The increased yield of rice due application of high-potassium-NPK fertilizer to low-potassium-soil content

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Abstract. The research aims to observe the optimal dose of 15-10-18 NPK fertilizer in rice growth and yields. This research is arranged in a Randomized Block Design with 4 replications. Treatment consists of 8 combinations of fertilizing which resulted in 32 treatments of 4x6 m² plot. The types of treatment studied are as follow: (A) Treatment with no fertilizer as control plot; (B) Treatment with recommendation dose of 200 kg ha⁻¹ Urea and 300 kg ha⁻¹ 15-15-15 NPK; (C) Fertilizer dose of 200 kg ha⁻¹ 15-10-18 NPK; (D) Fertilizer dose of 300 kg ha⁻¹ 15-10-18 NPK; (E) Fertilizer dose of 400 kg ha⁻¹ 15-10-18 NPK; (F) Fertilizer dose of 200 kg ha⁻¹ Urea and 200 kg ha⁻¹ 15-10-18 NPK; (G) Fertilizer dose of 300 kg ha⁻¹ Urea and 300 kg ha⁻¹ 15-10-18 NPK; (H) Fertilizer dose of 200 kg ha⁻¹ Urea and 400 kg ha⁻¹ 15-10-18 NPK. Characters observed are as follows plant height, the amount of productive tiller, plant height, unfilled grains percentage, the weight of 1,000 grain, and yields. The result showed that those treatments are significantly different in terms of plant height, the amount of productive tiller, unfilled grains percentage, the weight of 1,000 grains, and yields, but those treatments are not significantly different in panicle height. The highest R/C Ratio on F treatment (200 kg ha⁻¹ 15-10-18 NPK and 200 kg ha⁻¹ urea) reaches 3.18 and B/C Ratio 2.18 (income value IDR 27,966,000) with yields 7.63 ton ha⁻¹. It means that the high-potassium fertilizer of 200 kg ha⁻¹ 15-10-18 NPK and 200 kg ha⁻¹ urea is an optimal dosage to low-potassium-soil content.

1. Introduction

One of the most important factors that support the increase in national rice production is fertilizer. Fertilization is one of the efforts in increasing rice production through intensification efforts. To obtain a high level of efficiency requires the use of fertilizer in the right type, dosage, and time. Until now, the use of fertilizer by farmers has not been efficient, rational and balanced. The main problem that the fertilizer added to plant not rationally applied by a farmer. Some farmers use particular fertilizer with an overdose but some of them use lower dose which resulted in under-quality rice yield caused by unbalancing nutrients in soil [1]. Soil with the status of low potassium nutrients needs to be applied by NPK fertilizers with the higher potassium content.

The "leveling off" that occur on rice production in the last two decades was indicate that the efficiency of fertilizer is decreasing. Fertilizing efficiency in lowland rice plants not only contributes significantly in increasing farmers' income, but is also related to the sustainability of production systems, environmental sustainability, and savings in national energy resources [1]. The decreasing in rice productivity was partly due to the imbalance of nutrients in the soil. Fertilizing N, P, and K continuously in high doses is believed to have caused nutrient imbalance, suppressing the availability of micronutrients such as Cu and Zn [2]. In addition to the effects of too intensive
fertilization, the level of nutrient availability in the soil can also change depending on the level of planting, cultivate management, soil properties, climate, and types of plants. Thus the soil test criteria do not apply universally but are specific to crop conditions, management, nature, and climate in that time [3].

Balanced on fertilizing is not means that complete fertilization included macro and micro fertilizer such as N, P, and K plus Cu, Zn, Mn, and others. The need for balanced fertilizer to achieve the status of all essential elements macro and micro fertilizer, optimal balances in soil and the quality of crop yields increase [3,4]. K balances in the rice systems were reported by many researchers [5-7]. A recent review of BRRI research findings indicated that rice crops remove 19.13–22.31 kg K for production 1 t of grain [8]. Potassium requirement for 1 t rice production varied with yield potential where 18.7, 19.4, 20.5, and 21.7 kg K required for <7.5, 7.5 - 9.0, 9.0, and >10.5 t ha⁻¹ yield potential, respectively [9].

The nutrient input is not sufficient, and the plants will deplete nutrients from the soil. To soil types with optimal nutrient content or high macronutrient contents, need additional fertilizer to replace the nutrient that transported during harvest. If the insufficient soil macro and microelements and no additional fertilizer, rice plants will decrease in production not only in the short term but in the long period, there will be a decreasing in soil and crop production. The nutrient requirements of rice plants to produce grain about 6 t ha⁻¹ is 165 kg N, 19 kg P, and 112 kg K ha⁻¹ or equivalent with 350 kg of urea, 120 kg SP-36, and 225 kg KCl ha⁻¹ [1, 10].

Need of nutrients N, P, and can be obtained from a single fertilizer or compound fertilizer. The use of a single fertilizer consisting of Urea, SP-36, and KCl has been widely carried out by farmers both for horticulture and food crops [11]. Potassium is one of the most nutrient elements in crop growth and development. Potassium plays a major role in abundant enzyme activations, controls the cell osmoregulation, and the stomatal movements of photosynthesis [12, 13]. Photosynthesis is the basis of crop growth and yield in cotton, maize, rice and [14-16]. NPK 15-10-18 compound fertilizer is the fertilizer that contains three main nutrients namely N, P and K which are needed by plants. NPK Fertilizer 15-10-18 has a high K content suitable for applications on land with low K nutrient status. The research aims to observe the optimal dose of 15-10-18 NPK fertilizer in rice growth and yields.

2. Material and Methods
The research was carried out in Kedok Village, Turen District, Malang regency. The research started on May 27th and harvest when the plants were 103 DAP on September 6th, 2017.

2.1. Material
The research carried out in the area of rice production centers using Ciherang varieties, organic fertilizers, and inorganic fertilizers consisting of urea, NPK Phonska, and NPK 15-10-18 fertilizer using Palmo fertilizer (N content of 15%, P 10% and K of 18%). This fertilizer applied at the dosage according to treatment.

2.2. Methods
This research is arranged in a Randomized Block Design with 4 replications. Treatment consists of 8 combinations of fertilizing, which resulted in 32 treatments of 4x6 m² plot⁻¹. The types of treatment studied are as follow: (A) Treatment with no fertilizer as control plot; (B) Treatment with recommendation dose of 200 kg ha⁻¹ Urea and 300 kg ha⁻¹ 15-15-15 NPK; (C) Fertilizer dose of 200 kg ha⁻¹ 15-10-18 NPK; (D) Fertilizer dose of 300 kg ha⁻¹ 15-10-18 NPK; (E) Fertilizer dose of 400 kg ha⁻¹ 15-10-18 NPK; (F) Fertilizer dose of 200 kg ha⁻¹ Urea and 200 kg ha⁻¹ 15-10-18 NPK; (G) Fertilizer dose of 200 kg ha⁻¹ Urea and 300 kg ha⁻¹ 15-10-18 NPK; (H) Fertilizer dose of 200 kg ha⁻¹ Urea and 400 kg ha⁻¹ 15-10-18 NPK (Table 1).
Table 1. Research of NPK Fertilizer 15-10-18 in Kedok Village, Turen District, Malang Regency, 2017.

| Treatments | Urea (t ha⁻¹) | NPK 15-10-18 (t ha⁻¹) | NPK Phonska (t ha⁻¹) |
|------------|---------------|-----------------------|----------------------|
| A          | 0             | 0                     | 0                    |
| B*         | 200           | 0                     | 300                  |
| C          | 0             | 200                   | 0                    |
| D          | 0             | 300                   | 0                    |
| E          | 0             | 400                   | 0                    |
| F          | 200           | 200                   | 0                    |
| G          | 200           | 300                   | 0                    |
| H          | 200           | 400                   | 0                    |

Note: B = dosage of fertilizer recommendation

2.3. Research Procedures in the field
Field management is done by plowing, rotating, and then leveled. Organic fertilizer was applied to the land at a dose of 2 t ha⁻¹, applied after the soil was plowed. After applying organic fertilizer, the land is rotated and then leveled. Created a dike between research plots. Dike width 20-25 cm and height 20-25 cm. After that, done planting. The rice seedlings used were Cikerang varieties with seedlings aged 23 Days After Sowing (DAS). Planting with legowo row 2:1 planting system and 2-3 seedlings per planting hole.

NPK Fertilizer 15-10-18 is applied 2 times, which is when the plants at 5 DAP and 25 DAP. Urea fertilizer was applied 3 times, the first and second NPK fertilizer applications, the application last at the age of 35 DAP. Fertilization is given by spreading along a 20 cm wide groove in 40 x (20 x 10) cm legowo. One to two days before applied fertilization, water removed from the experimental plot. After that, one to two days after that the experimental plot began to be watered.

Optimal pest and disease control, taking into account the principle of Integrated Pest Management to obtain optimal yields. The use of pesticides is given as a last alternative following the recommended dosage. Characters observed are as follow: plant height, amount of productive tiller, panicle height, unfilled grains percentage, weight of 1,000 grains, and yield.

2.4. Data Analysis
Soil analysis is carried out before planting to study the soil nutrient contents at the experimental plot. Data from observations of growth components and crop yields analyzed by using the F Test with DMRT at a 5% level. To find out the financial benefits, an analysis of input-output compute by R/C and B/C ratio. R/C ratio (Revenue Cost Ratio) is an analysis of business efficiency, namely the ratio of business revenue (Revenue = R) to total costs (Cost = TC). With an R/C value. It can explain the benefit of a profitable or unprofitable business. The business was efficient (profitable) if the value of R/C>1. B/C ratio (Benefit-Cost Ratio) is a measure that can be compared between income (Benefit = B) and total production costs (Cost = C). Within the B/C value, it can be seen whether there is a profitable or unprofitable one. If the B/C ratio is>1, the business is feasible, but if the B/C value ratio <1 means that the business is not worth doing [17].

3. Results and discussion

3.1. Soil Analysis
Soil analysis was carried out before research at the Soil Laboratory of BPTP East Java with the results of the C-organic content test 2.13% (medium criteria), N-Total 0.19 % (low), P₂O₅ of 74 ppm (very high), K-dd of 0.27 me.100 g⁻¹ (low), Cation Exchange Capacity (CEC) of 22.55 me.100 g⁻¹ (Table 2). Location of research on the rice field with clay texture soil. The Cation Exchange Capacity (CEC) status is moderate, reached 22.55 me.100 g⁻¹. CEC or Cation Exchange Capacity (CEC) is the total number of...
Cations that can be exchanged on a colloid surface that is negatively charged. Cation exchange capacity is a chemical characteristic that is highly related to soil fertility [18].

Table 2. Results of pre-planting soil analysis in Kedok Village, Turen District, Malang Regency, 2017.

| No | Character test | Results | Unit | Criteria | Methods |
|----|----------------|---------|------|----------|---------|
| 1  | Water content  | 6.20    | %    |          | Oven 105°C |
| 2  | pH             |         |      |          |         |
|    | - H₂O          | 5.8     | -    | Slightly acid | (1:5), Electrochemistry |
|    | - KCl          | 4.9     | -    |          | (1:5), Electrochemistry |
| 3  | C-Organic*)    | 2.13    | %    | Moderate | Walkley & Black; Spectrophotometry |
| 4  | N-total*)      | 0.19    | %    | Low      | Kjeldahl; Titrimetric |
| 5  | P₂O₅*)         | 74      | ppm  | Very high | Olsen; Spectrophotometry |
| 6  | CEC*)          |         |      |          |         |
|    | - K-dd (can exchange) | 0.27 | me.100g⁻¹ | Low | Percolation NH₄-Acetat 1 M, pH 7; AAS |
|    | - CEC          | 22.55   | me.100g⁻¹ | Moderate | Percolation NH₄-Acetat 1 M, pH 7 + NaCl 10%; Titrimetric |
| 7  | Texture*)      |         |      |          |         |
|    | - Sand         | 27      | %    |          | Hydrometer |
|    | - Dust         | 41      | %    |          | Hydrometer |
|    | - Loam         | 32      | %    |          | Hydrometer |
|    | - Criteria     | Clay Loam | -     |          | Soil Texture Triangle (USDA) |

Source: Soil Laboratory AIAT East Java, 2017

Cations are positively charged ions such as Ca²⁺, Mg²⁺, K⁺, Na⁺, NH₄⁺, H⁺, Al³⁺, etc. In the soil, the cations are dissolved in groundwater or absorbed by soil colloids. CEC indicates the number of cations (in milliequivalents) that can be absorbed by the soil per unit weight of land (usually 100 g⁻¹). The cations that have been absorbed by the colloids are difficult to leach away by gravity water but can be exchanged by other cations found in the soil solution. The types of cations mentioned above are the cations commonly found in soil sorption complexes.

Land with a high CEC can provide more soil nutrients than land with a low CEC. Soils with high CEC when mostly content by cations of Ca, Mg, K, Na (high base saturation) can increase soil fertility, but if its dominate by acid cations, Al, H (low base saturation) can reduce soil fertility [18]. Therefore, the expected CEC status is moderate available for optimal rice plant growth.

3.2. Plant Growth Components

The results of the analysis showed that fertilizer treatment significantly affected the plant height of 50 HST and before harvest (Table 3). At 50 DAP plants, G and H treatments were higher and different from the control and dose recommendation. It is likely due to the addition of potassium encourage root growth and plant [19]. Plant height before harvesting in treatment G (Urea 200 kg ha⁻¹ + NPK 15-10-18 300 kg ha⁻¹) and H (Urea 200 kg ha⁻¹ + NPK 15-10-18 400 kg ha⁻¹) are also higher and significantly different from control plot. Meanwhile, C treatment (NPK 15-10-1 200 kg ha⁻¹), D treatment (NPK 15-10-18 300 kg ha⁻¹), E treatment (NPK 15-10-18 400 kg ha⁻¹), and F treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 200 kg ha⁻¹) is not significantly different.
Table 3. Effect of NPK 15-10-18 on plant height variables at 50 DAP and plant height at harvest time in Kedok Village, Turen District, Malang Regency, 2017.

| Treatments | Dosage and type of fertilizer | Plant height 50 DAP (cm) | Plant height before harvesting (cm) |
|------------|--------------------------------|--------------------------|-------------------------------------|
|            | Urea  NPK 15-10-18 NPK Phonska |                          |                                     |
| A          | 0 0 0                          | 78.03 b                  | 82.41 b                             |
| B          | 200 0 300                      | 84.09 ab                 | 86.37 b                             |
| C          | 0 200 0                        | 78.03 b                  | 82.45 b                             |
| D          | 0 300 0                        | 83.49 ab                 | 86.84 ab                            |
| E          | 0 400 0                        | 81.95 ab                 | 87.41 ab                            |
| F          | 200 200 0                      | 82.19 ab                 | 85.89 b                             |
| G          | 200 300 0                      | 84.83 a                  | 93.31 a                             |
| H          | 200 400 0                      | 87.36 a                  | 93.39 a                             |

CV (%) | 14.08 14.17

Note: Numbers are accompanied by the same letters in each column, there are means that no significant difference in DMRT (α = 0.05%)

3.3. Yields components

3.3.1. The amount of productive tiller and panicle height. The results of data analysis showed that the treatments not significant to panicle length, but the treatments showed that the character of the amount of productive tiller has a significant effect (Table 4).

The results of the analysis of observational data on the variable number of productive tillers and panicle length showed that the treatment had a significant effect (Table 4). Number of productive tillers in F treatment (Urea 200 kg ha\(^{-1}\) + NPK 15-10-18 200 kg ha\(^{-1}\)), G treatment (Urea 200 kg ha\(^{-1}\) + NPK 15-10-18 300 kg ha\(^{-1}\)) and H treatment (Urea 200 kg ha\(^{-1}\) + NPK 15-10-18 400 kg ha\(^{-1}\)) were higher than control plot and significantly different. Tiller and panicle production decreased in the control plot and increased in a higher K-treated plot. Adequate potassium supply encourages nitrogen uptake and tiller production increased with increasing N uptake [20].

Table 4. Effects of NPK 15-10-18 on the variable number of productive tillers and panicle lengths in Kedok Village, Turen District, Malang Regency, 2017.

| Treatments | Dosage and type of fertilizer (kg ha\(^{-1}\)) | Number of productive tillers | Panicle lengths (cm) |
|------------|-----------------------------------------------|-----------------------------|-----------------------|
|            | Urea  NPK 15-10-18 NPK Phonska                |                            |                       |
| A          | 0 0 0                                         | 29.13 c                     | 22.26 a               |
| B          | 200 0 300                                     | 33.33 bc                    | 21.96 a               |
| C          | 0 200 0                                       | 28.80 c                     | 22.70 a               |
| D          | 0 300 0                                       | 34.43 ab                    | 22.81 a               |
| E          | 0 400 0                                       | 34.90 ab                    | 22.00 a               |
| F          | 200 200 0                                     | 38.60 a                     | 22.99 a               |
| G          | 200 300 0                                     | 38.57 a                     | 22.76 a               |
| H          | 200 400 0                                     | 39.00 a                     | 22.97 a               |

CV (%) | 7.19 3.22

Note: Numbers are accompanied by the same letters in each column, there are means that no significant difference in DMRT (α = 0.05%)

During the reproductive period, rice plants required sufficient N and P so that the number of tillers higher than others. The number of productive tillers determines the number of panicles. The number of productive tillers (survival tillers) largely determines the number of panicles produced to form the seeds
of the grains. Adequacy of N and P in the reproductive phase is very important because it can promote rice plants to the generative phase. As more tiller die, the number of panicles per clump also decreases.

3.3.2. Unfilled Grains Percentage. The results of the analysis of the grains, unfilled grains, and % of unfilled grains showed a significant effect (Table 5). The number of unfilled grains in G treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 300 kg ha⁻¹) and H (Urea 200 kg ha⁻¹ + NPK 15-10-18 400 kg ha⁻¹) is significant and higher than control and dosage recommendations. However, those treatments have the amount of unfilled grain higher than controls plot and recommendations treatment. Percent of unfilled grain in H treatment was not significantly different from the control plot.

3.3.3. Weight of 1000 grains and yields. Fertilization treatment was a significant effect on the weight of 1,000 grains, rice, and yields (Table 5).

**Table 5.** Effects of NPK 15-10-18 on husked grain rice, empty grain, and % empty grain on Kedok Village, Turen District, Malang Regency, 2017.

| Treatments | Dosage and type of fertilizer (kg ha⁻¹) | Unhusked grain | Empty grain | % Empty grain |
|------------|----------------------------------------|----------------|-------------|--------------|
| A          | 0                                      | 0              | 97.33 c     | 9.60 ab      | 9.87 a       |
| B          | 200                                    | 0              | 101.53 c    | 8.10 cd      | 7.99 bc      |
| C          | 0                                      | 200            | 107.10 abc  | 7.30 cd      | 6.82 c       |
| D          | 0                                      | 300            | 109.00 abc  | 8.37 c       | 7.71 bc      |
| E          | 0                                      | 400            | 103.83 bc   | 7.03 d       | 6.81 c       |
| F          | 200                                    | 200            | 108.23 abc  | 8.53 bc      | 7.92 bc      |
| G          | 200                                    | 300            | 114.50 ab   | 10.27 a      | 8.76 ab      |
| H          | 200                                    | 400            | 119.07 a    | 10.00 a      | 8.50 abc     |

CV (%) = 5.79; 7.67; 10.90

Note: Numbers are accompanied by the same letters in each column, there are means that no significant difference in DMRT (α = 0.05)

Weight of 1,000 grains for H is higher than C and E but not different from F treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 200 kg ha⁻¹), G treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 300 kg ha⁻¹). On C treatment (NPK 15-10-18 200 kg ha⁻¹) and E treatment (NPK 15-10-18 400 kg ha⁻¹) no additional N nutrients, while the treatments of F and G gave N nutrients from urea fertilizer added. The nutrients adequacy in the filling and ripening phase of the grain supporting the increase assimilation filling to each grain unit so that the weight of the grain was higher.

The data analysis results showed a significant effect on the yields of DGH (Dry Grain Harvest). The yields of E treatment (NPK 15-10-18 400 kg ha⁻¹) was 8.03 t ha⁻¹ DGH, F treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 200 kg ha⁻¹) was 7.63 t ha⁻¹ DGH, G treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 300 kg ha⁻¹) was 7.75 t ha⁻¹ DGH and H treatment (Urea 200 kg ha⁻¹ + NPK 15-10-18 400 kg ha⁻¹) was 8.04 t ha⁻¹ DGH were higher than B treatment (Urea 200 kg ha⁻¹ + NPK Phonska 300 kg ha⁻¹) and have different effect compared to control plot (6.77 t ha⁻¹ DGH). This study is relevant to the study of Fageria [21] which states about the yields obtained by the increasing of the dosage of potassium.

In the control plot (A), no fertilizer was added so that the plant's nutrients N, P, and K, especially potassium, in the soil could not support the needs of plants. Plants lack nutrients so the yields are low production. As the research of Wang et al. [22] in soybean plants under the condition of lack of potassium. Potassium is mineral nutrients that are required in large quantities by plants [23]. Many reviews focused on the movement of Potassium or Magnesium within plants [24-27].

In the treatment without the addition of urea, the treatment E (NPK 15-10-18 400 kg ha⁻¹) (8.03 t ha⁻¹ DGH) was significantly different and higher when compared to the control plot (5.77 t ha⁻¹ DGH). The results of soil analysis at the experimental site showed that the field had a low N content (0.19%)
but had moderate C-organic content (2.13%) and without the addition of urea (treatment E) (NPK 15-10-18 400 kg ha⁻¹) still capable of high production even without the addition of N. With several treatments can be seen that the application of urea can be known when done with NPK dosages of 15-10-18 from 200 kg ha⁻¹ (Treatment F), 300 kg ha⁻¹ (Treatment G) or 400 kg ha⁻¹ (H treatment) does not provide significantly effect. Therefore, at locations with low N status and low C-organic content (<2.0%), fertilization is recommended equivalent to F treatment (Urea 200 kg ha⁻¹ + 200 kg ha⁻¹ NPK 15-10-18) for the needs of plants remain optimally to be fulfilled to be able to produce.

The results of this study indicate that research on potassium is very important. Potassium (K) is absorbed in large quantities by rice plants and is transported out with yields and straw. Straw is often removed or burned. So that large amounts of nutrients, especially N and K, are lost from the soil-plant system [28].

3.4. Financial Analysis

The calculation of financial analysis of rice farming system is carried out to study the financial feasibility, by calculating the estimated costs (expenses) needed in the production process and the revenue that will be obtained from the production that can be generated from the farming system. Financial analysis of rice farming with NPK fertilizer 15-10-18 in Table 6, Table 7, and Table 8.

Table 6. Recapitulation of the use of NPK fertilizer 15-10-18 in rice in Kedok Village, Turen District, Malang Regency, 2017.

| Treatments | Dosage and type of fertilizer (kg ha⁻¹) | Cost of fertilizer (IDR) | Yields DHG (t ha⁻¹) |
|------------|-----------------------------------------|--------------------------|---------------------|
| A          | 0                                       | 0                        | 6.77                |
| B          | 300 Phonska + 200 Urea                  | 1.065.000                | 7.08                |
| C          | 200 NPK 15-10-18                        | 1.128.000                | 7.03                |
| D          | NPK 15-10-18                            | 1.692.000                | 7.28                |
| E          | 400 NPK 15-10-18                        | 2.256.000                | 8.03                |
| F          | 200 NPK 15-10-18 + 200 Urea            | 1.488.000                | 7.63                |
| G          | 300 NPK 15-10-18 + 200 Urea            | 2.052.000                | 7.75                |
| H          | 400 NPK 15-10-18 + 200 Urea            | 2.616.000                | 8.04                |

Note: Fertilizer Prices 15-10-18 5,640 IDR; NPK Phonska = 2,350 IDR; Urea = 1,800 IDR; Organic fertilizer = 500 IDR kg⁻¹

Table 7. Simple economic analysis of the use of NPK 15-10-18 fertilizer in rice plants in the village of Kedok, District of Turen, Malang Regency.

| Treatments | Yields | Costs | Value | Benefit |
|------------|--------|-------|-------|---------|
| A          | 6.77   | 0     | 4.80  | 32,496.000 | 25,356.000 |
| B          | 7.08   | 1.065.000 | 4.80 | 33,984.000 | 25,779.000 |
| C          | 7.03   | 1.128.000 | 4.80 | 33,744.000 | 25,476.000 |
| D          | 7.28   | 1.692.000 | 4.80 | 34,944.000 | 26,112.000 |
| E          | 8.03   | 2.256.000 | 4.80 | 38,544.000 | 29,148.000 |
| F          | 7.63   | 1.488.000 | 4.80 | 36,624.000 | 27,996.000 |
| G          | 7.75   | 2.052.000 | 4.80 | 37,200.000 | 28,008.000 |
| H          | 8.04   | 2.616.000 | 4.80 | 38,592.000 | 28,836.000 |

Note: Non-fertilizer costs: include labor, seeds, pesticides, and land rent, HIPPA fees The selling price of the DHG at harvest is 4,800 IDR; Urea costs 1,800 IDR, NPK Phonska 2,350 IDR. NPK fertilizer 15-10-18 was 5,640 IDR.
Table 8. Financial analysis of rice farming systems using NPK fertilizer 15:10:18 in Kedok Village, Turen District, Malang Regency, 2017.

| Components | Amount | Unit | Cost  | Recommendati on fertilizer 300 kg Phonska + 200 kg Urea | Treatment E 400 kg/ha NPK 15-10-18 | Treatment F (200 Urea +200 NPK 15-10-18) |
|------------|--------|------|-------|------------------------------------------------------|-----------------------------------|--------------------------------------|
|            |        |      |       |                                                      |                                   |                                      |
| Seed       | 40     | kg   | 6.500 | 260.000                                            | 260.000                           | 260.000                              |
| Palmo (15-10-18) | 400 | kg   | 5.640 | 0                                                   |                                   |                                      |
| NPK Phonska | 300   | kg   | 2.350 | 705.000                                            | 0                                 | 0                                    |
| Urea       | 200    | kg   | 1.800 | 360.000                                            | 0                                 | 0                                    |
| Petroganic compost | 500 | kg   | 500   | 250.000                                            | 250.000                           | 250.000                              |
| Insecticide | 2     | lt   | 130.000 | 260.000                                           | 260.000                           | 260.000                              |
| Fungicide | 1      | lt   | 150.000 |                                             | 150.000                           | 150.000                              |
| Cost production components :       |        |      |       |                                                      |                                   |                                      |
| Seed       | 40     | kg   | 6.500 | 260.000                                            | 260.000                           | 260.000                              |
| Palmo (15-10-18) | 400 | kg   | 5.640 | 0                                                   |                                   |                                      |
| NPK Phonska | 300   | kg   | 2.350 | 705.000                                            | 0                                 | 0                                    |
| Urea       | 200    | kg   | 1.800 | 360.000                                            | 0                                 | 0                                    |
| Petroganic compost | 500 | kg   | 500   | 250.000                                            | 250.000                           | 250.000                              |
| Insecticide | 2     | lt   | 130.000 | 260.000                                           | 260.000                           | 260.000                              |
| Fungicide | 1      | lt   | 150.000 |                                             | 150.000                           | 150.000                              |
| Cost of labor:                      |        |      |       |                                                      |                                   |                                      |
| Land cultivation | 20 | HOK | 40.000 | 800.000                                           | 800.000                           | 800.000                              |
| Maintenance | 10     | HOK | 40.000 | 400.000                                           | 400.000                           | 400.000                              |
| Nursing    | 4      | HOK | 40.000 | 160.000                                           | 160.000                           | 160.000                              |
| Planting   | 24     | HOK | 20.000 | 480.000                                           | 480.000                           | 480.000                              |
| Fertilizing | 8     | HOK | 40.000 | 320.000                                           | 320.000                           | 320.000                              |
| Weeding    | 20     | HOK | 40.000 | 800.000                                           | 800.000                           | 800.000                              |
| Integrated Pest Management | 6   | HOK | 40.000 | 240.000                                           | 240.000                           | 240.000                              |
| Watering   | 10     | HOK | 20.000 | 200.000                                           | 200.000                           | 200.000                              |
| Harvesting | 48     | HOK | 40.000 | 1,920.000                                         | 1,920.000                         | 1,920.000                            |
| Others     |        |      |       |                                                      |                                   |                                      |
| Land lease | 1 MT   |      | 1.500.000 | 1.500.000                                        | 1.500.000                         | 1.500.000                            |
| HIPPA fees | 1 MT   |      | 200.000 | 200.000                                           | 200.000                           | 200.000                              |
| Cost total |        |      |       | 10.200.000                                        | 9.876.000                         | 9.108.000                            |
| Yields (kg ha<sup>-1</sup>) |        |      | 7.080 | 8030                                              | 7630                              |                                      |
| Yields Value |        |      | 26.904.000 | 30.514.000                                      | 28.994.000                         |                                      |
| Benefit    |        |      |       | 16.704.000                                        | 20.638.000                         | 19.886.000                           |
| R/C Ratio  |        |      | 2.64  | 3.09                                              | 3.18                              |                                      |
| B/C Ratio  |        |      | 1.64  | 2.09                                              | 2.18                              |                                      |

From the calculation in Table 8, obtained information that the cost of production inputs for treatment B (fertilizer recommendations) reached the lowest figure of 1,065,000 IDR compared to all other fertilization treatments. The highest fertilizer cost for treatment H is 2,616,000 IDR. Treatment E (NPK 15-10-18 400 kg ha<sup>-1</sup> production input costs in the form of fertilizer amounting to 2,256,000 IDR) and treatment F (Urea 200 kg ha<sup>-1</sup> + 200 kg ha<sup>-1</sup> NPK 15-10-18 amounting to 2,052,000 IDR.)
Simple economic analysis related to the influence of the use of NPK 15-10-18 fertilizer on rice plants in Kedok village, Turen sub-district, Malang regency is calculated from farm input and output data. The highest income was obtained in treatment E (NPK 15-10-18 400 kg ha\(^{-1}\)) in the amount of 29,148,000 IDR, while treatment F was 27,966.00 IDR G treatment was 28,008.00 IDR and H was 28,836,000 IDR.

In treatment E (NPK 15-10-18 400 kg ha\(^{-1}\)) the income reached 29,148,000 IDR, - with R/C Ratio of 3.09 and B/C ratio of 2.05 while treatment F of income reached 27,966.00 IDR, - with R/C Ratio 3.18 and B/C Ratio 2.18. Furthermore, treatment G reached income of 28,008.00 IDR with R/C Ratio of 3.04 and B/C ratio of 2.04 and H treatment achieved revenue of 28,836,000 IDR with the R/C Ratio 2.98 and B/C Ratio 1.98.

4. Conclusion

1. The results of the research of NPK 15-10-18 fertilizer showed that the treatment have a significant effect on plant height, number of productive tillers, grain, unfilled, percent unfilled grains, 1,000 grain weight, and yields
2. The highest R/C Ratio on F treatment (200 kg ha\(^{-1}\) 15-10-18 NPK and 200 kg ha\(^{-1}\) urea) reaches 3.18 and B/C Ratio 2.18 (income value IDR 27,966,000) with yields 7.63 ton ha\(^{-1}\). It means that the high-potassium fertilizer of 200 kg ha\(^{-1}\) 15-10-18 NPK and 200 kg ha\(^{-1}\) urea is the optimal dosage on low-potassium-soil content.

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