Effectivity of inorganic fertilizer NPK (15-15-6) to growth and yield of lowland rice (*Oryza sativa* L.) on alfisol soil

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Abstract. This study was conducted to determine the effectiveness of NPK (15-15-6) fertilizer on the growth and yield of lowland rice. It was carried out on irrigated rice fields in the second season (March-June), on Alfisol soil (25 m asl). RCBD experimental design with 8 doses of fertilizer treatment and 3 replications. Treatment: a) without fertilizer, b) local recommendation of NPK (15-15-15) 300 + Urea 200 kg/ha, c) NPK (15-15-6) 200 + Urea 0 kg/ha, d) NPK (15-15-6) 300 + Urea 0 kg/ha, e) NPK (15-15-6) 400 + Urea 0 kg/ha, f) NPK (15-15-6) 200 + Urea 200 kg/ha, g) NPK (15-15-6) 300 + Urea 200 kg/ha, and h) NPK (15-15-6) 400 + Urea 100 kg/ha. The results showed that the application of NPK (15-15-6) 300 + 200 urea kg/ha had a significant effect on plant height, productive tillers and yield. The yield was 7,448 t/ha and the RAE (Relative Agronomic Effectiveness) value was 106.46, while the recommended fertilizer yield was 7.20 t/ha and the RAE value was 100. NPK fertilizer (15-15-6) dose of 300 + 200 Urea kg/ha can recomdate as an alternative NPK fertilizer in lowland rice.

1. Introduction

Efforts to forwarded rice self-sufficiency in Indonesia are still confront hindrance. This constraint is caused by rice production just notably concentrated in Java, the high rate of population growth and rivalry for land use [1]. National rice production from the last two years showed an increase of 57.16 million tons in 2012 [2]. In 2013, the rice production raised to 59.88 million tons [2]. One of several endeavor to increase growth and production is intensification through technological improvements, these include: the use of high-yielding varieties, the use of labeled seeds and fertilization to sufficient nutrient requirements [3]. NPK significantly increased grain yields [4] and effectively raised rice production [5].

Various attempts that can be made to overcome the lack of nutrients are the provision of inorganic fertilizers which are usually in the form of single fertilizers such as Urea, TSP/SP-36 and KCL. But in practice, most farmers only apply fertilizer in the form of nitrogen, so it is feared that it can lead to nutrient deficiency in the soil. To cope with this problem, it is necessary to apply a balanced fertilization policy. The concept of balanced fertilization is that plants are not only fertilized with nitrogen and phosphate, but need to be fertilized with other nutrients according to plant requirements and their availability in the soil [6]. Ways to increase domestic production can be done by extensification and intensification of agriculture, especially fertilization which is one of the methods to increase yields, especially fertilization with NPK compound fertilizers [7]. In principle, the overall nutrient balance or fertility must be such that it can promote optimal and normal plant growth [8]. According [9] 50% organic fertilizer (total N 4%) and 50% inorganic fertilizer led to an increase in NPK availability and
rice yield during treatment of 100% inorganic fertilizer, reducing the use of inorganic fertilizers and conducing to sustainable agriculture. While fertilizer subsidies are decreasing, research results [10] that fertilizer subsidies have a significant effect on the paddy industry. In its development, balanced fertilization is generally applied, so that the efficiency of fertilization is low [11]. In general, farmers only provide macronutrients, because they directly affect the quantity of the harvest. If this continues for a long period of time, there will be an imbalance of nutrients in the soil, it will be exacerbated if the organic matter content is also lower in agricultural lands.

Productivity that tends to slop recently is closely related to the nutrient imbalance in paddy fields where the average organic matter is less than 2%. Because few farmers are aware of using organic fertilizers for their paddy fields. With the application of NPK fertilizer and the application of organic fertilizer, it is expected to improve the nutrient adequacy for rice plants, so that crop yields will increase. The purpose of the study was to determine the effectiveness of NPK (15-15-6) fertilizer on the growth and production of lowland rice plants.

2. Materials and Methods
The location of the research on the effectiveness of NPK fertilizer (15-15-6), in Nglebur Village, Kedungpring, Lamongan, on second season in March - September 2018, in irrigated rice fields. The Inpari 30 rice variety is a new superior rice that has been planted in many locations. NPK (15-15-6) and NPK (15-15-15) inorganic fertilizers, urea fertilizers, and organic fertilizers.

Field research method, cropping pattern in one year paddy-paddy-secondary crops, experimental plots were arranged based on Randomized Block Design with 3 replications, there were 8 treatments. The application of organic fertilizer at a dose of 2 tons per hectare, in the last tillage before leveling the fertilizer evenly distributed. Treatment plots were carried out between 3 days after being leveled or adjusted to soil conditions so that it was easy to plot by making plots according to treatment and replication. Move planting age 21 days, planting jajar legowo 2:1, the number of seeds 2-3 plants per planting hole. Application of NPK fertilizer (15-15-6) and comparison of NPK (15-15-15) at the age of 10 days after planting (days after planting), Urea fertilizer application 3 times, the first and second time application of 0.5% NPK fertilizer, the last application at the age of 35 dap. Optimal pest and disease control, taking into account the principles of IPM to obtain optimum results.

| Table 1. NPK (15-15-6) Fertilizer Effectiveness Test Treatment. |
|---------------------------------------------------------------|
| Treatment | Kinds and Dosage of Fertilizer (kg/ha) | Nutrient content (kg/ha) |
|------------|--------------------------------------|--------------------------|
|            | Urea | NPK (15-15-15) | NPK (15-15-6) | N | P2O5 | K2O |
| A          | 0    | 0            | 0              | 0 | 0    | 0    |
| B          | 200  | 300          | 0              | 137| 45   | 45   |
| C          | 0    | 0            | 200            | 30 | 30   | 12   |
| D          | 0    | 0            | 300            | 45 | 45   | 18   |
| E          | 0    | 0            | 400            | 60 | 60   | 24   |
| F          | 200  | 0            | 200            | 120| 30   | 12   |
| G          | 200  | 0            | 300            | 135| 45   | 18   |
| H          | 100  | 0            | 400            | 105| 60   | 24   |

Information: Treatment A was control without fertilization to calculate RAE. Treatment B fertilizer recommendation.
The results of soil analysis at the test site are: pH neutral, P₂O₅: very high, K available: low and Mg content: very high, low C - organic and CEC is high and the texture is classified as clay. Observations were made on the components of growth and yield, namely: (a) plant height at the age of 50 days after harvest and before harvest, (b) number of productive tillers. Observation of yields: (a) panicle length, number of filled grain, percentage of void grain, weight of 1,000 grains; and (b) yield - DGH (Dry Grain Harvest).

Observational data were analyzed using the F test followed by DMRT at a level of 5%. The effectiveness of NPK Fertilizer (15-15-6) was measured using the RAE method (Relative Agronomic Effectiveness) to standard fertilizers. As a standard fertilizer, the recommended dose is 200 kg/ha Urea + 300 kg/ha NPK (15-15-15). The RAE formula is as follows:

$$RAE = \frac{Yield \ on \ tested \ fertilizers - Yield \ on \ control}{Yield \ on \ standard \ fertilizers - Yield \ on \ control} \times 100 \%$$

3. Results and Discussion

The research treatment of NPK fertilizer (15-15-6) with the addition of organic fertilizer 2t/ha, showed an effect on plant height, at the age of 50 days after harvest and before harvest. At the age of 50 DAP showed a proportion of NPK and Urea fertilizers in comparison to NPK (15-15-6) and NPK fertilizers (15-15-15). Plant height before harvest application of NPK (15-15-6) 300 kg and Urea 200 kg/ha, showed optimal growth and had a significant effect. According [12] soil analysis showed that the increase in soil fertility was indicated by an increase in C-organic content from 0.89% to 2.43%.

| Treatment | Plant Height | Tillers Number |
|-----------|--------------|----------------|
|           | 50 (dap)     | Before harvest | 50 (dap) | Before harvest |
| A         | 67.27 c      | 88.50 f        | 7.36 c   | 8.16 f         |
| B         | 87.57 a      | 108.90 b       | 12.53 a  | 15.73 a        |
| C         | 70.57 bc     | 96.76 e        | 9.30 b   | 10.26 e        |
| D         | 71.13 bc     | 99.47 d        | 9.30 b   | 11.46 de       |
| E         | 73.46 b      | 103.13 c       | 9.56 b   | 12.13 cd       |
| F         | 88.06 a      | 109.93 ab      | 11.50 a  | 14.16 ab       |
| G         | 89.63 a      | 111.90 a       | 12.967 a | 14.56 ab       |
| H         | 85.26 a      | 110.03 ab      | 12.06 a  | 13.76 bc       |
| CV        | 2.98         | 1.45           | 7.81     | 7.56           |

Information: The line numbers followed by the same letter were not significantly different based on the DMRT follow-up test at the 0.05 level.

The number of tillers in the NPK (15-15-6) treatment with a combination of organic fertilizer 2t/ha, showed an effect on plant height, at the age of 50 days after harvest, and before harvest. At the age of 50 DAP showed a proportion of NPK and Urea fertilizers in comparison to NPK (15-15-6) and NPK fertilizers (15-15-15). Plant height before harvest application of NPK (15-15-6) 300 kg and Urea 200 kg/ha, showed optimal growth and had a significant effect. According [12] soil analysis showed that the increase in soil fertility was indicated by an increase in C-organic content from 0.89% to 2.43%.

The number of tillers is strongly influenced by the availability of nitrogen and phosphorus nutrients in the soil, although the number of tillers that grow not all produce panicles [14]. Tillers begin to form at the age of 10 days and reach a maximum at the age of 50-60 days after planting [15]. After reaching
the maximum, the number of tillers decreases. According [16] stated on wheat that there was a very significant difference in the number of effective tillers, plant height, grain content, panicle length, number of grain, straw and harvest index. Based on the results of [13] it was shown that the dose of site-specific NPK fertilizer for the growth of swamp rice plants was a dose of 150% NPK and a dose of 10 Mg ha⁻¹ compost straw. This is indicated by the maximum number of tillers and the highest productive tillers in rice plants.

The number of filled grains, the effectiveness test of NPK fertilizer (15-15-6) showed a significant effect on the number of grains per panicle, the number of filled grains was not significantly different from NPK (15-15-6) 400 + Ura 100, NPK (15-15-6) 600 + Urea 200 kg/ha and comparator NPK (15-15-15) 300 + 200 kg/ha. The percentage of empty grain had no significant effect on all NPK fertilizer treatments (15-15-6).

Table 3. Void Grain Percentage, Yield t/ha and RAE value of NPK Fertilizer (15-15-6)

| Treatment | Void Grain Percentage | Weight 1000 Grains (gram) | Yield t/ha (DGH) | RAE Value |
|-----------|-----------------------|---------------------------|-----------------|-----------|
| A         | 4.51 a                | 27.30 c                   | 3.33 e          | -         |
| B         | 5.86 a                | 28.56 ab                  | 7.20 ab         | 100       |
| C         | 4.22 a                | 27.76 bc                  | 4.41 d          | 28,17     |
| D         | 4.68 a                | 27.76 bc                  | 4.70 d          | 35,4      |
| E         | 6.56 a                | 28.23 ab                  | 5.46 c          | 55,04     |
| F         | 6.19 a                | 28.20 ab                  | 7.12 ab         | 98,12     |
| G         | 5.62 a                | 28.86 a                   | 7.44 a          | 106,46    |
| H         | 5.51 a                | 28.60 ab                  | 6.71 b          | 87,34     |
| CV        | 26.33                 | 1.61                       | 4.82            |           |

Weight of 1000 grains and real yield, the highest weight was indicated by NPK (15-15-6) 300 + Urea 200 kg/ha treatment. The highest weight was not significantly different in the NPK (15-15-6) 400 kg/ha treatment and the ratio treatment for NPK (15-15-15) 300 + Urea 200.

4. Yield

The yield of the effectiveness test of NPK fertilizer (15-15-6) has a significant effect on the dry grain harvest (DGH). The highest yield was shown in the application of NPK 300 + Urea 200 kg/ha, production of 7.45 t/ha. The results were not significantly different at the dose of NPK (15-15-6) 200 + Urea 200 kg/ha and the comparison of NPK (15-15-15) 300 + Urea 200 kg/ha from the results of various studies showing that the average NPK nutrient transported by superior varieties of inbred rice were 17.5 kg N, 3 kg P and 17 kg K for each tonne of grain and straw produced [17]. [18] Showed the NPK nutrient requirement for hybrid rice 19.1; 3.2; and 1.8 kg/t grain. In general, the more grain and straw produced (to a certain extent), the higher the NPK nutrients absorbed by the plant. According [19] stated that the yield of red rice with a dose of NPK fertilization consisted of urea: 150, SP-36: 100, and KCL: 70 kg/ha and according [20], NPK and organic fertilizers increase rice farming yields.

To determine the value of the effectiveness of the fertilizer used “Relative Agronomic Effectiveness” (RAE) to fertilizer recommendations. As a recommended fertilizer, the recommended dose of NPK (15-15-6) is used, which is used as the basis for the RDKK preparation (Rencana Detail Kebutuhan Kelompok), i.e. 300 kg Phonska + 200 kg Urea. The RAE value of the use of NPK fertilizer (15-15-6) in the treatment of NPK 15-15-6 (300 + 200 Urea/ha) was 106.46 suitable for application as a substitute for NPK fertilizer in rice plants.
5. Conclusion

Application of NPK fertilizer (15-15-6) 300 + 200 Urea kg/ha and comparison of NPK (15-15-15) 300 + 200 kg/ha, Inpari 30 rice varieties in plant height and number of productive tillers were not significantly different, production 7,448 t/ha above the recommended fertilizer production of 7.20 t/ha. The highest RAE value in the treatment (NPK (15-15-6) 300+200 Urea/ha) was 106.46. So that NPK fertilizer (15-15-6) is suitable for application as a substitute for NPK fertilizer in rice plants. Research results [21] the use of fertilizers with the right dose will greatly increase crop yields.

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