True Drip Irrigation Performance on Discharge Variation and Distance of Lateral Pipes"

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True drip irrigation performance on discharge variation and distance of lateral pipes

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Absract. Agricultural activities must be carried out even in limited water conditions to ensure the availability of food reserves. Poor forest management has potentially reduced the availability of groundwater and surface water in fulfilling irrigation needs. In general, the irrigation water availability is limited during the dry season which causes Agricultural activities to be limited. Then it needs adequate water-saving irrigation techniques, such as drip irrigation systems. This study aims to determine the effect of lateral pipe distance on droplet uniformity, and the effect of lateral pipe length on usage discharge. The uniformity test was carried out for a duration of 5 minutes, while the lateral pipe distance variation test consisted of 0.3m; 0.5m, 0.7m and 1m. The results that the coefficient of uniformity (CU) at the variation of the lateral pipe distance and discharge was around 94% - 100% and was a good category. The highest CU was obtained at the distance between the lateral pipes of 0.3m and Qp 0.461/s of 97.6%, while at the distance of lateral pipes of 1m and Qp of 0.30l/s, the CU was 94.6%. The conclusion of this study is the greater the lateral pipe distance, the greater the discharge is required to reach CU number of 95% and above.

Keywords: Uniformity (Cu); deviation; discharge; irrigation

1. Introduction

The reduction of water recharge from rain in watersheds (DAS) due to global climate change has had an adverse impact on water supply in the watershed, including on water reserves that are below ground level such as shallow wells. To be able to use limited water sparingly in agricultural activities, efficient irrigation techniques such as the true drip irrigation system that are currently on the market are needed. Drip irrigation is a method of providing water which is described as providing water with low discharge, so that it can save water consumption, because it can minimize possible water losses such as per location, evaporation and surface flow so that it is adequate to be applied in agricultural areas that have limited water sources [1]. According to[2] tests on the design of integrated water-saving irrigation systems on groundwater irrigation networks show that the drip irrigation system with PVC pipes can be drained with a three-nozzle mini sprinkler at a flow rate of 2.8 l / s - 7, 4 l / s and the area of planting that can be irrigated is around 15 acres, while at the network discharge below 2.8 l / s only drip irrigation can be done and the area of land that can be irrigated is around 10 acres. Based on these conditions, low irrigation water sources such as shallow well water can also be used to support community agricultural businesses in locations where the surface irrigation network has been closed.[3] who examined the use of true drip irrigation in dry land of Roots obtained an average level of uniformity of each lateral is above 70%, with the average discharge size used every time irrigating plants is up to 0.22 liters / second. With the existence of a true drip pipe on the market, it is necessary to know how the water requirements that can be provided at different lengths of NTF pipes, how the uniformity is obtained with the distance between the lateral drip pipes also varies. By knowing this information from the test results, the use of this drip irrigation pipe can be known by the public more simply and may encourage a wider use of efficient irrigation.

2. Drip Irrigation System

There have been many studies related to drip irrigation and some of them are as follows.[4], have examined the utilization of the potential of solar powered water pump in dry land of Pringgabaya with an integrated drip irrigation system, the results of the drip uniformity of an average of 72% can be used for irrigation of short-lived plants, while with mini sprinkle uniformity above 77 , 6% in the application of two sprinkles can be used to overcome the daily needs of evaporated water in the field.
Testing of the drip irrigation system with a single tank with a series pipe shows that the size of the droplets is very dependent on the amount of pressure applied. Whereas in the pipeline flow without pressure shows that, the size of the droplets really depends on the volume of the flow above it. From this preliminary research, it is also known that the droplets that occur in pipes can be regulated by pressure. At low pressure droplets occur in large and small diameter holes, and very low intensity occurs in large diameter holes. Meanwhile, at moderate pressure, the droplets occur in large and small holes with almost even intensity [5].

Meanwhile, [6] in his research on the benefits of drip irrigation in the cultivation of chili (capsicum annum), it is known that the drip irrigation system can save water consumption, because it can minimize possible water losses such as percolation, evaporation and surface runoff, so that it is adequate. to be applied in agricultural areas that have limited water sources. Drip irrigation is generally used for high economic value crops, including chili plants.

[7] who examined true drip and drip tip drip irrigation systems in the dry land of North Lombok sand showed that the ability to wet the land with these two types of pipes in the lateral direction showed the same performance. In the true drip pipe, the wetting occurs 2 times greater in the lateral direction than in the ground, while in the drip tip pipe, on average, it is only 1.5 times greater in the lateral direction. So these two types of drip pipe have somewhat different performance in providing wetting in sandy soils. Meanwhile, from the other side, [8] who examined the use of true drip irrigation networks in Salut Village said that, from the analysis of irrigation uniformity data, each lateral drip pipe showed an average result of above 80%. The average discharge used for each irrigation is 0.14 liters / second with an average volume of water used 359.5 liters on a land area of 2.5 are.

The term irrigation comes from the Dutch language, namely irrigate or in English, irrigation which means irrigation or inundation. According to Law no. 7 of 2004 Article 41 paragraph 1 concerning Water Resources, irrigation is an effort to provide, regulate and discharge water to support agriculture.

[9] stated that the main purpose of drip irrigation is to supply water and nutrients to plants in a high frequency and low volume sufficient to meet their fertility and consumptive needs.

According to [10] that drip irrigation is characterized by the following properties: water is flowed at low velocity over a long period of time, at high intervals; water is administered around or within the root zone through a low-pressure administration system. Therefore, an ideal drip irrigation is one in which all the emitters are able to provide the same volume of water in a given irrigation so that each root receives the same amount of water during the irrigation period. There are many factors that play a role in the accuracy of providing water, including: soil properties, but the most critical system component in this case may be the emitter [11].

According to [12], uniformity of water supply is determined based on the variation of the discharge generated by the emitter. Because pressure affects the emitter discharge, the greater the height of the water in the storage tank, the higher the pressure, so that the discharge will be even greater. The provision of drip irrigation water includes several methods of administration, namely as follows. Drip irrigation. In this method, irrigation water is provided in the form of almost continuous drops on the soil surface around the root zone. The discharge rate is very low, usually from 12 l / hr for point source emitters or less than 12 l / hr per m. The main goal of designing and managing a good irrigation system is to obtain a system capacity that can meet the water needs of all plants. The relationship between minimum and average dropper discharge is the most important factor in the use of this irrigation system. The degree of uniformity of the drip irrigation system is expressed as droplet uniformity (Emission Uniformity, EU).

3. Research Method

3.1. Research tools and materials

The equipment used in this research is a tool, water meter, measuring cup, stopwatch, stationery, camera, and the shimizu PS 121 BIT water pump. Meanwhile, the materials used consist of clean water, 3/4 inch and 1/2 inch paralon / PVC pipe, NTF drip pipe with a distance of 30 cm between holes, 3/4 inch stopkran and pipe accessories.

3.2. Preparation of drip irrigation network design.

The design of the carrier network as the main (primary) pipe and the secondary pipe of the 1 "PVC pipe. The drip irrigation network is installed on the land measuring 13 m x 6 m as in Figure 1.

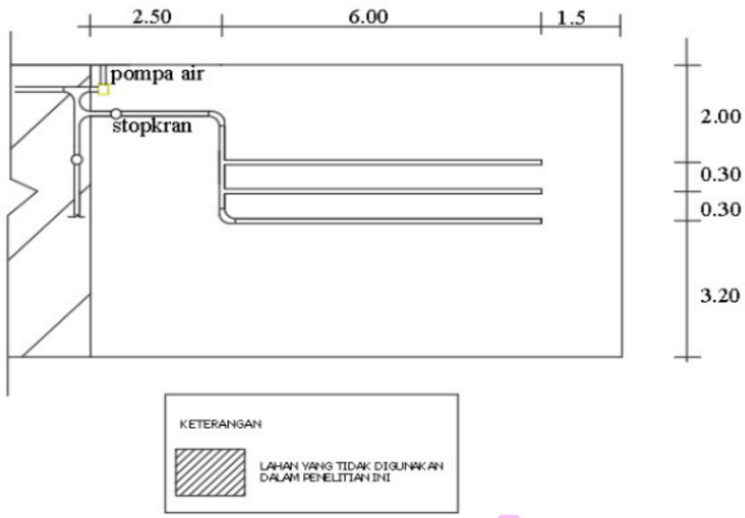

Figure 1. Example of drip irrigation network design with a lateral pipe distance of 0.30 m

3.3. Initial Test

At this stage, an initial test is carried out on the variation of discharge that can be used from the pump, with the following steps:

- When the network has been prepared on the ground, the test is carried out on the pump discharge, by opening the main pipe network after the 90 ° stop valve (full opening of the stop valve); 70 °; 50 ° and 30 °. Before entering the drip irrigation network.
- Record the volume of the outflow with the bucket and divide it by the time used, to get the discharge. Measurements are carried out 3 times, for each variation of the valve opening. The data obtained were recorded and tabulated.

3.4. Irrigation uniformity testing

This test is carried out after testing the discharge of each lateral pipe variation. The right design for a drip irrigation system must obtain water uniformity in the soil, so that it is able to provide the right water during the right time intervals. The ideal drip irrigation system design will achieve 100% uniform droplet distribution, so that each plant can receive the same amount of water for growth. But in reality in the field, it is impossible to achieve 100% uniform distribution of droplets due to many factors that influence it. The uniformity test was carried out by placing plastic cups as a means of collecting the droplets at a distance of 30 cm on each lateral pipe. The measurement of the volume of drop flow was carried out for a duration of 10 minutes, the volume was measured with a measuring cup and the data were recorded. This test is carried out at variations in the lateral drip pipe distance of 30cm, 50cm, 75cm and 100cm.

3.5 Data Analysis

The analysis was carried out on the uniformity (CU) of drip irrigation, the variation in flow rate and the amount of use of discharge the effect of the variation of the lateral distance between NTF drip pipes. The results of data analysis are presented in tables and graphs and are discussed to draw descriptive conclusions.

4. Analysis and Discussion

Based on the data obtained, the data analysis will be carried out on the variation of the pump flow rate (Qp), the flow rate for each NTF drip pipe length variation and irrigation uniformity (CU) to the distance variation between the length of the lateral pipe. Based on the variation of the opening of the faucet, it is obtained a variation of the discharge of 0.46 l / s at the 90^0 valve opening; discharge size 0.44 l / sec at faucet opening 70^0; discharge size 0.41 l / s at 50^0 valve opening; and the amount of discharge 0.30 l / sec at the valve opening 30^0.

4.1. Use of Irrigation Discharge

Based on the analysis of the flow rate data on the lateral drop pipe, it is known that the amount of discharge flowing in each lateral pipe is highly dependent on the distance between the lateral drip pipe in the network. The indication of the increasing influence on the lateral network is shown in the low flow rate, namely Q = 0.30 l / s, where at a lateral distance of 1 m, the discharge of 3 lateral pipes of each pipe is 0.110 l / s, while at a lateral distance of 0 , 7 m to 0.30 m at the same flow rate obtained an average lateral pipeline flow rate of 0.114 l / s. Therefore, it can be predicted that the greater the distance between the lateral pipes, the smaller the discharge obtained by each lateral pipe. So, if the greater the distance of the lateral pipe, a larger flow is required to be able to provide a more even flow to all the drip lateral pipes. According to [2], true drip drip irrigation is carried out using a discharge of 0.22 l / s and the uniformity obtained is below 80%, namely 70% only. Therefore, the amount of discharge determines the level of uniformity of drip irrigation that can be achieved.

4.2. Irrigation Uniformity Coeficient (CU)

The calculation of the CU value of the irrigation system used [3] and the results of the uniformity data analysis are presented in the graphs of Figures 3 to 6.

4.2.1. Uniformity Coefficient at 1m lateral pipe distance. Figure 3 shows the plotting graph of the calculation of the coefficient of uniformity (Cu) of true drip drip irrigation to the variation of pump discharge (Qp). The greatest uniformity of 97.068% was obtained at Qp 0.46 l / s, and the lowest uniformity was obtained at Qp 0.30 l / s with 94.619% CU. According to ASEA, stated that a CU value of around 94% - 100% is considered very good for drip irrigation so that the drip irrigation system with a distance of 1 m with various pump flows includes very good uniformity.

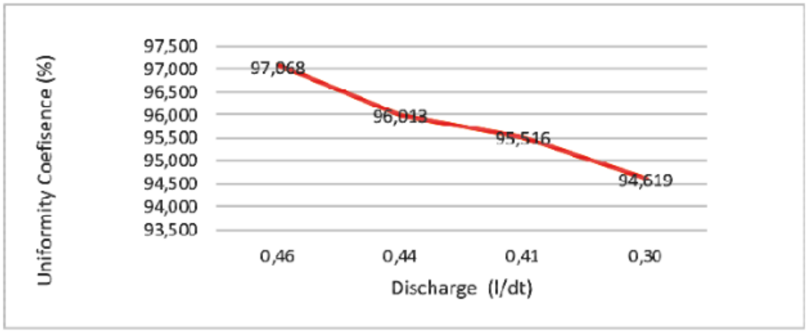

Figure 3. Uniformity relationship (CU) at variation of Qp and lateral pipe distance of 1.0m

However, if you look at the minimum CU value obtained and its tendency, the lowest uniformity coefficient value is obtained at Qp 0.30 l / s, which is 94.619%, with a trend that the greater the flow rate, the greater the CU value obtained. Even though the lateral distance is 1 m, it turns out that the test results obtained a CU value much better than the test results on pvc pipes which only reached 72%, [10]. This shows that true drip pipe does have better irrigation ability to be applied to certain plants than PVC pipe.

4.3.2. The irrigation uniformity coefficient at the distance between the lateral pipes drops 0.7m. Based on Figure 4 below shows the results of the uniformity coefficient (Cu) of drip irrigation obtained at Qp 0.46 l / s discharge of 96.628%, at Qp discharge 0.44 l / s it is obtained 96.603%, at Qp 0.41 l / s obtained CU 96.368% and at a discharge of Qp 0.30 l / s obtained 96.229% Cu. According to ASEA, the CU value of around 94% - 100% is considered very good so that the drip irrigation system with a distance of 0.7 m with various pump flows has a very good level of uniformity.

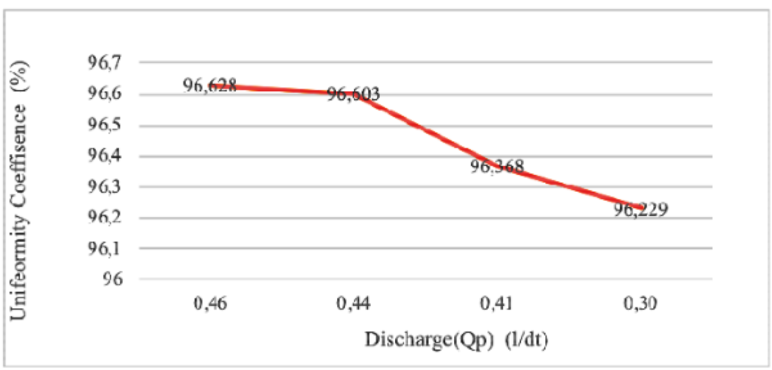

Figure 4. Uniformity relationship (CU) on Qp variation and 0.7m lateral pipe distance

Based on the graph above, it can also be seen that the uniformity coefficient value obtained is very high, but the magnitude decreases when the flow rate is getting smaller. The CU uniformity obtained in this drip pipe network is on average above 90% and greater than the value obtained in [6], where the average is above 80% who use the lateral network more than what was examined in this study. So, with the larger number of lateral pipes, it turns out that a larger amount of discharge is required in order to significantly increase the CU value.

4.3.3. Uniformity coefficient drops over the 0.5m lateral pipe distance. The analysis of the graph in Figure 5 shows that the drip irrigation uniformity coefficient obtained is 96.628% at Qp 0.46 l / s, 96.603% for Qp 0.44 l / s, 96.368% for Qp 0.41 l / s and 96.229% for Qp 0.30 l / s. According to ASEA, the CU value of around 94% - 100% is considered very good for drip irrigation so that the drip irrigation system with a distance of 0.5 m at various discharge variations obtained an excellent level of droplet uniformity.

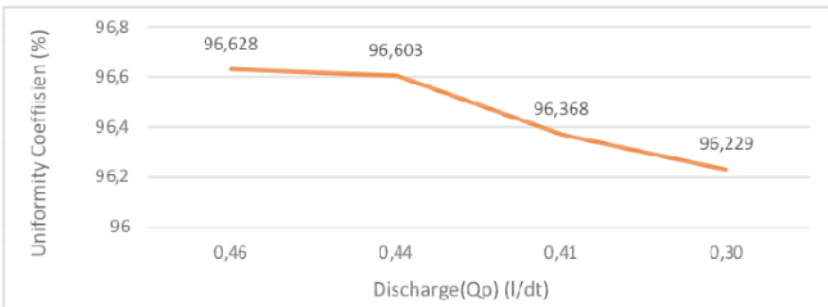

Figure 5. Uniformity relationship (CU) on the variation of Qp and 0.5m lateral pipe distance

Based on the graph above, the largest drop uniformity coefficient value is 96.628% at Qp 0.46 l / s and the smallest CU is obtained at Qp 0.30 l / s at 96.229%. So that the greater the pump discharge, the greater the coefficient value of the resulting drop uniformity.

4.3.4 Coefficient of irrigation uniformity at the distance between the lateral pipes 0.3 m. Figure 6 shows the results of the calculation of the uniformity coefficient (Cu) at each pump discharge of 97.634% for Qp 0.46 l / s, 97.462% for Qp 0.44 l / s, 97.028% for Qp 0.41 l / s and 96.074% for Qp 0.30 l / s. According to ASEA, the CU value of around 94% - 100% is considered very good for drip irrigation so that the drip irrigation system with a distance of 0.3 m with various pump flows has a very good level of droplet uniformity.

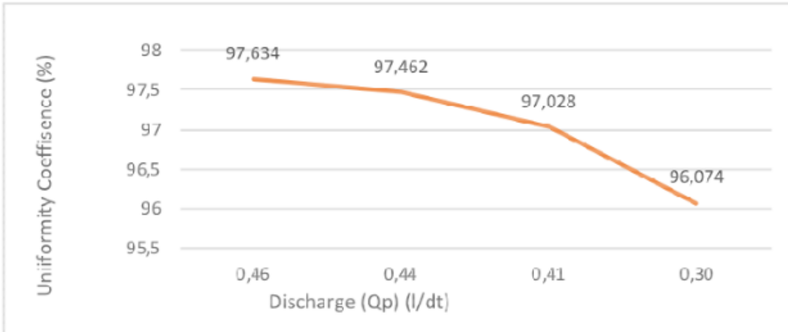

Figure 6. Uniformity relationship (CU) at variation of Qp and lateral pipe distance of 0.3m

Based on the graph above, the largest drop uniformity coefficient value is 97.634% at Qp 0.46 1 / s. While the smallest coefficient of uniformity is at Qp 0.30 1 / s of 96.074%. So that the greater the pump discharge, the greater the coefficient value of the resulting drop uniformity. Based on the results of the average irrigation uniformity test, it was found that the effect of lateral drip pipe distance variations on the irrigation discharge was 0.46 1 / s, did not show a big difference, but the flow rate below this value showed a large difference in results, as in Table 2 below.

Table 2. Average Uniformity Results at Lateral Pipes Variation

Qp (l/s)	CU (%) 1m	CU(%) 0.7m	CU(%) 0.5m	CU(%) 0.30 m
0.46	97.1	97.0	97.0	97.6
0.44	96.0	96.8	96.6	97.4
0.41	95.1	96.4	96.3	97.0
0.30	94.6	96.2	96.2	96.0

Based on these test results, the lateral pipe variations used still show very good results based on their uniformity when compared with the results of the test by [10] which examined the use of pvc pipes for drip irrigation networks and [8], who also examined the use of true drip pipes. for irrigation of tomato plants. So that the use of true drip pipe is indeed good for plant irrigation.

5. Research and Development Outlook

Based on the results of this study, the design of true drip drip irrigation networks must take into account the distance between the lateral pipe (drip pipe) and its length, because it will affect the amount of discharge that will be used in the irrigation network. The more lateral drip pipes that are installed, the greater the discharge that must be provided.

6. Conclusions

The uniformity resulting from the study of the variation in the distance between the lateral drip pipes in the flow variation used is around 94% - 100%, and is in the very good category. The highest irrigation uniformity was obtained at the distance between the lateral drip pipes of 0.3m, which was 97.63% at the discharge of 0.46 / s, while at the distance between the lateral drip pipes 1m the average CU value was 94.61% at Qp 0.30 l / dt. The greater the distance between the lateral drip pipes used in the irrigation network, the greater the discharge used.

References

[1] Fajar, F. Study of Water Supply Patterns Based on the Efficiency of Water Use in Eggplant Plants with the Drip Irrigation Method [Thesis], 2015. Department of Water Engineering, Faculty of Engineering, Universitas Brawijaya.

[2] Negara, I.D.G.J., & Supriyadi, A, "Analysis of the Design of Integrated Water Saving Irrigation System Based on Groundwater Irrigation Network (JIAT) on Dry Land with Smooth Radical Soil in Pringgabaya, East Lombok Regency,". Proceedings of the National Conference on Researchers Meeting (SENAPATI) 2015. PoliTeknik Negeri Bali, Badung-Bali.

[3] Rai, I B. 2010. Analysis of Drip Irrigation System Water Supply in the Roots Dry Land Area of North Lombok Regency. Thesis, University of Matararam, Mataram.

[4] Negara, I D G J et al," Utilization of Solar Energy in Groundwater Pumping for Integrated Drip Irrigation Development in Dryland Watersheds, East Lombok Regency,". BOPTN Research Report 2013, p.46, Mataram.

[5] Negara, I D G J, "The Influence of Pipe Orrifice Distance to Flow Uniformity in the Series Pipeline Drip Irrigation System"2008. Engineering Journal Engineering Journal, vol. 9, p. 69, Mataram.

[6] Fusanto, Tomi," Drip Irrigation in Chili (Capsicum annum) Cultivation" 2014. Journal of the Faculty of Agriculture, Batanghari University. Jambi.

[7] Negara, I D G J & Suwardji, "The Influence of Drip Irrigation on Soil Wetting in Pasiran Dry Land, Akar Akar Village, North Lombok, NTB". Journal of Civil Spectrum, Vol. 1, No 1: 57 - 64, ISSN 1858-4896, April 2010. Mataram.

[8] Nurrahmawati, A,"Efficiency of Drip Irrigation Water in Salut Village, North Lombok Regency [Thesis],"2018. Department of Civil Engineering, Faculty of Engineering, Mataram University.

[9] Nakayama, F.S. and D.A. Bucks (eds)". Trickle irrigation for crop production," 1986. Development in agricultural engineering 9. Elsevier, Amsterdam.

[10] Bucks, D.A. and S. Davis, Historical development of trickle irrigation in Nakayama, F.S. and Bucks (ed), "Trickle irrigation for crop production"1986: Development in agricultural engineering 9.

[11] Warrick, A.W. Design principles of soil water distribution. In Nakayama F.S. and Bucks (eds), 1986. Trickle irrigation for crop production development in agricultural. Eng. Elsevier, Amsterdam.

[12] Milala, Desnatalia. Analysis of Drip Irrigation with Infusion as Emiter on Cucumber (Cucumis sativus L.)," 2010. University of Northern Sumatra. Field.

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