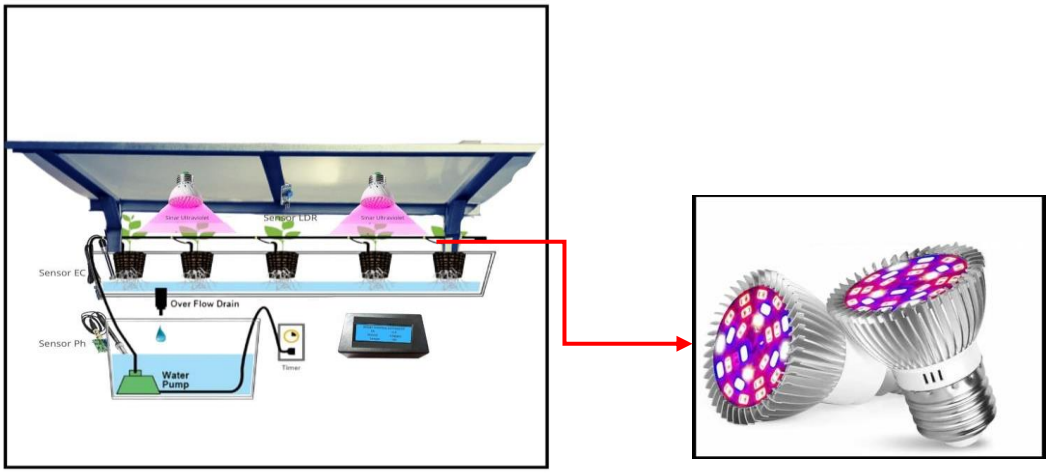


Figure 2. Hydroponics Smart control automatic design with UV light

An ultraviolet lamp that functions as a substitute for sunlight at night so that plants get sunlight for 24 hours and also so that the pH and plant nutrients remain stable. After the smart plant control automatic tool is designed, it is then installed to install the LDR sensor, where the LDR sensor functions as a light sensor so that when the light is dark the UV light will automatically turn on. LDR sensor This system has advantages in terms of the growth process of hydroponic chili plants because this tool is equipped with a UV lamp that functions as sunlight at night and also has several sensors that support the process of maintaining pH stability and nutrients in the smart plant tool automatic control, namely by using Electrical Conductivity (EC) which is used to check the PPM value of nutrients in water. For more details, the installation of automatic smart control on UV lamps for hydroponic plant innovation can be seen in Figure 3.



Figure 3. Chili plants at night use Smart control automatic with UV light

3. Result and Discussion

In an effort to improve the economy, hydroponic chili cultivation in current conditions is a form of realization in the manufacture of automatic smart plant control devices using UV lamps. The potential profit that will be obtained by partners based on the results of the system testing carried out is that this technology system can maximize harvest time efficiency from manual hydroponic cultivation which was initially 90 days to 70-80 days. The following is the initial research study data obtained based on table 1.

Table 1. Results of the initial study on the use of Smart UV Light Control Technology and Conventional method

Testing using Smart Technology Control UV rays		**Testing With Conventional Method**	
Time at 7:00 p.m	Time at 05.00 a.m	Time at 7.00 p.m	Time at 05.00 a.m
7 cm	7 cm	7.3 cm	7.3 cm
7.5 cm	7.6 cm	7.6 cm	7.6 cm
8.1 cm	8.2 cm	7.9 cm	8 cm
8.8 cm	8.8 cm	8.2 cm	8.2 cm
9.3 cm	9.4 cm	8.6 cm	8.6 cm
9.7 cm	9.8 cm	9.1 cm	9.2 cm
10.7 cm	10.9 cm	9.6 cm	9.7 cm
11.8 cm	12.0 cm	10.3 cm	10.3 cm
12.9 cm	13.1 cm	10.8 cm	10.8 cm
13.8 cm	13.9 cm	11.3 cm	11.4 cm
14.6 cm	14.8 cm	11.8 cm	11.9 cm
15.3 cm	15.4 cm	12.3 cm	12.3 cm
15.7 cm	15.9 cm	12.8 cm	12.8 cm
16.5 cm	16.6 cm	13.2 cm	13.3 cm
17.0 cm	17.2 cm	13.7 cm	13.8 cm
17.8 cm	18.0 cm	14.1 cm	14.1 cm
18.4 cm	18.6 cm	14.5 cm	14.6 cm
19.1 cm	19.2 cm	15.0 cm	15.0 cm
19.8 cm	20.0 cm	15.5 cm	15.6 cm
21.4 cm	21.6 cm	15.9 cm	16.0 cm
22.1 cm	22.2 cm	16.5 cm	16.5 cm

Based on Table 1 above by testing for 3 weeks (21 days), it can be seen that using additional UV lamps on chili plants can accelerate the growth process of plants. This is because plants get a supply of light at night so that it can encourage the growth of these plants. Then the data is simulated in graphical form so that analysis is easier as in figure 4 (a) and figure 4 (b).

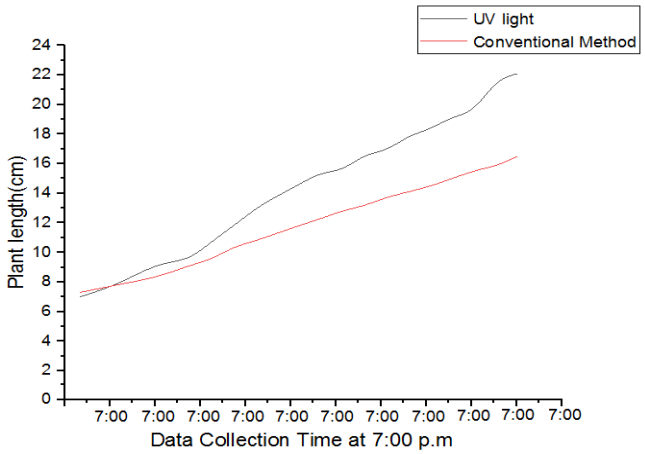


Figure 4. Graphs of plant growth and test results at night using UV Light Control Smart Technology and Conventional methods at 7.00 p.m

At night the test is based on 2 methods, the first using Smart UV Light Control Technology and the second using the Conventional method. The results of the analysis on the graph show the condition of the chili plants with faster growth using Smart UV Light Control Technology. Then testing was also carried out in the early hours of the morning so that validation of plant growth could get better results based on figure 5 below.

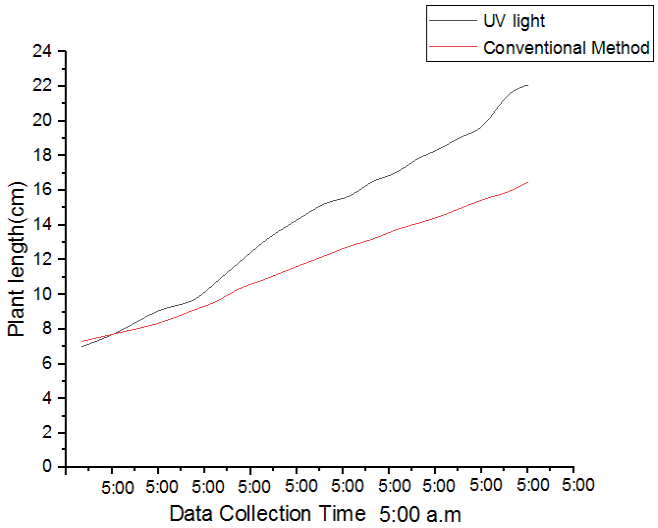


Figure 5. Graphs of plant growth and test results in the early hours of the morning using Smart UV Light Control Technology and Conventional methods at 5.00 a.m

Based on the picture in the test, the results obtained are still the same, namely the addition of UV light Smart Control Technology to hydroponic plants at night increases the growth of chili plants even though the resulting graph is not significant. Data on day 21 or week 3 obtained accurate results from the growth of chili plants using Smart UV Light Control Technology reaching 22.2 cm while with the Conventional method reaching 16.5 cm. This of course encourages farmers to further develop chili plants with Smart Control UV light technology so that farmers can harvest chilies more quickly later.

4. Conclusion

Based on the results of the research conducted, it can be concluded that using a smart plant control system automatically using UV lamps has a harvest speed of 70-80 days while the manual method reaches 90 days. Thus, it is expected that the economy of chili cultivators will increase if the smart plant control automatic system is used. Hydroponic farmers, especially chili farmers, are expected to be able to change the paradigm of farmers so that they don't have to heat up in large areas continuously but can become more modern farmers by utilizing more minimalist land so that later young farmers who have just started a business are more enthusiastic and can also increase production of agricultural products during a food crisis now or in the future.

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