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DRIP IRRIGATION DESIGN FOR HORTICULTURAL CROPS

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ABSTRACT

Irrigation Is One Of The Activities In The Field Of Agriculture That Aims To Provide Water For Plants Water Is One Of The Factors That Determine The Quality And Quantity Of Plant Production. The Amount Of Water Used By Plants Is An Important Factor In Drip Irrigation Planning Because It Is The Basis For Calculating The Amount Of Water Needed In The Irrigation Area That Is To Be Designed. One Of The Constraints Of Providing Water For Plants Is Still Applying The Rainwater System And Providing Conventional Irrigation Water. This Can Lead To In-Efficiency Of Irrigation Water And Labor Therefore, It Is Necessary To Implement An Effective And Efficient Method Of Providing Irrigation Water. Designing Drip Irrigation Technology Is One Of The Solutions For Problems And Providing Irrigation Water For Plants. This Research. Aimed To Design And Implement Drip Irrigation Technology For Horticultural Plants. As For This Research, The Design Of Drip Irrigation Technology With A Gravity Flow System Was Carried Out. The Results Of The Research Showed That Model Design Two Was The Best In This Research With A Flow Discharge Value Of 0.0078 M3/S And Had An Economic Value Of 1,764,091. Total Pressure Loss (Head Loss) Had A Value Of 0.0166 M Which Consisted Of Major Head Loss Of 0.0052 M And Minor Head Loss Of 0.0114 M. Design Model Two Had An Efficiency Value Of Cu-92.50%, Efficiency Value Of Du-87.95% And Efficiency Value Of Su-91.15%, So It Was Included In The Good Category. This Research Design Model Could Be Used For Horticultural Plants.

Keywords:
Irrigation Water Efficiency, Piping Network, Drip Irrigation, Imgation Water Supply

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INTRODUCTION

Irrigation is one of the activities in agriculture which aims to provide water for plants. Water is a very important factor for plant growth, especially in the process of absorption of nutrients in the soil. Nutrient absorption by plants can be carried out if there is sufficient water in the root zone [1]

The presence of water must be in accordance with the water needs of plants, because water is one of the factors that greatly determines the quality and quantity of a crop production. The existence of water is strongly influenced by vegetation, evapotranspiration, and climate change, especially rainfall. According to [2] stated that climate change which causes more frequent occurrence of rain patterns has a broad impact on the agricultural sector, especially those related to the availability of plant water. The diversity and irregularity of the rain pattern affects agricultural production.

One of the obstacles to providing water in the experimental field of the Faculty of Agriculture, University of Borneo Tarakan is the unavailability of irrigation networks. Most of the plant cultivation activities in the experimental field of the Faculty of Agriculture, University of Borneo Tarakan still apply conventional rain-fed systems and plant watering. The application of conventional methods of providing plant water causes efficiency in labor, time and irrigation water. The unavailability of irrigation networks affects the uncertainty of providing water for plants. One method of providing water to plants can be done by designing and implementing drip irrigation technology.

Drip irrigation has an efficiency value of 80 – 95% compared to bulk irrigation and surface irrigation. The application of drip irrigation technology can provide high efficiency and effectiveness in meeting the water needs of plants [3] Besides that, the design of a lateral pipe system, especially drip irrigation, can be a good investment if it is designed and maintained properly. Piping system design good lateral drip irrigation is to pay attention to pipes, pressure distribution, emitter discharge and a number of other hydraulic parameters.

The amount of water used by plants is an important factor in drip irrigation planning because it is the basis for calculating the amount of water needed in the irrigation area you want to design. Apart from that, it is also necessary to analyze climate data, rainfall, plant species and spacing, as well as other meteorological data which is used to calculate the amount of water used by plants.

Based on the description above, we need an effective and efficient method of providing water to plants. One method of providing plant water is to design and apply drip irrigation technology in the experimental field of the Faculty of Agriculture, University of Borneo Tarakan.

METHOD

This research was carried out from December 2021 to July 2022 at the Experimental Field of the Faculty of Agriculture, University of Borneo Tarakan.

The tools used in this study were a tape measure, stopwatch, stationery, scissors, measuring cups, and a set of computers with the Microsoft Excel program. While the materials used are 11 mm diameter pipe, 7 mm pipe,

elbow connector, 4 way cross connector, joiner nepel connector, tee connector, emitter head, pipe glue, seal tape, and valve.

At the piping network design stage, a piping system design is carried out which consists of several

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components, namely monifold pipes, lateral pipes, and emitter outlets. The design of the pipeline network was installed in the experimental field of the Faculty of Agriculture, University of Borneo Tarakan which consisted of 42 polybags with a land size of 7x6 m and a drainage system using gravity pressure.

In the monifold pipe using a pipe with a diameter of 11 mm with 3 branches. Furthermore, in the lateral pipe with a diameter of 7 mm there are 14 branches with 42 dropper emitters.

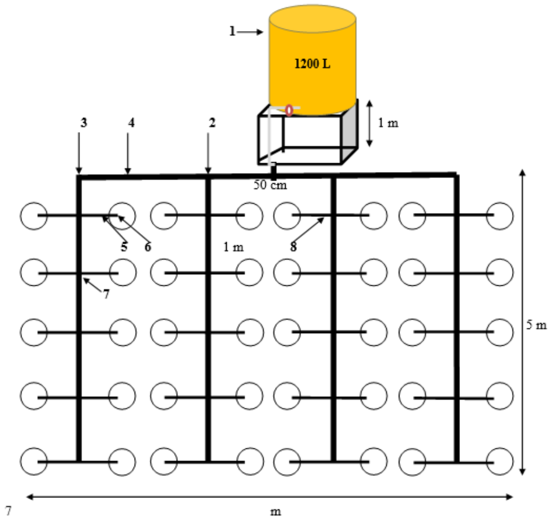

Figure 1. layout pipping design

The parameters of this study consisted of technical analysis, economic analysis, pressure loss (major head loss and minor head loss) and efficiency of drip irrigation.

RESULT AND DISCUSSION

Result

In this research, the design of drip irrigation technology with a drainage system using gravity was carried out. In this study, four design models were carried out for technical analysis, while the main components were: main unit (head unit), polyethylene pipe, dividing pipe (sub-main, manifold), lateral pipe and application tools (applicator, emission device).) consists of a dropper (emitter). The primary channel uses a pipe with a diameter of 11 mm and a lateral pipe with a diameter of 7 mm, then uses a dropper (emitter). The technical analysis of the drip irrigation design model in this study can be seen in Table 1.

Table 1. analysis of drip irrigation

layout	Channel cross-sectional area (m^2)		Flow velicity(m/s)		discharge(m3/s)		Q tot (m^3/dt)
	A11	A7	*v*11	*v*7	Q11	Q7	
layout 1	0,0097	0,00 41	0,7005	0,5457	0,0068	0,0024	0,0092
layout 2	0,0097	0,00 41	0,6028	0,4389	0,0058	0,0020	0,0078
layout 3	0,0097	0,00 41	0,5056	0,4336	0,0049	0,0019	0,0070
layout 4	0,0097	0,00 41	0,4573	0,4035	0,0044	0,0018	0,0062
		average					0,0019

Table 1 explains that in this study four designs were modeled. Each design has different specifications, with the same pipe diameter, with the difference only in each branch. As for the calculation of technical analysis with the cross-sectional area of the pipeline obtained from the pipe diameter changed to meters, then the results are calculated using the area of the circle. Then the flow velocity is obtained from each unequal pipe length. These results are found from each flow rate of water that comes out later calculated on each pipe with the pipe length of each design. While the flow rate of each of these designs can be obtained from the cross-sectional area of the channel through calculations referring to the flow velocity. So that the results of Q tot are obtained from the results of the flow rate for each irrigation design. Then it can be seen that the highest value is found in the first design of 0.0092 (m3/s). The four irrigation design models have an overall average of 0.0019 m3/sec.

Discussion

Based on Table 5, it shows that the technical analysis of drip irrigation technology using four design models was carried out in the experimental field of the Faculty of Agriculture, University of Borneo Tarakan. In each drip infusion design each has the same channel cross-sectional area, using a pipe with a diameter of 11 mm has a value of 0.0097 m2 and a pipe with a diameter of 7 mm has a value of 0.0041 m2. Then it is known that the flow velocity of each design is different, due to the different lateral pipe lengths and the number of lanes for each design. The first design has two lateral pipelines, then the second design has three lateral pipelines, while the third design has four lateral pipelines and the fourth design has five lateral pipelines. It can be seen that of the four very high design models there are in the first design with values of 0.7005 m/s and 0.5457 m/s.

This value is seen from the operating time and the short lateral pipeline, the result is the greater the speed. So that the first design has a greater flow velocity than the second, third and fourth designs. This is due to the slow release of water. According to [4], the flow velocity at the emitter is determined based on the discharge that comes out, the distance between the droppers and the lateral length.

The flow rate in this study from each of the resulting designs can be seen that in the first design the flow rate is greater than the other designs, with a diameter of 11 mm having a value of 0.0068 m3/s and a diameter of 7 mm having a value of 0 .0024 m3/s. This affects the cross-sectional area and flow velocity, so that from the overall results of the total Q it is the first design that has a high discharge value of 0.0092 m3/s. With an average of the four overall irrigation design models of 0.0019 m3/sec. The average size can be seen that the greater the discharge, the greater the flow rate, because the flow rate is directly influenced by the length of the lateral pipe and the number of branches for each design.

CONCLUSION

1. The second design model is the best in this study with a flow rate of 0.0078 m3/s and has an economic value of 1,764,091. The total head loss has a value of 0.0166 m consisting of a major head loss of 0.0052 m and a minor head loss of 0.0114 m.
2. The second design model has an efficiency value of CU = 92.50%, an efficiency value of DU = 87.95% and the efficiency value of SU = 91.15% so that it is included in the good category.
3. This research design model can be used for horticultural crops.

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