Analysis of Chilli Plant Physiology Conventional System, Green House Hydroponic Utilization System Using Fuzzy Logic

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Abstract. The chili (Capsicum Annum L) is one of the vegetable crops that have high economic value. Red hydroponic cultivation is an effort to increase the yield of red chilies by minimizing the use of chemical fertilizers, thus using biological fertilizer on red pepper plant is expected to increase the growth and yield of red peppers. This study aims to determine the physiology of red chili plants with hydroponic system with the utilization of green house. Both physiology studies of red pepper plant with hydroponic system with green house utilization and the three physiological studies of red pepper plant with hydroponic system with green house utilization. The variables observed in this study include plant height (cm), plant width (cm), and number of leaves (strands). The method used conventional chili plant, hydroponic system is Fuzzy Logic. The main discussion is to study the comparison of cultivation of chili plants with hydroponics and conventional using plant physiology with green house. The results of physiology simulation of red pepper cultivation using plant length, weight of plant weight, hardness of plants, number of leaves, number of flowers, water content produce better hydroponic system growth than conventional system on red pepper plant. In the cultivation of soil media plants require fertilizer is always done watering in times of growth while the hydroponic media require nutrient fertilizer hydroponic kits have been found. This is according to previous research that the parameters of the success rate of a hulticulture cultivation is can be seen from the vegetative and generative plants. The Conclusion of the study of chili cultivation with hydroponics more than conventional physiological review of plant methods of fuzzy logic.
1. Introduction

Vegetables are one of the horticultural products that are in great demand by the community because it has nutritional content that is beneficial to health. Vegetables can be consumed in raw or processed first in accordance with the needs to be used. One vegetable commodity that is needed by almost everyone from all walks of life, is chili, so it is not surprising that the volume of circulation in the market on a large scale. Chili cultivation is still a lot of obstacles encountered include pest disease, less conducive climatic conditions, and less intensive cultivation. There is an effort to increase the production of chili pepper, by planting conventional chili and hydroponics.

Providing a solution to the constraints of horticulture cultivation in general and chili studies reviewed or previous research is Natural agriculture in the cultivation of agricultural crops can increase the dominance of effective microorganisms in the soil as well as promising growth and yields [1]. The cultivation of agricultural that the parameters of the success rate of a hulticulture cultivation is can be seen from vegetative and generative plant crops [2].

Hydroponics is an efficient technology for growing plants in nutrient solutions (water containing fertilizers), with or without the use of an artificial medium (sand, gravel, vermiculite, rockwool, perlite, peatmoss, coir, or sawdust) [3]. Chili (Capsicum Annum L.) is one of the horticultural crops of vegetables that much needed by the community as a flavoring dish [4]. The hydroponic excess is that it does not require fertile soil for the cultivation of plants. And avoid the problems of diseases caused by soil, pests and weeds. Therefore the minimum use of harmless plant protection chemicals, so the results of hydroponics fresh and healthy [5]. The hydroponic system more plants in the greenhouse hydroponics rapidly react to changes in the environment around with some reactions can be changed like hot weather or narrow oxygen [6]. The Hydroponic system has the advantages of cultivating plants under a landless culture to succeed. Plant growth including horticultural crops with nutritional medium, it was found that the growth was much better than the same plants grown on the soil and the organic nutrient systems it supplied [7, 8]. Hydroponic planting medium can be derived from natural materials such as gravel, sand, coconut fiber, rice husk, pumice stone, peat, and pieces of wood or artificial material such as brick shards [9].

The observation method includes plant height, number of leaves, number of branch armpits, and number of flowers, root volume, dry weight, and fruit weight. The data obtained were analyzed by F test of 5% level. If there is a real difference in treatment followed by Duncan Multiple Range Test (DMRT) test at 95% confidence level. and yield of are stem fiber have significant effect on all growth and chili pepper variables (plant height number of branch type, number of flower, root volume, dry weight of plant and fruit weight) nutrition have significant effect on 2 observation variables only, number of leaves and amount axillary stem, nutritional mix with the addition of NPK can increase the number of branch leaves and armpits [10]. The cultivation of pepper plants with drip irrigation system feasible to be applied, because the system has been able to regulate the amount and timing of its giving. The system was applied with an average drip discharge of 137.685 mm3 / sec. When viewed from three feasibility parameters, the drip irrigation system is still not maximized, because only one criterion that meets the standard value is the value of distribution efficiency [11]. Methods for physiology of pepper plants The main plot of the condition is the puddle that is inundated for 1, 2, 3 and 4 days while the subplot is red chili varieties and the result of the puddle damage causes root damage with different degrees of damage on all varieties tested. Root damage correlates with agronomic and physiological characters. Based on the observed agronomic character, Kiyo F1 varieties are tolerated, Serosa, Bravo F1 and semi-tolerant, and Riawan's varieties are not tolerant. Flood-tolerant varieties are characterized by minimal root damage in the endodermis, resulting in the highest amount and weight of fruit. Increased ethylene occurs along with increasing inundation and does not correlate with chili tolerance to inundation stress. The high content of N tissue is an indicator of physiological character in puddle tolerant inundation plants [12].

The purpose of this study was to compare the study of pepper cultivation with conventional systems and hydroponics systems using Fuzzy Logic method.
2. Methods
Fuzzy logic is a method different from ordinary or traditional logic where the basic fuzzy logic is obscurity and uncertainty [5-8]. Fuzzy logic is a way to map input space into the output space. Fuzzy logic has a mathematical concept underlying fuzzy reasoning that is very simple and easy to understand [13, 14].

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Fuzzy logic allows membership values between 0 and 1, the level of gray and also black and white, and in linguistic form, uncertain concepts such as "little", "tolerable", and "very". This method is related to the fuzzy set and probability theory. Fuzzy logic was introduced by Dr. Lotfi Zadeh from the University of California, Berkeley in 1965 [5].

The Fuzzy Logic main frame as shown below is future:

![Fuzzy Logic Main Frame](image)

**Figure 1.** The fuzzy logic main frame.

Data as input of system inference consist of leaf length, leaf width, fruit weight, fruit hardness for functional membership of fuzzyfication processed with stages of rule evaluation resulting fuzzy output quality physiology of pepper plant. The next stage of defuzzyfication is to obtain crisp output with a good three-dimensional image on conventional chili system cultivation systems and hydroponics systems.

3. Results and discussion

3.1. *Simulation with conventional system*
Fuzzyfication with input consists of 4 plant length input, plant weight, number leaf, the amount of fruit processed by mamdani system to produce plant physiology quality.
Figure 2. FIS conventional system.
In the input system output produces 4 member functions according to input.

Figure 3. Member function conventional system.
This System rule kind of 50 rules with 4 inputs and 1 output.

Figure 4. Rule conventional system.

- If (fruit-length is short) and (weight/fruit is small) and (hardness is soft) and (water-content is little) then (quality is bad) (1)
- If (fruit-length is short) and (weight/fruit is small) and (hardness is soft) and (water-content is medium) then (quality is bad) (1)
- If (fruit-length is short) and (weight/fruit is small) and (hardness is soft) and (water-content is many) then (quality is bad) (1)
• If (fruit-lenght is short) and (weight/fruit is small) and (hardness is hard) and (water-content is little) then (quality is bad) (1)
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• If (fruit-length is long) and (weight/fruit is small) and (hardness is soft) and (water-content is many) then (quality is bad) (1)
• If (fruit-length is long) and (weight/fruit is small) and (hardness is hard) and (water-content is little) then (quality is medium) (1)
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Surface view conventional system consists of 3 dimensions showing X fruit length, y weight fruit as input and Z is not good quality output based on rule base.
3.2. Simulation with hydroponic system with fuzzy logic input
Fuzzyfication with input consists of 5 plant length input, plant weight, weight fruit, the number of leaves, the number of flowers processed by mamdani system to produce plant physiological quality.

This System kind of 71 rules 5 inputs 1 output.
Figure 8. Rule hydroponic system.

- If (plant-height is short) and (weight/fruit is small) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is little) then (quality is bad) (1)
- If (plant-height is short) and (weight/fruit is small) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is many) then (quality is bad) (1)
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- If (plant-height is short) and (weight/fruit is small) and (number-of-leaves is many) and (number-of-flowers is little) and (number-of-armpit-leaves is little) then (quality is medium) (1)
- If (plant-height is short) and (weight/fruit is small) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is little) then (quality is bad) (1)
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- If (plant-height is short) and (weight/fruit is medium) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is little) then (quality is bad) (1)
- If (plant-height is short) and (weight/fruit is medium) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is many) then (quality is bad) (1)
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If (plant-height is medium) and (weight/fruit is medium) and (number-of-leaves is many) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is good) (1)

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If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)

If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)

If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)

If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)

If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)

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If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)

If (plant-height is medium) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is medium) (1)
• If (plant-height is long) and (weight/fruit is medium) and (number-of-leaves is many) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is good) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is little) then (quality is medium) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is many) then (quality is medium) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) then (quality is medium) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is little) and (number-of-armpit-leaves is many) then (quality is good) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is many) then (quality is good) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is many) and (number-of-armpit-leaves is little) and (number-of-flowers is medium) then (quality is medium) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is medium) and (number-of-armpit-leaves is many) then (quality is good) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is medium) and (number-of-armpit-leaves is little) and (number-of-flowers is medium) then (quality is good) (1)
• If (plant-height is long) and (weight/fruit is big) and (number-of-leaves is little) and (number-of-flowers is medium) and (number-of-armpit-leaves is medium) then (quality is good) (1)

Surface view hydroponic system consists of 3 dimensions showing X fruit length, y weight fruit as input and Z is a good quality output based on rule base.

![Figure 9. Surface viewer Hydroponic.](image)

In accordance with the results of the review referred to [5, 6 7 and 8] it is appropriate that the quality hydroponic system produces 57.1 is better than the conventional system of quality 51.4.

4. Conclusions
The results of physiology simulation of red pepper cultivation using plant length, weight of plant weight, hardness of plants, number of leaves, number of flowers, water content produce better hydroponic system growth than conventional system on red pepper plant. In the cultivation of soil media plants require fertilizer is always done watering in times of growth while the hydroponic media require nutrient fertilizer hydroponic kits have been found. This is according to previous research that the parameters of the success rate of a hulticulture cultivation is can be seen from the vegetative and generative plants. The study of chili cultivation with hydroponics more than conventional physiological review of plant methods of fuzzy logic.

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