Application of liquid organic fertilizer and N, P, K to the properties of soil chemicals and growth of rice plant

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Abstract. Rice is a food source of carbohydrate which is a staple food in Indonesia. One way to increase production is to control soil productivity by using organic and inorganic fertilizers. This research was conducted to determine the effect of organic fertilizer combined with N, P, K inorganic fertilizers on the chemical properties and growth of rice plants. This research was conducted from June-September 2018. The experimental design was carried out using a Randomized Block Design (RBD) consisting of 10 treatments with three replications. The treatment combination consisted of liquid organic fertilizer dosages of 0 ml / L, 2.5 ml / L, 5 ml / L, 7.5 ml / L and 10 ml / L and inorganic fertilizer N doses of 0 kg / ha, 50 kg / ha, 100 kg / ha, 150 kg / ha, 200 kg / ha. Inorganic P 0 kg / ha, 37.5 kg / ha, 75 kg / ha, 112.5 kg / ha, 150 kg / ha inorganic K 0 kg / ha, 12.5 kg / ha, 25 kg / ha, 37.5 kg / ha, 50 kg / ha. The results showed that the combination of organic and inorganic fertilizers N, P, K did not influence the soil chemical properties and plant growth. The highest yields on plant height after 8 WAP were shown in treatment D (1 dose of LOF + 1 N, P, K) with 58.03 cm.

1. Introduction
Rice production in Indonesia has increased every year. In 2015, Indonesia's total rice production was 75 million tons. The increase occurred in 2016 and 2017 with a total rice production of 79 million tons and 81 million tons [1]. Increased rice yields are also accompanied by an increase in population in Indonesia, which means an increase in the need for rice in Indonesia. The increase in production which is not too significant every year causes rice imports to be carried out in order to meet the people's food needs. To overcome this, an effort to increase rice production is needed to meet the people's food needs [2]. One effort that can be done to increase the productivity of rice plants is to balance the application of inorganic fertilizers with organic fertilizers, so as to increase the content of organic matter and nutrients in the soil that can meet the needs of plant growth and development.

The use of inorganic fertilizers continuously causes the fertilizer function to be ineffective. This is due to the residual effects of these chemicals which can cause soil biological ecosystems to become unbalanced and can have an impact on the soil, plants and the environment. One way to reduce the use of inorganic fertilizers is to combine them with organic fertilizers. [3] States that the combination of organic and inorganic fertilizers can create well-maintained soil conditions so as to increase plant productivity and efficiency in fertilizer use. [4] States that organic fertilizers have various benefits which can increase soil fertility, improve the chemical, biological and physical properties of soil, the use of organic fertilizers is safe for humans and the environment because it does not cause residues, and can
increase agricultural production. If used in the long term it can increase land productivity and prevent land degradation so that it can help soil conservation efforts be better.

Liquid organic fertilizer (LOF) contains more varied nutrients, namely macro and micro nutrients. Liquid fertilizers are more easily absorbed by plants because the compounds inside are already decomposed. Harness also runs faster than solid fertilizer because it is dissolved. [5] Also mentioned that organic liquid fertilizer also has a binding material, so fertilizer solutions given to the surface of the soil can be directly used by plants. So that in this study the provision of organic liquid fertilizer and N, P, K is expected to improve chemical properties in the soil and increase the growth of rice plants.

2. Method
The experiment was conducted from June to October 2019 in the Experimental Field of the Department of Soil and Land Resources of the Faculty of Agriculture, Padjadjaran University, Jatinangor District, Sumedang Regency, West Java Province. The trial location is located at an altitude of ± 700 meters above sea level (meters above sea level). The tools used in this experiment are field equipment ranging from land preparation to harvest, namely hoes, gasrok, ticks, rulers, stationery, analytical scales, measuring cups, label paper, sample plastics, plant sprayers and stationery. Laboratory equipment, namely analytical scales, shaking bottles, shaking machines, pH meters, test tubes, 2 ml volume pipettes, 10 ml measuring pipettes, filter paper, UV-VIS spectrophotometers and Atomic Absorption Spectrophotometers. The materials used in this experiment are paddy soil, Ciherang variety rice seeds, organic liquid fertilizer, Urea fertilizer, SP-36, and KCl and chemicals for soil chemical analysis in the laboratory.

This experiment used the Randomized Block Design (RBD) experimental method consisting of ten (10) treatment combinations. The treatment combination consists of A (control) B (1 N,P,K) C (1/2 LOF dose + 1 N,P,K) D (1 LOF dose + 1 N,P,K) E (1 1/2 LOF dose + 1 N,P,K) F (2 LOF dose + 1 N,P,K) G (1 LOF dose + 3/4 N,P,K) H (1 LOF dose + 1/2 N,P,K) I (1 LOF dose + 1/4 N,P,K) J (1 LOF dose). Each treatment was repeated three (3) times so that the total treatment was 30 experimental units. The plot size is 4 x 5 m, with a spacing of 25 cm x 25 cm. so that the total number of plants in a plot is 320 plants.

3. Research Results and Discussion

3.1. Chemical Properties Of The Soil
The results of statistical analysis showed that the application of organic liquid fertilizer formulations with the combination of inorganic fertilizers N, P, K did not show a significant difference between treatment with control of several parameters pH, C-organic, N-total and P2O5 while the K2O was significantly different. Table 1 presents the results of statistical analysis of soil pH with pH values that are close to neutral, which is shown in the treatment of G 1 dose of LOF + 3/4 N,P,K with a pH value of 6.27. While the treatment without organic liquid fertilizer is treatment A without LOF and without NPK and B 1 dose of NPK shows the smallest pH value of 5.87 and 5.92. [6] States that organic fertilizer can release minerals in the form of base cations (Ca, Mg, Na, K) so that the OH-ion concentration increases and soil pH increases.

The treatment of organic liquid fertilizer formulation with a combination of inorganic fertilizer N, P, K to the organic carbon content in the soil showed the highest results in the increase of carbon in the treatment of G 1 dose of LOF + 3/4 N,P,K with the amount of organic carbon 3.47%. While the treatment without organic liquid fertilizer is treatment A without LOF and without NPK and B 1 dose of NPK shows the smallest pH value of 5.87 and 5.92. According to [7]. high or low soil C-organic content is influenced by the amount of organic matter. Addition of organic material can increase the amount of C-organic directly. This is in line with the opinion of [8] that organic fertilizer can increase soil C-organic content. In addition, nutrients obtained from organic matter supplied to the
soil are the main energy source in the entire process of plant metabolism [9]. The addition of C-organic soil is also directly related to the improvement of plant root systems and exudation of organic compounds by plant roots.

**Table 1.** The effect of liquid organic fertilizer plus the nutrient content of rice fields

| Treatment               | pH   | C-organic (mg/100 g) | N-total (mg/100 g) | P₂O₅ (mg/100 g) | K₂O (mg/100 g) |
|-------------------------|------|----------------------|--------------------|-----------------|----------------|
| A (control)             | 5.87 a | 3.01 a               | 0.27 a             | 29.59 a         | 38.24 a        |
| B (1 N,P,K)             | 5.92 a | 3.03 a               | 0.33 a             | 30.43 a         | 43.87 ab       |
| C (1/2 Dose LOF + 1 N,P,K) | 6.02 a | 3.26 a               | 0.31 a             | 32.34 a         | 49.13 abc      |
| D (1 Dose LOF + 1 N,P,K) | 6.13 a | 3.12 a               | 0.27 a             | 31.95 a         | 57.36 abc      |
| E (1 1/2 Dose LOF + 1 N,P,K) | 6.25 a | 3.53 a               | 0.32 a             | 27.27 a         | 71.59 bc       |
| F (2 Dose LOF + 1 N,P,K) | 6.03 a | 3.34 a               | 0.28 a             | 32.90 a         | 54.52 abc      |
| G (1 Dose LOF + 3/4 N,P,K) | 6.27 a | 3.47 a               | 0.31 a             | 27.13 a         | 46.09 ab       |
| H (1 Dose LOF + 1/2 N,P,K) | 6.05 a | 3.40 a               | 0.28 a             | 31.00 a         | 80.20 c        |
| I (1 Dose LOF + 1/4 N,P,K) | 6.25 a | 3.26 a               | 0.30 a             | 28.86 a         | 39.70 ab       |
| J (1 Dose LOF)           | 6.10 a | 3.39 a               | 0.28 a             | 27.28 a         | 50.74 abc      |

Note: The average number followed by the same letter is not significantly different based on Duncan's Multiple Range Test at a Level of 5%.

The effect of organic fertilizer in the formulation of organic liquid fertilizer with the combination of inorganic fertilizer N, P, K on the P-potential soil content showed the highest results in the treatment of F 2 DOC LOF + 1 N,P,K with a value of 32.90 mg / 100g. The increase in P-potential depends on the amount of phosphorus that comes from fertilizer into the soil, the higher the dose of phosphorus, the phosphorus content in the soil will increase. Phosphorus in the soil is present in the form of H₂PO₄⁻, HPO₄²⁻, and PO₄³⁻, and in the form of bonds with metal ions such as Fe, Mn ions. Phosphorus is expressed in its oxidative form, P₂O₅, which then reacts to produce phosphoric acid (H₃PO₄). The resulting phosphoric acid reacts with OH⁻ forms H₂PO₄ ions. The H₂PO₄ ions will form bonds with metal ions such as Mn and Fe. While the effect of giving organic liquid fertilizer formulations with a combination of inorganic fertilizer N, P, K to the K-potential soil content showed the highest results in the treatment of H 1 dose of LOF + 1/2 N,P,K with a value of 80.20 mg / 100 g.

**3.2. Plant Growth**

Measurement of rice plant height is an important parameter because it is a characteristic of plant growth related to other growth factors and components, such as the environment that suppresses or encourages growth, number of leaves, leaf length, roots and saplings that will develop. Because of that height according to its genetic trait is very relevant to the productivity of the crop's yield and the growing environment that affects it. High plants will affect the nature of the shade between the composition of the leaves that grow and will not necessarily produce grain filled to the maximum.

Table 2 shows the plant height from 2 WAP - 8 WAP showing that the height increase was not significantly different. It is considered that nutrient availability is still lacking for plants. Nutrient deficiency in rice plants will cause symptoms such as slow growth, leaves become short and erect, old leaves quickly turn yellow and die, and do not stimulate growth spots on plants [10]. Plant height at 2 WAP - 8 WAP which showed the lowest plant height was shown by treatment A (without the application of organic liquid fertilizers and inorganic fertilizers N, P, K). Treatment B administering 1 dose of N, P, K fertilizer gave the highest yield at plant age 2 WAP with height 22.17. While at plant age 4 WAP treatment E with 1 dose of LOF + 1 N, P, K which gave the highest value with high plant 32.21 cm. While at the age of 6 WAP and 8 WAP the treatment that showed the highest value was the treatment B dose of 1 N, P, K with plant height of 37.23 cm and 58.03 cm.
Table 2. Effect of liquid organic fertilizer plus on rice plant height

| Treatment                          | 2 WAP  | 4 WAP  | 6 WAP  | 8 WAP  |
|------------------------------------|--------|--------|--------|--------|
| A (control)                        | 20.67 a| 25.75 a| 36.75 a| 49.29 a|
| B (1 N,P,K)                       | 22.17 a| 28.38 a| 37.23 a| 54.49 a|
| C (1/2 Dose LOF + 1 N,P,K)        | 21.29 a| 28.81 a| 34.30 a| 51.85 a|
| D (1 Dose LOF + 1 N,P,K)          | 21.94 a| 32.21 a| 34.22 a| 58.03 a|
| E (1 1/2 Dose LOF + 1 N,P,K)      | 21.59 a| 28.12 a| 34.63 a| 53.05 a|
| F (2 Dose LOF + 1 N,P,K)          | 21.51 a| 28.01 a| 35.88 a| 52.77 a|
| G (1 Dose LOF + 3/4 N,P,K)        | 22.65 a| 29.65 a| 35.77 a| 54.45 a|
| H (1 Dose LOF + 1/2 N,P,K)        | 21.44 a| 27.35 a| 33.25 a| 50.99 a|
| I (1 Dose LOF + 1/4 N,P,K)        | 20.94 a| 26.44 a| 35.87 a| 52.67 a|
| J (1 Dose LOF)                    | 21.48 a| 26.17 a| 32.83 a| 52.00 a|

Note: The average number followed by the same letter is not significantly different based on Duncan's Multiple Range Test at a Level of 5%.

3.3. Number Of Tillers

Plant height and seedling formation are indicators of growth as a result of interactions from photosynthesis, respiration, and nutrient transport processes [11]. Based on table 8 shows the number of tillers at age 2 WAP - 8 WAP there was no significant difference between treatments when compared with controls. This is because the availability of nutrients is not sufficient to increase the number of tillers. The number of tillers in rice plants is also influenced by the amount of nutrients available and can be absorbed by plants. Nutrients are needed by plants for their growth and development so that they can affect the number of tillers in rice plants. Rice plant growth is influenced by nutrients supplied, where N elements can increase the maximum number of tillers and P elements can increase the number of productive tillers [10].

Table 3. Effect of liquid organic fertilizer plus on the number of tillers

| Treatment                          | 2 WAP  | 4 WAP  | 6 WAP  | 8 WAP  |
|------------------------------------|--------|--------|--------|--------|
| A (control)                        | 4.93 a | 9.13 a | 17.93 a| 18.87 a|
| B (1 N,P,K)                       | 5.00 a | 9.20 a | 16.87 a| 20.60 a|
| C (1/2 Dose LOF + 1 N,P,K)        | 5.13 a | 11.73 a| 18.33 a| 21.87 a|
| D (1 Dose LOF + 1 N,P,K)          | 5.27 a | 12.93 a| 17.40 a| 23.53 a|
| E (1 1/2 Dose LOF + 1 N,P,K)      | 5.07 a | 10.00 a| 15.20 a| 19.80 a|
| F (2 Dose LOF + 1 N,P,K)          | 5.07 a | 9.93 a | 16.47 a| 20.60 a|
| G (1 Dose LOF + 3/4 N,P,K)        | 5.33 a | 10.07 a| 18.07 a| 22.53 a|
| H (1 Dose LOF + 1/2 N,P,K)        | 4.87 a | 10.47 a| 16.40 a| 18.13 a|
| I (1 Dose LOF + 1/4 N,P,K)        | 5.20 a | 10.67 a| 15.87 a| 20.00 a|
| J (1 Dose LOF)                    | 4.53 a | 9.20 a | 16.20 a| 18.53 a|

Note: The average number followed by the same letter is not significantly different based on Duncan's Multiple Range Test at a Level of 5%.

The age of 2 WAP rice plants the treatment that showed the highest number of tillers was addressed by treatment G 1 dose of LOF + 3/4 N,P,K with a number of plants 5.33. While at the age of 4 WAP and 6 WAP the number of plant tillers was shown by the treatment of C 1/2 dose of LOF + 1 NPK with the number of plants 11.73 and 18.33, while at the end of the vegetative period that is at the age of 8 WAP plants the highest number of plants is shown by the treatment D 1 LOF + 1 N,P,K dose with plant height 23.53.
4. Conclusion

The application of liquid organic and inorganic fertilizers N, P, K can improve soil chemical properties, but not significantly different from pH, C-organic, N-total and P₂O₅, whereas for K₂O is significantly different. The highest yields on plant height after 8 WAP. were shown in treatment D (1 dose of LOF + 1 N,P,K) with 58.03 cm. while the number of tillers in treatment G (1 dose of LOF + 3/4 N,P,K) with an average number of 22.53.

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