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Effect of Water Management Techniques on Plant Rice Yields

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Abstract:- One method to increase the growth and production of rice (Oryza sativa L.) Ciherang variety is by water management techniques and the addition of straw compost. This research was conducted for 5 months from September 2015 to February 2016 on the experimental land of the Department of Agricultural Production of Jember State Polytechnic with an altitude of 89 meters above sea level. This research was conducted using a Randomized Block Design (RAK) with two factors and four replications. The first factor was water management technique (A): A1: continuously irrigated, A2 intermittently irrigated, 3: irrigated only by water/random while the second factor is the dose of straw compost (K): K1: 4.5 tons/ha, K2: 5 tons/ha, K3: 5.5 tons/ha, K4: 6 tons/ha. the results of this study is that the treatment of water management technique (A3) tends to give the best results compared to other treatments on all parameters while the treatment of 6 tons of straw compost per Ha (K4) shows the best results compared to other treatments on all parameters.

Keywords:- *Straw Compost, Rice, Irrigation Techniques Introduction.*

I. INTRODUCTION

Rice is one of the staple food crops in Indonesia that will produce rice. Until now, rice is the main food for the fulfillment of basic needs for the people of Indonesia. The need for rice as the staple food of most Indonesians will increase in line with the increasing population. Indonesia's population growth is increasing every year. Indonesia's population increased from 1971 to 1980 by 28.2 million people (23.6%). The overall average rate of population increase is 2% per year. The total population of Indonesia in 2013 amounted to 248.8 million people and increased in 2014 by 252.1 million people [1]. In the period 2011-2014 grain production is still fluctuating, so far this production has not met the need for rice in Indonesia so the shortage is still imported. The need for rice in Indonesia has increased annually by 0.44% per year [2].

The need for rice as a major food source for the Indonesian population is not only due to the growing population but also due to changes in the consumption patterns of the population from non-rice to rice and the shrinking of fertile paddy fields due to land conversion for non-agricultural purposes as well as the occurrence of irrigated rice paddy productivity phenomena tend to fall [3]. The occurrence of a decrease in the yield of paddy rice is caused by many factors, including the ever-changing climate, water availability, soil fertility, varieties, crop management systems and the development of pests and diseases [4].

Irrigation is an important key in the cultivation of paddy rice, because rice is a plant that requires quite a lot of water. The need for water in each growth phase is different. Therefore, the right irrigation technique can have a positive impact on the growth and yield of rice plants. Intermittent irrigation or also called intermitten is the arrangement of land conditions in dry and flooded conditions alternately to: Save irrigation water so that the area that can be irrigated becomes wider [5]. Give the roots a chance to get air so that they can develop deeper. The current farmer's habit is to inundate rice fields continuously from the time the rice seedlings are planted until the plants approach harvest time, either in the rainy season or dry season. The main reason for flooding in paddy rice cultivation is because most varieties of paddy rice grow better and produce higher productivity when grown on flooded soil compared to non-flooded soil [6].

Another factor that causes rice productivity to decline is unbalanced fertilization. In general, farmers will only fertilize using N and P alone throughout the season will stimulate the lack of other elements such as K and S and micro elements. The application of balanced fertilization is very important for increasing production. Carbohydrate-producing plants such as rice really need the element K. Where the element K is very important to increase the rate of photosistesis and channel the results to the storage [1]. In addition to fertilizing with chemical fertilizers, an effort to

increase K fertilizer in the soil is to use straw, because straw contains a lot of K. The availability of straw in rice fields is abundant, which is about 5-6 tons/ha [7]. Farmers tend to burn straw rather than use it again even though straw can be used as organic fertilizer containing nutrients needed by the soil. The content of nutrients in straw consists of N 0.66%, P 0.07%, K 0.93%, Ca 0.29%, Mg 0.64% [8;9].

From the description above, it is necessary to do how the effect of water management techniques and the provision of straw compost on the growth and production of rice plants. The objective of this research is to find out the effect of water management techniques and several doses of straw compost on plant rice yields.

II. MATERIAL AND METHODS

A. Place and Time

The place of research was carried out in the research field of Jember State Polytechnic, Sumbersari District, Jember Regency with an altitude of approximately 89 meters above sea level. The temperature of Jember region ranges from 23 - 31ºC and rainfall ranges from 1,969 mm - 3,394 mm. Research activities will begin in September 2015 until February 2016.

B. Tools and Materials

Tools used in this study include agricultural tools, sieve, measuring instruments (cloth meter or ruler), analytical scales, camera, stationery, white cloth and nameplate. Materials used in this study were: ciherang rice seeds, straw compost, Urea fertilizer, SP-36, KCL, label paper and pesticides.

C. Research Design

This research was conducted using a Randomized Group Design with two treatment factors, namely:

➢ *Water Management Technique (A) which consists of:*

- *A1 = Irrigated Continuously*

The irrigation technique used is that the irrigation in the polybag is conditioned in a puddle 10 cm above the soil surface is left and then at 10 days before harvest the puddle has begun to dry.

- *A2 = Intermittent Irrigation*

The irrigation technique used is irrigation in the polybag inundation is carried out at the beginning of planting until 4 HST Subsequent water management is arranged as follows: Perform water rotation at 3-day intervals. The inundation height on the first day the polybags were irrigated was about 3 cm and for the next 2 days there was no additional water, this treatment was carried out until 10 days before harvest.

- *A3 = Irrigated Only by Watering*

The irrigation technique used was irrigating the polybags conditioned in a state of water up to 2 cm above the soil surface left during all phases of plant growth and then at 10 days before harvest the flooding had begun to dry.

➢ *Dosage of Jerani Compost*

K1 = 4.5 tons/h K3 = 5.5 tons/ha

K2 = 5 tons/ha K4 = 6 tons/ha

So there are 12 treatment combinations as follows A1K1, A1K2, A1K3, A1K4, A2K1, A2K2, A2K3.A2K4, A3K1, A3K2, A3K3, and A3K4.

- *Description*:

✓ A1K1: Continuously irrigated plots and straw compost 4.5 tons/ha
✓ A1K2: Continuously irrigated plots and 5 tons/ha straw compost
✓ A1K3: Continuously irrigated plots and straw compost 5.5 tons/ha
✓ A1K4: Continuously irrigated plots and 6 tons/ha straw compost
✓ A2K1: Intermittent irrigated plots and 4.5 tons/ha straw compost
✓ A2K2: Intermittently irrigated plots and straw compost 5 tons/ha
✓ A2K3: Intermittent irrigated plots and straw compost 5.5 tons/ha
✓ A2K4: Intermittent irrigated plots and 6 tons/ha straw compost
✓ A3K1: Plots irrigated with only kemalir, and straw compost 4.5 tons/ha
✓ A3K2: Plots irrigated with only kemalir and 5 tons/ha of straw compost
✓ A3K3: Irrigated plots with only kemalir and straw compost 5.5 tons/ha
✓ A3K4: Irrigated plots only chemigation and 6 tons/ha straw compost

Observation parameters observed in the yield component of paddy rice include:

- *Number of Filled Grain Per Panicle.* Calculation of the number of grains that contain permalai in 3 panicles for each sample.
- *Percentage of Empty Grain Per Panicle (%).* Calculated from the calculation of the number of empty grains per panicle divided by the number of grains per panicle then multiplied by 100%.
- *Weight Per 100 Grains.* Weighed from grain taken compositely from each unit of 100 grains and repeated 3 times.
- *Potential Yield Per Hectare.* Calculated from the multiplication of productive tillers, number of grains per panicle, weight of 100 grains and population in one unit converted into hectares.

D. Data Analysis

Each treatment was repeated 4 times resulting in 48 experimental units. Data were analyzed using the F test (ANOVA). If there was a significant difference between treatments, it was done with the Duncan Multiple Range Test (DMRT) with an error rate of 5%.

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III. RESULT AND DISCUSSION

Water is the main component that plants need in addition to nutrients, light, and air. In general, plants need water in a balanced state, that is, a state when the available water is equal to the needs of the plant, not less, and not more. Lack and excess water can disrupt metabolic processes and even kill plants. Drought can affect plant growth, yield and quality. Prolonged water shortage results in plant death [10].

Stated that the application of straw compost can improve soil quality in the form of increased pH and organic matter content [11]. Nutrient supply from organic fertilizers such as rice straw compost with soil structure that is able to support plant growth will increase plant productivity [12]. Straw is a cheap source of in situ organic matter to improve soil quality. Rice straw can be given in the form of compost. Composting straw is a beneficial step, in addition to nutrient conservation, it also reduces environmental pollution and provides added value for farmers. Compost returned to the soil will preserve the physical, chemical and biological fertility of the soil. Thus, it can support the sustainability of crop production.

From the results of the research "Yield of Rice Plants (Oryza sativa L.) on Various Water Management Techniques and the Addition of Straw Compost" which has been carried out with the observation parameters of the yield components, the following results were obtained:

A. Number of Filled Grain Per Panicle

The number of filled grains was measured by counting the number of filled grains in a panicle. The average number of hulledgrain per plant in various treatments of water management techniques can be seen in Figure 1.

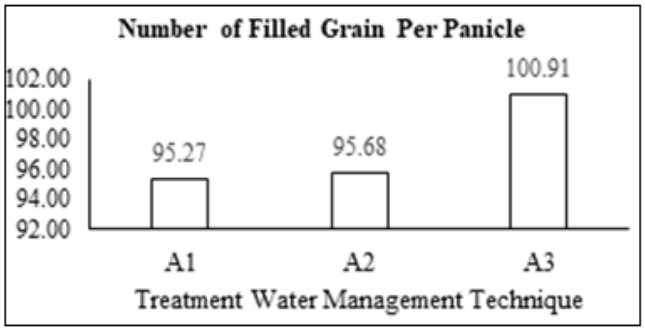

Fig 1 Graph of Average Number of Grain in Permalai in Various Water Management Techniques

Based on Figure 1 it can be seen that the treatment of various water management techniques resulted in the number of hulled grains that were not significantly different. In the figure, the treatment (A1) Watering kemalir produced the highest number of grains per head which was 100.91 grains. However, in general, all treatments given had no effect on the number of grains per grain. This is possible because seed filling is not influenced by water management techniques but based on the availability of sufficient water during the grain filling process as stated [12;13] that flowering and fertilization and seed filling are important events in the production of cultivated plants. This process is controlled by genetic factors and environmental factors, especially growth and photosynthesis results. Genetic factors are related to the ability of rice plants to optimize production in the regulation of seed filling by allocating photosynthetic products appropriately, while environmental factors are related to the photosynthetic process, namely the absorption of nutrients, water and light.

The treatment of straw compost dosage also had no significant effect on the number of hulled grains per plant. The average number of hulled grains per head in various treatments of Straw Compost Dosage can be seen in Figure 2.

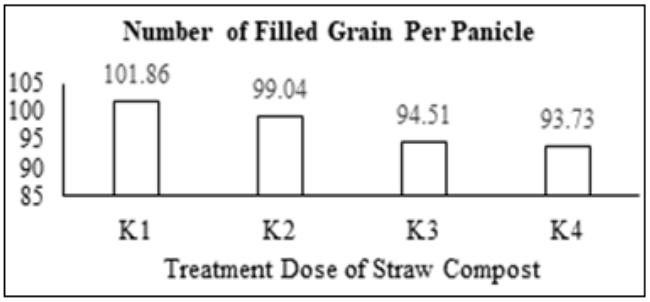

Fig 2 Graph Graph of Average Number of Empty Grain Permalai at Various Doses of Straw Compost

Based on Figure 2 it can be seen that the number of pithy grains is not significantly different. In the picture, the treatment of K1 compost dose of 4.5 tons/ha produced the highest number of grains of 101.86 grains. But in general, all treatments given had no effect on the number of grains per grain. This is probably because the photosynthesis process during the generative phase takes place optimally. According to [14] the number of pithy grains and the number of empty grains is determined by the number of photosynthetic products that are translocated to the seed-filling area.

B. Percentage of Empty Grain

The percentage of empty grain is obtained from the calculation between the number of empty grains per plant divided by the number of grains per plant and then multiplied by 100%. The percentage of hollow grain per plant can be seen in Figure 3.

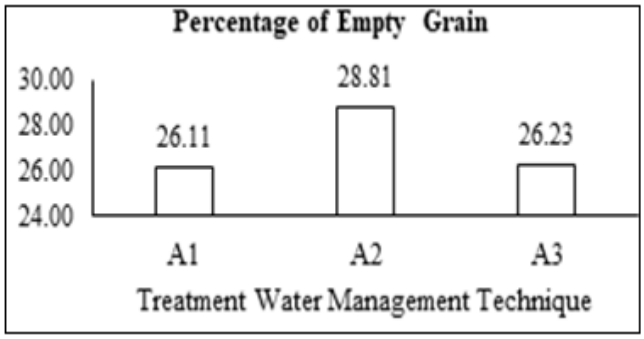

Fig 3 Graph of Average Percentage of Empty Grain Permalai in Various Water Management Techniques

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Based on Figure 4.6 the highest percentage of empty grain is in the treatment of intermittent water management techniques (A2), this is in line with research conducted by Sauku et al (no year) which shows the highest % of empty grain in conventional, intermittent flooding. According [15] Lack of water during the flowering phase can result in the fall of flowers and grain becomes empty, so the yield becomes low). The availability of water during rice growth has a significant effect on yield, while high yields can only be obtained if water can be maintained at least until the flowering phase. In addition, [16] states that irrigation in principle should be adjusted to the growth period of rice plants, in the generative phase irrigation is carried out at the time of panicle flower formation, irrigation is increased for a moment then water is gradually reduced.

While the observation of the percentage of empty grain in various doses of straw compost treatment can be seen in Figure 4.

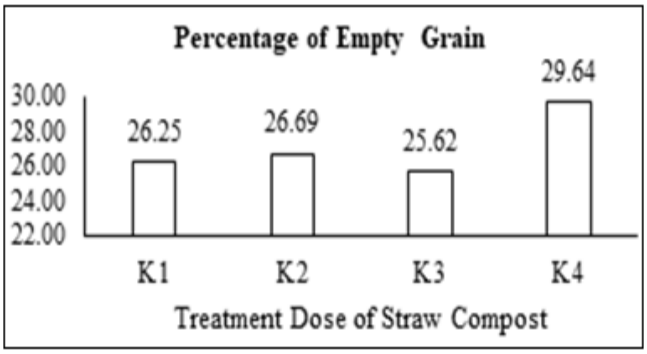

Fig 4 Graph of Average Percentage of Empty Grain (%) at Various Doses of Straw Compost

Based on Figure 4 the highest percentage of empty grain is in the treatment of intermittent water management technique (A2). From this figure, it can be explained that the increase in the number of doses of straw compost in the treatment has not been able to reduce the percentage of empty grain per panicle (%) because in this treatment the lowest percentage of empty grain is in the treatment of compost dose of 5.5 Ton/Ha with a percentage of empty grain of 25.62%. According [17] states that plant growth and production will be better if the factors that affect growth and production are balanced and provide benefits, if these factors cannot be controlled then the expected production cannot be obtained.

C. Weight of 100 grains

The weight of 100 grains was measured by weighing 100 rice grains taken from composite samples of each experimental unit and repeated four times. The observation results of the treatment of water management techniques and doses of straw compost on the weight of 100 grains can be seen in figure 5.

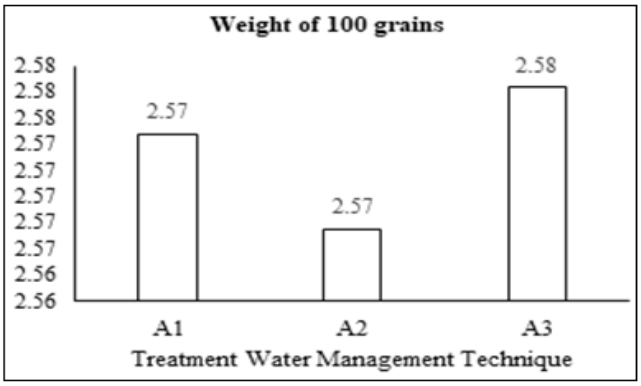

Fig 5 Graph of Average Number of Grain in Permalai in Various Water Management Techniques

Based on Figure 4.8, it can be seen that the intermittent irrigation treatment has a weight of 100 grains which tends to be lower at 2.5675 grams and the watering treatment produces the highest weight of 100 grains at 2.5783 grams. This condition is thought to be because the intermittent irrigation is still carried out during the flowering phase and the ripening phase. This is because the ability to produce grain is influenced by the availability of water in the soil. The availability of water that produces a high number of grains is related to the absorption of nutrients. In conditions of sufficient water availability, nutrients can be absorbed by plants optimally. The greater the nutrients that can be absorbed provide high growth which is directly proportional to the increase in photosynthate produced from the photosynthesis process. Photosynthate affects the filling of grain formation.

The treatment of straw compost dosage also has no effect on the weight of 100 grains. The average weight of 100 grains of rice in various doses of straw compost treatment can be seen in Figure 6.

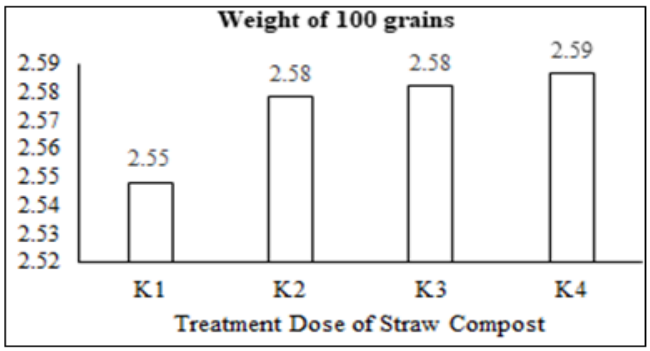

Fig 6 Graph of Average Weight of 100 Grains at Various Dosage Treatments of Straw Compost

Based on Figure 6 it can be seen that the treatment of straw compost dosage of 4.5 tons/ha, straw compost dosage of 5 tons/ha, straw compost of 5.5 tons/ha and straw compost of 6 tons/ha have almost the same 100-grain weight. However, the greater the amount of straw compost given, the greater the weight of 100 grains. The weight of 100 grains describes the quality of the grain, the heavier the grain, the appearance of the grain will look pithy and filled with good quality grain. The treatment of straw compost can increase the weight of 100 grains.

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The condition of the weight of 100 grains is almost the same, presumably because the weight of 100 grains is more influenced by plant genetic factors. In addition [18] also stated that the average seed weight is largely determined by the shape and size of seeds in a variety. added that if there is no difference in seed size then the role is genetic factors [19].

D. Potential Yield Per Ha

Yield potential is the ability of plants to produce rice on a certain area under optimal conditions. Potential yield per Ha is obtained from the multiplication of the number of productive tillers, the number of grains per plant, the weight of 100 grains, and the population in one unit which is then converted into hectares [20]. Potential yield per hectare can be seen in Figure 7.

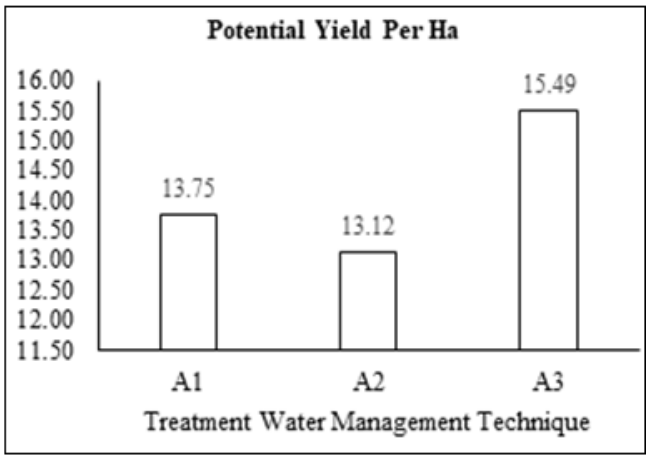

Fig 7 Graph of Average Number of Grain in Permalai in Various Water Management Techniques

The Figure 7 shows that the treatment of water management technique (A1) with the Kemalir technique (A3) produces the highest potential per ha of 15.49 tons/ha and the lowest is in the intermittent water management technique (A2) which produces production per ha of 13.12 tons/ha but in the treatment of continuous inundation but not significantly different from the treatment of intermittent inundation. The observation results of various doses of straw compost on production per ha and potential per ha can be seen in Figure 8.

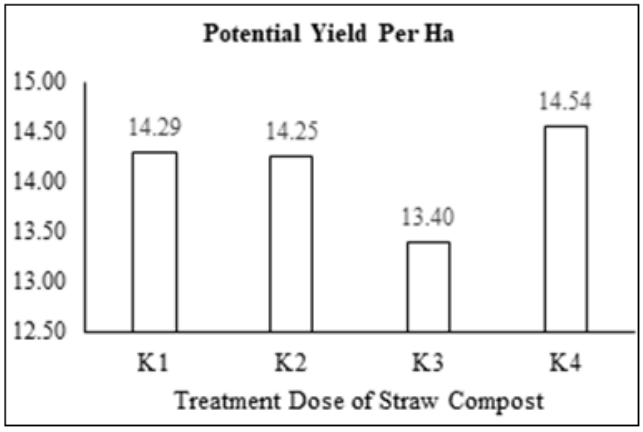

Fig 8 Graph Average Potential Per Ha at Various Dosage Treatments of Straw Compost

Based on Figure 8 shows that the most straw compost treatment gives good results, namely the dose of 6 tons/ha of straw compost with a potential per ha of 14.54, the lowest at a dose of 5.5 tons/ha resulting in a potential per ha of 13.40 tons/ha. According [21], the heavier a seed reflects the greater biomass produced and reflects the accumulation of dry weight.

IV. CONCLUSION

The conclusion from the results of this study is that the treatment of water management technique (A3) tends to give the best results compared to other treatments on all parameters while the treatment of 6 tons of straw compost per Ha (K4) shows the best results compared to other treatments on all parameters.

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