The effect of mixed liming and NPK fertilizer to yield of some rice varieties on new openings of acid sulfate tidal swamp land

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Abstract. The strategies to meet the staple food needs in Indonesia is to open new paddy fields in the sub-optimal land. The research aims to get adaptive rice varieties with the highest yield on new openings of the acid sulfate tidal swamp applying mixed liming and NPK fertilizer. The experiment was conducted in a greenhouse at the Faculty of Agriculture, Tanjungpura University, Pontianak. The trials used a factorial completely randomized block design consisting of two factors. The first factor is a mixture of dolomite with NPK fertilizer, consisting of 3 levels (1 ton/ha dolomite and 60 kg/ha NPK; 2 ton/ha dolomite and 90 kg/ha of NPK, and 3 ton/ha dolomite and 120 kg/ha NPK). The second factor is rice varieties, consisting of 6 levels (Ciherang, Situ Bagendit, Inpara, Mira, Si Randah and Ringkak Janggut). Each treatment replicated four times. The results showed that the application of a mixture of 3 ton/ha dolomite and 120 kg/ha of NPK fertilizer showed the best results to improve rice yield on new opening of the acid sulfate tidal swap. Local rice varieties, Ringkak Janggut, applied 3 ton/ha dolomite and 120 kg/ha of NPK fertilizer showed the best result of 1000 seed weight, i.e., 28.19 g, and total grain amount per panicle is 110.75 grains, with the lowest number of empty grains. Local rice varieties Ringkak Janggut potential to be developed as superior varieties on new opening acid sulfate tidal swamps by applying liming and fertilizer.

1. Introduction
Rice (Oryza sativa L.) is a staple food for most of the world population, especially in Indonesia. Rice crop is cultivated in wetland or dry land. Some obstacles of rice cultivation in Indonesia are the limited availability of land and majority of paddy fields are degraded. One strategy to overcome this problem is to open new paddy fields in the submarginal soil, such as tidal swamp. The new openings of the acid sulfate tidal swamp land have limiting factors, i.e., low pH and nutrient availability. Therefore, it is necessary to apply lime and NPK fertilizer. Besides that, it is required to find rice varieties that are tolerant of acidity and high production. Some rice varieties that can adapt to low pH and potentially high yields include Ciherang, Situ Bagendit, Inpara, Mira, Si Randah and Ringkak Janggut. This study aims to determine the effect of NPK fertilization and liming on the growth and yield of several varieties of rice, to obtain paddy that is adaptive and high production.

2. Methods
The experiment conducted at the greenhouse using randomized completely block design (RCBD) comprise two factors. The first factor was Rice Varieties (V), consists of six varieties, namely: Ciherang (V1), Situ Bagendit (V2), Inpara 3 (V3), Mira 1 (V4), Si Rendah (V5) and Ringkak Janggut (V6). The second factor was the dosage of mixed dolomite lime, and NPK fertilizer (P) consists of three levels. Those treatments are 1-ton dolomite + 60 kg NPK per ha (P1), 2-ton dolomite + 90 kg of NPK per ha (P2), and 3-ton dolomite + 120 kg NPK per hectare (P3). Each treatment replicates four times.

3. Results and Discussion

3.1. Total Grain Content Per Penicle
Treatment varieties and calcification of dolomite-NPK fertilization happens real influence on the treatment of liming dolomite-NPK fertilizer, to determine which treatment is different, then the Duncan Range Test (Table 1).

Table 1. Effect of Liming Dolomite-NPK fertilization Duncan Range Test to the Grain Total Content Per Penicle

| Rank | Mean   | Name | Mean     |
|------|--------|------|----------|
| 1    | 79.42  | P_3  | a        |
| 2    | 73.21  | P_2  | ab       |
| 3    | 68.50  | P_1  | b        |

Table 1 shows that treatment P_3, P_1 significantly different from the treatment, but no significant effect of treatment with P_2, while P_2 treatment, no significant effect on the treatment P_1.

In Figure 1, can be explained that the P_3 is a treatment highs and lows P_1. Number of filled grain per panicle grain meant is truly filled with grain rather shiny color. NPK fertilizer can affect rice yields (number of grains per panicle and the number of filled grain per panicle) were associated with increased availability of nitrogen in the soil and nitrogen uptake by plants, but it is also the availability of Nitrogen and Phosphorus in the soil. The third element of this macro is a very important nutrient required by plants, where the interaction of these three elements will be able to support the growth and yield of rice is better. Nitrogen can increase the number of grains per panicle and the number of filled grain per panicle [1].

3.2. Empty Grain Per Penicle
In empty grain unfilled grain flour for charging failure caused by various factors, such as nutritional deficiencies while charging seeds. Many factors affect the emptiness grains. Such factors as of lodging, lack the intensity of sunlight, leaf-leaves dry as well as pests and diseases that cause low.

Analysis of diversity of varieties and liming treatment dolomite NPK-fertilizer to the number of grains per panicle empty, it turns out real effect on the treatment of varieties, to determine which treatment is different, then the Duncan Range Test (Table 2).
Table 2. Effect of Varieties Duncan Range Test to Total Empty Grain Per Penicle

| Rank | Name | Mean  |
|------|------|-------|
| 1    | V₄   | 5.64 a |
| 2    | V₃   | 4.91 ab|
| 3    | V₁   | 4.10 b |
| 4    | V₅   | 3.99 b |
| 5    | V₂   | 3.44 b |
| 6    | V₆   | 3.32 b |

From Table 2 above shows that no significant V₄ to V₃, but significantly different from the V₁, V₂, V₅ and V₆, while the V₃ was not significantly different from the treatment V₁, P₂, P₅ and V₆. Among treatment V₁, P₂, P₃, V₅ and V₆ not real different.

![Histogram Total Empty Grain Per Penicle](image)

Figure 2. Histogram Total Empty Grain Per Penicle

In Figure 2, it can be explained that V₄ and V₆ is the highest treatment lows, ability to replenish grain rice-grain. Another opinion said that the large number of empty grain caused by lack of Nitrogen nutrients while charging seeds [2]. Nitrogen deficiency rice plants, will be the least amount of seedling and stunted growth, grains of rice produced would be an empty lot.

3.3. Number of Grain Per Penicle.

In a variable number of grains per panicle, it showed an obvious effect on the interaction between varieties and dolomite liming-NPK fertilizer. Where different treatment combinations, Duncan Range Test performed (Table 3).

Table 3. Duncan Range Test Interaction Effect to Total Grain Per Penicle

| Name                  | Mean n Non-significant ranges |
|-----------------------|-------------------------------|
| Varieties/ Fertilizer | P₁   | P₂   | P₃   |
| V₁                    | 106.75 b | 86.50 a | 97.00 a |
| V₂                    | 84.50 a  | 78.75 a | 75.00 a |
| V₃                    | 99.25 a  | 109.00 b| 98.00 a |
| V₄                    | 96.50 a  | 92.00 a | 103.75 a|
| V₅                    | 83.75 a  | 95.00 a | 95.50 a |
| V₆                    | 65.50 a  | 99.75 a | 110.75 b|

From Table 3 above can be explained, that the treatment V₆ and P₃, gives the number of grains per panicle best when compared with other treatments interactions.
In Figure 3, it can be explained that a combination treatment $V_6P_1$ highest and lowest $V_5P_1$.

One of the components of rice yields is the number of grains per panicle. NPK fertilizer can affect rice yields. NPK fertilizer independently can increase the available nitrogen generative growth, including number of grains per panicle. Besides nutrients Phosphorus and Potassium together with the nitrogen will be able to support the rice yield and better. The nitrogen may increase the number of grains per panicle [1].

3.4. Weight 1,000 Grain Rice
In 1000 grain weight variable, it appears that the combined treatment of liming varieties and dolomite-NPK fertilization, occurs very real effect on the interaction. Which treatment combination significantly different, then the Test Distance Duncan, as presented in Table 4.

Table 4. Influence Interaction Duncan Range Test to Weights 1,000 Grain Rice

| Name          | Mean n Non-significant ranges |
|---------------|-------------------------------|
| Varieties/Fertilizer | P$_1$ | P$_2$ | P$_3$ |
| $V_1$         | 28.65 b                   | 25.23 a                   | 25.25 a               |
| $V_2$         | 25.98 b                   | 26.20 b                   | 28.00 b               |
| $V_3$         | 25.30 a                   | 26.85 b                   | 28.33 b               |
| $V_4$         | 26.48 b                   | 28.10 b                   | 28.58 b               |
| $V_5$         | 25.80 b                   | 27.93 b                   | 25.00 a               |
| $V_6$         | 21.65 a                   | 26.15 b                   | 28.19 b               |

In Figure 4, it can be explained that the combination treatment is the treatment $V_1P_1$, $V_6P_1$ highs and lows.
1000 grain weights of each variety are affected by the condition after flowering, such as the availability of nutrients, good or bad weather and the number of leaves. This condition affects the amount of carbohydrates produced by photosynthesis and will then determine the size of the grain.

From Table 4 is known, that each variety has an average weight of 1,000 grains different. 1000 grain weight is influenced by genetic and environmental factors and environmental conditions experienced during the time of planting seed filling. Weight of 1,000 grains of seeds is affected by the shape of grains as well as the size of the grain. The larger the grain size, has the potential weight of 1,000 grains also increase further, while the grain size is influenced by genetic factors plant itself.

Potassium can increase the weight of 1000 grain and rice crops increased tolerance to adverse climatic conditions and pest attack [3]. Nutrients Potassium helps the enzyme activity in the opening and closing of stomata and Potassium deficiency can inhibit the translocation of carbohydrate and nitrogen metabolism.

3.5. Grain Weight Per Clump and Converted Into Per Hectare

In variable grain weight per clump, it showed an obvious effect on the treatment of varieties and dolomite liming-NPK fertilization, between the treatment of varieties and dolomite liming-NPK fertilizer. Which treatment was significantly different, do Duncan Range Test (Tables 5 and 6).

**Table 5. Effect of Varieties Duncan Range Test to Grain Weight Per Clump**

| Rank | Name | Mean |
|------|------|------|
| 1    | V6   | 12.75a |
| 2    | V5   | 12.34ab |
| 3    | V2   | 11.7ab |
| 4    | V3   | 11.48ab |
| 5    | V1   | 10.54b |
| 6    | V4   | 9.89b  |

From Table 5 can be explained, that the V6 no significant effect on the V1, V2, V3 and V5, but significantly different with V1 and V4. Among treatment V1, V2, V3, V4 and V5 is not significant.

**Figure 5. Histogram Grain Weight Per Clump**

In Figure 5, it can be explained that the V6 is the highest treatment and lowest V4.

**Table 6. Test Distance Duncan Effect of Liming Dolomite and NPK fertilization to Heavy Grain Per Clump**

| Rank | Name | Mean |
|------|------|------|
| 1    | P3   | 12.10a |
| 2    | P2   | 11.10a |
| 3    | P1   | 10.30b |

From Table 6, it can be explained, that no significant P3 to P2, P3 and P2 but significantly different with P1.
In Figure 6, can be explained that $P_3$ is the treatment of the highest and $P_1$ lows. Of variable grain production per hectare, it showed an obvious effect on the treatment of liming dolomite-NPK fertilization, liming of treatment varieties and dolomite-NPK fertilization. Which treatment was significantly different, then the Test Distance Duncan (Table 7).

Table 7. Effect of Liming Duncan Range Test Dolomite and NPK fertilization to the Grain Production Per Hectare

| Rank | Name | Mean  |
|------|------|-------|
| 1    | $P_3$ | 1.94 a |
| 2    | $P_2$ | 1.91 ab |
| 3    | $P_1$ | 1.64 b |

Table 7 can be explained, that no significant $P_3$ to $P_2$, $P_3$ and $P_2$ but significantly different with $P_1$.

In Figure 7, it can be explained that the $P_3$ is the highest treatment dan $P_1$ lowest. One of the considerations in selecting varieties of rice farmers to be cultured is the large potential for the results to be obtained. The yield per clump (per hectare) is determine how large the results of these varieties, so it is feasible to cultivated varieties [2].

As is well known, that the factors affecting the production of rice plants are: the number of plants per land area, number of tillers per hill, number of grains per panicle and grain weight of 1,000 grains. So the production of rice plants is the resultant of the photosynthetic process, assimilates decline due to respiration and translocation of dry ingredients into the crop. Increased production is directly proportional to the increase in the relative growth and yield net photosynthesis. Further explained that the components of the results is influenced by genetic factors, environmental factors such as liming and fertilizing, plant spacing and solar radiation.

So the highest production on V6 (Ringkak Janggut Variety). Ringkak Janggut is a local variety that is the result of a cross between the Ringkak Kuning (Sambas Local) with Rojolele (National Superior). The crosses result in a slightly broader leaf shape, slightly erect and slightly tapered at the end. The stem is not very high 106.08 cm, the maximum number of tillows is 10.67 stems and the number of productive tillers is 9.48 stems. Number of grain content per panicle 79.83 grains, empty grain per panicle 12.17 grains, grain total 110.75 grains and weight of 1,000 grains 28.19 grams.
4. Conclusion
Rice varieties adaftif and the highest production in the swamp tidal acid sulphate new openings: From research in Plastichouse, all variables reproductive (number of filled grain per panicle, number of grain hollow per panicle, number of grains per panicle, weight of 1,000 grains and production per clumps / per plot and conversion to a per hectare, significantly.

Varieties discovery Ringkak Janggut as a variety of the most adaptive and highest production, with a dose of dolomite liming 3 Ton-120 kg NPK / ha in Plastichouse, with a production of 1.94 tons / hectare.

References
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