artikel _11

by Ahmad Jupri_2021 [3]

Submission date: 28-Apr-2021 09:46AM (UTC+0700)
Submission ID: 1571981382
File name: Sunarpi_2021_IOP_Conf._Ser.__Earth_Environ._Sci._712_012035.pdf (614.86K)
Word count: 2405
Character count: 13029

IOP Conference Series: Earth and Environmental Science

PAPER · **OPEN ACCESS**

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To cite this article: H Sunarpi *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **712** 012035

IOP Conf. Series: Earth and Environmental Science **712** (2021) 012035 doi:10.1088/1755-1315/712/1/012035

Combination of inorganic and organic fertilizer in rice plants (*Oryza sativa*) in screen houses

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Abstract. The demand for agricultural commodities increases from year to year, so farmers also have to increase the production of agricultural products. Farmers can increase agricultural yields through the excessive use of inorganic fertilizers. This causes many problems for the environment, so it is required to reduce the use of inorganic fertilizers in agricultural land. This study aimed to determine the effect of a combination of organic and inorganic fertilizers on the growth and yield of rice. This research was carried out in a screen house in Jatisela, Gunung Sari Subdistrict, Lombok from June to October 2020. The three treatments used in this study were P0 N0 with no organic and inorganic fertilizers; P0 N100 with a dose of 100% inorganic fertilizer and P50 N50 with a dose of 50% organic fertilizer and 50% inorganic fertilizer. The results showed that the combination of organic fertilizers (50%) and inorganic fertilizers (50%) can increase the growth and yield of rice in the screen house compared to control plants and plants which given only 100% inorganic fertilizers. In summary, the combination of organic and inorganic fertilizers can reduce the use of inorganic fertilizers.

1. Introduction

Improving the agriculture sector is one way to boost the economy. Growing demand for food has meant that farmers must meet consumer needs. The use of inorganic fertilizer aims to increase crop production in both Indonesia and the world. Among the commodities that almost 90% of Indonesia's population urgently needs is rice that serves as a staple. The inorganic fertilizers used are urea, KCL, TSP, and SP36. Extensive and continuous use of inorganic fertilizers resulted in a decline in the fertility of the soil [1,2], environmental pollution [3], affecting the activity of soil organisms and increase the cost of plant production. Also, the excessive use of nitrates in inorganic fertilizer (urea) results in increased accumulated nitrates in the edible parts of the plant, thus harmful to human health [4].

Application of organic fertilizers or the combination of organic and inorganic fertilizers can be an alternative option to reduce the utilization of inorganic fertilizers [5]. Application of organic fertilizers used brown macroalgae in Nusa Tenggara Barat (NTB). Brown macroalgae contain macro and micro essential elements in solid extract and also contain plant growth hormones such as auxin, cytokinins, ethylene, abscisic acid, and gibberellin in the liquid extract [6]. A combination of organic and inorganic fertilizer use is expected to complement the nutritional needs of plants thus it can increase and stimulate plant growth and yields [7].

Some researchers report that giving high levels of solid fertilizer containing macroalga can promote the growth of corn [8], pepper [9], and tomatoes [10]. Also, biostimulants of macroalga can improve plant salt

tolerance [11] and mung beans germination [12]. The extract of macroalga *Kappaphycus alvarezii* increases corn productivity [13,14] and leaf quality on baby lettuce [15].

This article reported the effect of application organic and inorganic fertilizers on rice plants (*Oryza sativa* L.). The result shown that the combination of organic and inorganic fertilizer have the highest result compare to the other treatment. This indicates that the combination can reduce application dose of inorganic fertilizer.

2. Materials and Methods

2.1 Time, place and design of experiment

The experiment was conducted in a screen house at Jatisela village, Gunung Sari sub-district, West Lombok, from June to October 2020. Samples were taken from Jatisela village to measure the parameters in Bioscience and Biotechnology Research Centre University of Mataram. The treatments used in this experiment were a combination dose of inorganic and organic fertilizer. The three treatments were P0 N0, no application of inorganic and organic fertilizers in soil media; P0 N100, application of organic fertilizers and 100% dose of inorganic fertilizers in soil media; P50 N50, the combination of 50% dose organic fertilizers and 50% dose of inorganic fertilizers. Since each treatment was replicated six times, there was 18 experimental pot. Organic fertilizer used in this study contains seaweed substrate.

2.2. Preparation of rice seedlings and soil media

Seedling of rice plants was conducted by sowing rice seeds in the pot containing 7 kg soil and they were left to grow. The seedling was transplanted 21 days. Soil media was prepared by addition 7 kg soil obtained from a rice field in Jatisela village, Lombok**.** Organic fertilizers were mixed with soil media by each dose: P0, no organic fertilizer, and P50, 50% dose of organic fertilizers. Inorganic fertilizers, such as urea, TSP, and KCl, were added to soil media on day 10 and 30 after transplanting as procedure as follows: N0, no addition of inorganic fertilizers; N50, the addition of 50% dose of NPK at day 10 and 30 after planting; N100, the addition of 100% dose of NPK at day 10 and 30 after planting.

2.3. Cultivation

The rice plants were transplanted from the seedling pot after 21 days. Inorganic fertilizers were applied on the 10th day and 30th day after planting. The rice plants were maintained until harvesting time. The observation did every week to control a pest found in rice plants.

2.4 Data analysis

To examine the variation of data, we used analysis of variance (ANOVA). If the analysis was significantly different, we continue with the HSD test with 5% significance level. The value was presented in a box-plot which was made using R Statistic Program.

3. Results and Discussion

3.1 Effect of combination of inorganic and organic fertilizers on growth

The number of tillers was affected by the combination of dose inorganic and organic fertilizer (Figure 1). The box-plot picture shows that the treated rice plants differ significantly from the untreated rice plants. There is a difference in the number of tillers between the two treatments also when compared with control. A combination of 50% inorganic fertilizer and 50% organic fertilizer have the best result in the number of tillers as a growth parameter. These results show that the application of a combination of organic and inorganic fertilizers increased the number of rice tillers. The phytohormones in seaweed extract in organic fertilizer can initiate and stimulate rice plant growth such as tiller and the other rice plant organ [16,17].

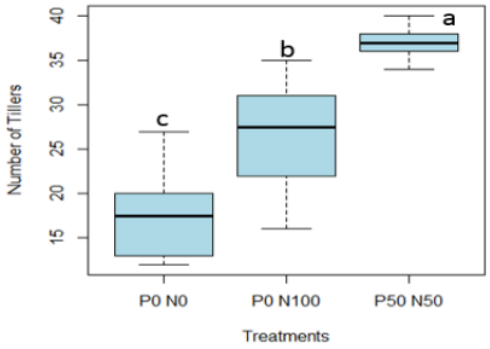

Figure 1. Effect of combination organic and inorganic fertilizers on number of rice plants tiller in soil media. Different alphabets indicating significantly different based on HSD test at 5% significant level.

The treatments also affect the shoot dry weight. In figure 2, the shoot dry weight of the rice plants in treatment P50 N50 showed significant results compared to control plants (P0 N0) and treatment P0 N100. A combination of 50% organic fertilizer (P50) and 50% inorganic fertilizer (N50) can increase the weight of the dry shoot. An increased shoot weight supports an increase in crop yields like the dry seed weight. It is assumed that seaweed extract in organic fertilizer affects shoot dry weight. The other research found that brown algae extract can support rice plants growth in several parameters i.e. tillers number, shoot dry weight, root dry weight, panicle number, etc. [6]

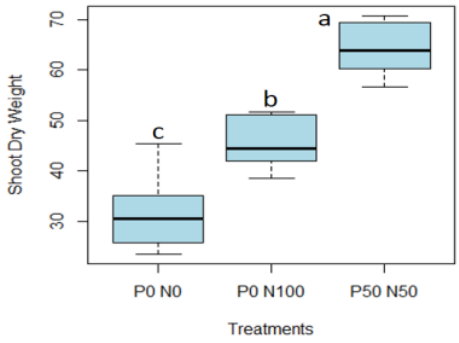

Figure 2. Effect of combination organic and inorganic fertilizers on shoot dry weight in soil media. Different alphabets indicating significantly different based on HSD test at 5% significant level.

3.2 Effect of combination of inorganic and organic fertilizers on yield

In this experiment, we also measure the rice plants yield. One of the parameter is dry seed weight (grains weight). The dry seed weight in treatment P50 N50 showed significant results compared to control plants (P0 N0) and treatment P0 N100 (Figure 3). The results of this study showed that the combination of 50% organic fertilizer (P50) and 50% inorganic fertilizer (N50) could increase the dry weight of seeds compared to the control or those using only inorganic fertilizers. The increase in the number of tillers and

shoot weight are the factors that can increase rice plant yields. The other study in India also found that soil nutrient and yield of rice was increase after 50% N substitute by organic fertilizer [18].

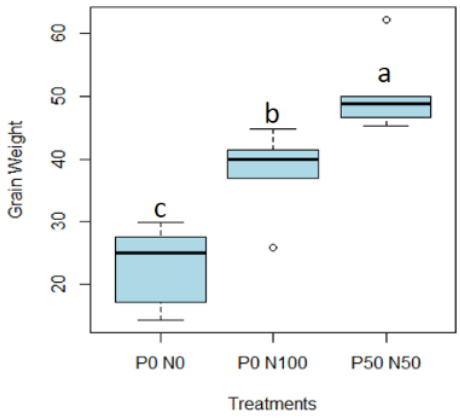

Figure 3. Effect of combination organic and inorganic fertilizers on grain weight in soil media. Different alphabets indicating significantly different based on HSD test at 5% significant level.

4. Conclusion In conclusion, the combination of organic and inorganic fertilizers can stimulate plant growth and increase yield in rice plants. A combination of organic fertilizers and inorganic fertilizers (50% organic fertilizers and 50% inorganic fertilizers) have the highest results that mean it can replace or suppress the use of chemical fertilizers.

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