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September 10 -11- 2018
Malang, Indonesia

Held on Cooperation between :

University of Islam Malang (Faculty of Agriculture, Animal Husbandry, Mathematic and Science, and Engineering) and some abroad Universities.

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MODEL SPRINKLER IRRIGATION BASED ON GRAVITY

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ABSTRACT

To help solve the problem security of food and increase agricultural land conservation in Indonesia, technological innovations that are environmentally friendly is needed Sprinkler irrigation systems is one of technology that can improve efficiency and effectiveness of the water use. Sprinkler irrigation applications are still little known by the public, although this system has a high irrigation efficiency. This research introduce new innovations on irrigation sprinklers that can be applied to the micro Agropolitan agriculture-based on gravity in Indonesia. The method using a laboratory test. Sprinkler design has a groove which water flows from the reservoir subsequently routed through a flexible hose then flow to the pipe. Because the position higher than the sprinkler water will hit the sprinkler head and spray. Sprinklers position can be changed according to the treatment in laboratory tests. The distribution pattern is the result of a water pressure combination and sprinkler head. Test results showed that the potential energy (pressure) enters the fluid and flow capacity does not change pattern of flow distribution sprinkle.

Keywords: gravity, Irrigation, sprinkler, water

1. Introduction

In order to support the National Food Security program, self-sufficiency in rice, increasing economic capacity and the welfare of the Indonesian people, efforts need to be made to increase farmers' harvest crop. Because rising of food demand and availability of irrigation water is not sufficient make rice farmers have to faced with three major challenges, as: (1) conserving water usage; (2) increasing water productivity; and (3) increasing rice production with little water (Bouman et. al., 2007). Devi (2010) water management treatment effect on height of plant, number of rice tillers and harvest crops. Meanwhile, according to Yulia (Julia, 2012), optimization of irrigation water use requires good management and well-planned. Conventional irrigation with open channels is wasteful irrigation, this is because a lot of water is wasted due to leakage and evaporation. Pressurized irrigation can overcome these problems with higher water distribution efficiency. This irrigation can called sprinkler irrigation is one method of irrigation where water is given by spraying water into the air and then falling to the surface of the ground like rainwater (Schwabet. al., 1981).

The purpose of the bulk irrigation system is water can be given equally and efficiently in the planting area with the amount and speed that is less or equal to the rate of absorption of water into the soil (infiltration capacity). Therefore the bulk irrigation system model needs to be developed continuously. Finding a model of water supply with sprinkler irrigation is an alternative water supply that is very appropriate for areas that are difficult to flowed water, especially during the dry season and can used for the area which is the target of becoming an agropolitan agricultural area.

2. Material and Methods

The research was conducted at the Civil Engineering Laboratory of the Faculty of Engineering, Unisma for simulation and implemented in paddy fields suitable for the agropolitan agriculture.

2.1 Research Materials

The material used in this study are: a sprinkler which is useful to spray water; Water reservoir for water storage; Measuring cup to measure the volume of storage; a ½ "water pipe to drain water from a flexible hose to a sprinkler; a drive motor as a vertical plumbing drive; Stopwatch to measure the observation time;Stationery and paper to record research results; Camera and tripod for research documentation; Flexible hose to drain water from the reservoir to the water pipe; Vertical locking latch to lock the movement of the device when going up and down; Vertical pole as a support for rising and falling tools; The galvalum shelf as a place for plants; Thrust term to measure tool diameter; Faucet as opening and closing the course of water;

2.2 Method

The method used is a field survey method to obtain agricultural land and laboratory tests. The design consists of two parts, there are pipe and electrical networks. Pipeline and sprinkler materials were tested because based on previous research it was known that none of the low pressure sprinkle shape design in the market had a good flow distribution. This condition is mainly due to its design which does not consider the analysis of the flow distribution for the wetting area segment as a function of its radius. From the test results it was found that the potential energy (pressure) of fluid inlet and flow capacity did not change the pattern of sprinkle flow distribution (Susilo, 2015). The pipe material was tested with PVC material, then tested to find out how the flow and assembly techniques affect the irrigation network. The sources of the data in this study were primary data and secondary data. Primary data is data obtained directly by researchers in the laboratory and observation. Primary data needed are: sprinkler discharge, sprinkler diameter and size, emission distance, distribution area, coefficient of uniformity and uniformity distribution. Secondary data in the form of data obtained from other parties or previous research that has relevance to the problems in this study. Data collection procedures are: Preparation of tools and materials installed according to treatment in the laboratory

3. Result and Discussion

3.1 Sprinkler Irrigation Design

Before testing the Gravity Sprinkler Irrigation Network in the laboratory, the initial research was conducting a survey on agricultural land namely Poncokusumo Village Figure 3.1 to obtain a pilot project. The survey results revealed that Poncokusumo Village, Poncokusumo Subdistrict is feasible as a place for agricultural research using sprinklers. The irrigation network design was made and then tested in the Hydraulic Laboratory of University of Islam Malang.

This sprinkler Figure 3.2 can be run and based on gravity which is consists of reservoirs that positioned higher than the head sprinkler position and holds water with a constant water discharge. Water from the reservoir will flow into the flexible hose following the specified spray height according to the plants to be sprayed. Flexible hose serves to drain water from the reservoir to the main pipe and also to facilitate the pipe when moved vertically and horizontally or forward and backward or up and down. The main pipe, placed between a drive wheels mounted on a shackle so that it can move forward and backward according to the distance of the plant. Pipes can also move up and down because the pulleys are installed in the upper and lower shackle and pipes have iron slings to facilitate moving pulleys. The base of the pipe is equipped with a tap to control the amount of flow. The sprinkler head is positioned at the end of the pipe drat with facing down position. This sprinkler head is a trapezoidal shape made from zinc and has several holes with different diameters and a circular shape at the bottom for the discharge of water flowing through the pipe. This water will generate an outpouring and spray of water into a predetermined plant. The sprinkler head can be moved forward and backward, up and down according to the position of the plant.The last is a rectangular shelf made of galvalum with two upper and lower parts to put the plants which is tested.

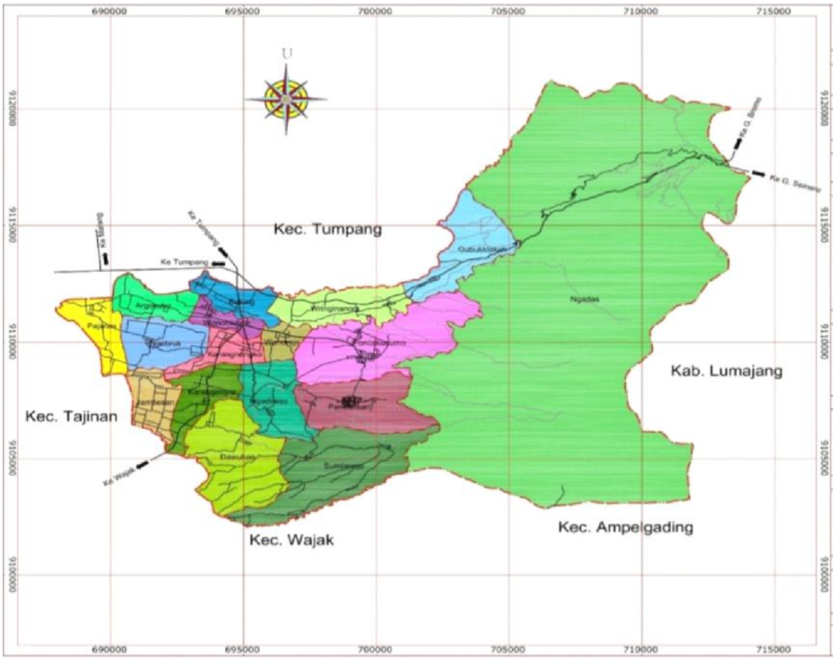

Figure 3.1. The village of Poncokusumo

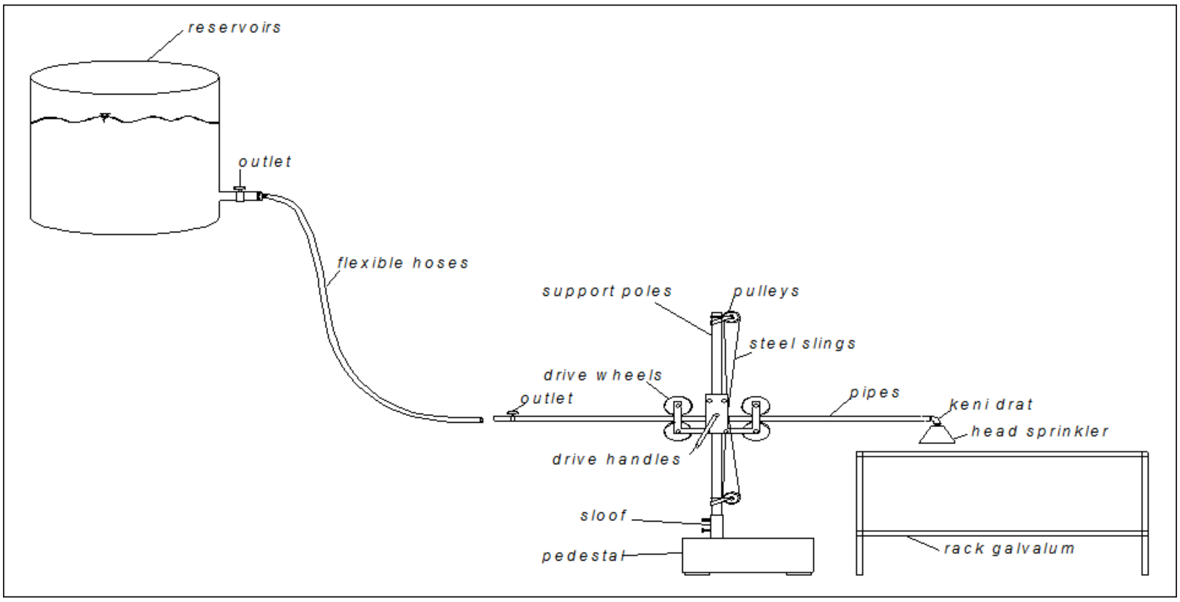

Figure 3.2. Sprinkler irrigation design

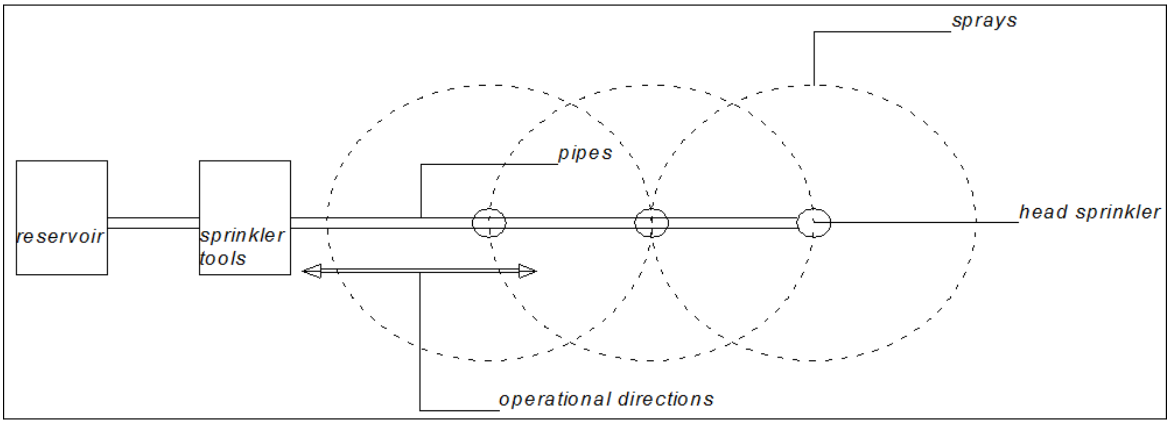

Figure 3.3. Distribution pattern sprinkler irrigation scheme

Figure 3.3. water distribution pattern scheme is to determine the distribution pattern and maximum range spray on research in the laboratory. The result will be analyzed to adjust conditions in the field.

3.2 The uniformity coefficient (CU) on the observations in the laboratory

The uniformity of the water spread was assessed using the CU index (coefficient of uniformity). CU value obtained from 1.0 reduced by dividing the total value of each observation net - average number with the number of each observation. Each treatment was observed 10 times. Table 3.1 is the acquisition of the results of experimental calculations 1 - 9 with each different treatment combination.

Table 3.1. The results of the CU scores on experiments in the Laboratory

Number	Experiment	treatment	CU (%)
1	Experiment 1	P1	85,164
2	Experiment 2	P2	89,403
3	Experiment 3	P3	75,838
4	Experiment 4	P4	93,641
5	Experiment 5	P5	67,501
6	Experiment 6	P6	75,414
7	Experiment 7	P7	82,055
8	Experiment 8	P8	91,239
9	Experiment 9	P9	88,979

From the observation data, it is known that the average value of CU is 83,248%, which means that the value of uniform distribution of water flowing in the sprinkler is good.

4. Conclusion

Distribution patterns are the result of a combination of water pressure and sprinkler head. From the test results show that potential energy (pressure) entering the fluid and its flow capacity does not change the pattern of spark flow distribution. While the average distribution value of CU is 83,248% which means that the value of uniform distribution of water flowing in the sprinkler is good

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