The effect of the combination of urea, manure of cow and Azolla on the growth and N uptake of the black rice of Ominio variety

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Abstract. The application of inorganic fertilizers is carried out continuously and it is not balanced with the organic fertilizers causes the soil to harden more easily, unstable pH, the ability of the soil to absorb nutrients, especially Nitrogen is low. A combination of inorganic fertilizers such as manure of cow and Azolla as well as organic fertilizers, urea are used as an alternative to increasing Nitrogen and plant growth. This research has been carried out at Agriculture’s screen house Universitas Sumatera Utara and Socfindo Laboratory. This study was conducted using non-factorial randomized block design with 5 treatments such as U0 (without urea), U1 (urea 250 kg/ Ha), U2 (urea 250 kg/ Ha with manure of cow 20 ton/ Ha), U3 (urea 250 kg/ Ha with Azolla 10 ton/ Ha), U4 (the combination of urea 250 kg/ Ha, manure of cow 20 ton/ Ha and Azolla 10 ton/ Ha) and 4 replications. The combination of urea, manure of cow and Azolla (U3 treatment) was able to show the best results on plant height, the number of tillers per clump, root dry weight and N-uptake of black rice plants of varieties Ominio. The recommended dosages of urea, manure of cow and Azolla are 250 kg/ Ha, 20 ton/ Ha and 10 ton/ Ha, respectively.

1. Introduction

One of the Oryza sativa L. species which is very much consumed by the public is black rice because it is very beneficial for human health. Black rice has a higher protein, vitamin, and mineral content than white rice [1]. In Indonesia, black rice is less well known by the general public due to a lack of knowledge about the benefits of black rice, so farmers rarely cultivate it [2]. Although it is less attractive to some farmers in some parts of Indonesia, for example, West Sumatra and Central Java, they have started to cultivate this black rice. Rice plants generally require N nutrients during the vegetative growth period. Nitrogen is the main element for plant growth, which is generally needed for the formation or growth of plant parts. Low nitrogen content is a problem in lowland soils [3]. However, the presence of nitrogen in the soil is so mobile that nitrogen changes rapidly in its form or can evaporate. Loss of nitrogen in the soil can occur through processes of denitrification, volatilization, plant removal, leaching and soil erosion [4]. One of the efforts to supply nitrogen needs is by adding organic fertilizers that contain high nitrogen as a supplement to inorganic fertilizers. This inorganic fertilizer supplement that contains high nitrogen levels is obtained from manure of cow and Azolla fertilizers. Azolla plants are aquatic plants that grow on the surface of rice fields and it can maintain nitrogen (N2) through living symbiosis with blue-green algae plants (Anabaena Azollae) [5]. Manure of cow is a contributor to macro and micronutrients needed by plants and it can maintain...
nutrient balance in the soil. The fresh material manure of cow fertilizers contains nutrients 0.5% N, 0.3 % P, 0.5% K, Ca 0.3% and 0.1% Mg [6]. Based on the high nitrogen content of manure of cow and the ability of Azolla to fix nitrogen, application of a combination of urea, manure of cow and Azolla is expected to increase the growth and N uptake of black rice varieties Ominio.

2. Materials and methods
The research was conducted at the Faculty of Agriculture’s greenhouse and Socfin Laboratory from June to November 2019. The paddy soils used is obtained from Sungai Merah Village, Tanjung Morawa, Deli Serdang District. The Azolla plant is cultivated and then harvested according to treatment needs. The manure of cow fertilizers used is compost which is black, odorless and has a crumb structure. Then equipment needed includes a hoe, tape measure, polybags, scales and the 10 mesh sieves. This research was carried out using a non-factorial randomized block design with 5 (five) treatments and 4 (four) replications consisting of U0 (control), U1 (urea 250 kg/ha), U2 (urea 250 kg/ha with manure of cow 20 ton/ha), U3 (urea 250 kg/ha with Azolla 10 ton/ha, U4 (urea 250 kg/ha with manure of cow 20 ton/ha with Azolla 10 ton/ha. Parameters measured consist of plant height, number of tillers, dry weight of plant shoot and root, and plant N uptake (wet destruction) [7]. The parameters were analyzed using ANOVA procedures and then analyzed significantly different treatments using the BNJ test at the 5% level [8].

3. Results and discussion

3.1. Plant height
The highest plant average is at the age of 13 weeks after planting namely 156.6 cm in treatment U2. Application of urea, manure of cow and Azolla didn’t significantly affect plant height each week. However, the height of rice plants for the treated soil (single or combined urea) tended to increase each week when compared to the control treatment. This can be presumed because the given N undergoes a denitrification reaction of solid acidic acid and then can form N gas which is lost to the atmosphere. This causes the nutrients given can't all be absorbed by the plants for growth. The formation of N₂O occurs at pH <5.5 and it is a gas form that is detected on soils with a slightly acidic to neutral pH. The form of N₂O will be reduced by microbes to N₂ at pH> 6 [9].

| Treatment                                      | 4 WAP | 5 WAP | 6 WAP | 7 WAP | 8 WAP | 9 WAP | 10 WAP | 11 WAP | 12 WAP | 13 WAP |
|------------------------------------------------|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|
| U0 (control)                                   | 43.7  | 58.0  | 70.4  | 89.9  | 104.8 |       |        |        |        |        |
| U1 (urea 250 kg/ha)                            | 46.4  | 63.1  | 75.6  | 100.2 | 111.8 |       |        |        |        |        |
| U2 (urea 250 kg/ha with manure of cow 20 ton/ha) | 49.7  | 60.3  | 81.4  | 99.2  | 119.0 |       |        |        |        |        |
| U3 (urea 250 kg/ha with Azolla 10 ton/ha)       | 50.3  | 67.9  | 85.6  | 110.5 | 118.5 |       |        |        |        |        |
| U4 (urea 250 kg/ha with cow manure 20 ton/ha and Azolla 10 ton/ha) | 47.9  | 68.2  | 86.6  | 109.3 | 115.9 |       |        |        |        |        |
| U0 (control)                                   |       |       |       |       |       | 124.7 | 131.1  | 139.8  | 143.9  | 146.5  |
| U1 (urea 250 kg/ha)                            |       |       |       |       |       | 130.4 | 138.7  | 142.4  | 146.0  | 149.3  |
| U2 (urea 250 kg/ha with manure of cow 20 ton/ha) |       |       |       |       |       | 129.6 | 138.8  | 143.5  | 152.7  | 156.6  |
| U3 (urea 250 kg/ha with Azolla 10 ton/ha)       |       |       |       |       |       | 131.9 | 139.0  | 145.4  | 152.3  | 153.6  |
| U4 (Urea 250 kg/ha with cow manure 20 ton/ha and Azolla 10 ton/ha) |       |       |       |       |       | 133.9 | 139.0  | 145.0  | 150.1  | 153.8  |

Table 1. The average height of black rice plant varieties Ominio due to treatment of urea, manure of cow and Azolla at the age of 4-13 weeks after planting (WAP) (cm).
3.2. Number of tillers
The number of tillers per hill had a significant yield on the application of urea, manure of cow and Azolla at weeks 9, 10, 11 and 12 but has no significant effect on weeks 5, 6, 7, 8 and 13. The application of urea 250 kg/Ha with 20 tonnes/Ha of cow manure and Azolla 10 tonnes/Ha is the best way to increase the number of tillers per clump of black rice in the tenth week after planting. The number of tillers per clump does not increase at week 11 – 13 presumably because the nitrogen element from urea, manure of cow and Azolla were optimally absorbed at week 5 - 10 MST to form rice tillers. Increased uptake of nitrogen content by rice plants in the vegetative period will cause the number of tillers per clump also increase [10]. Besides that, rice growth has started to enter the generative period so that the growth for the negative period is almost over.

Table 2. The average number of tillers of black rice varieties Ominio due to treatment of urea, manure of cow and Azolla at the age of 5-13 weeks after planting (WAP).

| Treatment                                      | 5 WAP | 6 WAP | 7 WAP | 8 WAP | 9 WAP | 10 WAP | 11 WAP | 12 WAP | 13 WAP |
|------------------------------------------------|-------|-------|-------|-------|-------|--------|--------|--------|--------|
| U0 (control)                                   | 3     | 5     | 6     | 8     | 9 b   | 11 b   | 10 b   | 8 c    | 7      |
| U1 (urea 250 kg/Ha)                            | 3     | 5     | 6     | 8     | 12 ab | 13 ab  | 11 ab  | 9 ab   | 7      |
| U2 (urea 250 kg/Ha with manure of cow 20 ton/Ha)| 4     | 6     | 9     | 11    | 13 a  | 14 ab  | 13 ab  | 11 ab  | 8      |
| U3 (urea 250 kg/Ha with Azolla 10 ton/Ha)      | 3     | 6     | 7     | 10    | 11 ab | 14 ab  | 13 ab  | 11 ab  | 8      |
| U4 (urea 250 kg/Ha with cow manure 20 ton/Ha and Azolla 10 ton/Ha) | 4 | 6 | 8 | 10 | 13 ab | 15 a | 14 a | 11 a | 9 |

Note: The numbers followed by the same letter are not significantly different in the BNJ test at 5 %.

3.3. The dry weight of plant and roots, N-uptake of black rice of Ominio

Table 3. The average N-uptake and dry weight of crown, dry weight of roots of black rice Ominio to the application of a combination of urea, cow manure fertilizer and Azolla at thirteenth week.

| Treatment | Dry weight of crown (g) | Dry weight of roots (g) | N uptake of plants (mg N/plant) |
|-----------|-------------------------|------------------------|-------------------------------|
| U0 (control) | 14.49                  | 2.32 b               | 29.88 c                       |
| U1 (urea 250 kg/Ha) | 15.93                  | 3.20 b               | 40.76 ab                      |
| U2 (urea 250 kg/Ha with manure of cow 20 ton/Ha) | 18.47                  | 3.27 b               | 37.01 ab                      |
| U3 (urea 250 kg/Ha plus Azolla 10 ton/Ha) | 20.86                 | 5.68 a               | 42.85 ab                      |
| U4 (urea 250 kg/Ha with manure of cow 20 ton/Ha and Azolla 10 ton/Ha) | 18.22                 | 3.94 ab               | 43.04 a                       |

Note: The number followed by the same letter are not significantly different in the BNJ test at the 5 %

The application of urea, manure of cow and Azolla shows a significant effect on the dry weight of roots and N uptake of rice plants, but has no significant effect on rice crown dry weight. The combination of urea and Azolla can increase the root dry weight in black rice plants so the highest plant roots dry weight was obtained in the U3 treatment of 5.68 g. This inhibition of black rice growth
is thought to be due to the suboptimal uptake of N nutrients thus reducing the biomass formed. The dry weight of the crown describes the utilization of sunlight and total nutrient absorbed during the crown growth, especially leaves [11].

The highest root dry weight was found in treatment U3, about 5.68 g which was not significantly different from treatment U4, about 3.94 g. The highest N-uptake was found in treatment U4, about 43.04 mg N/tree which was not significantly different from treatment U1, U2 and U3. The absorption of the nutrient is affected by several factors including the availability of nutrients that can be absorbed by plants in soil solutions, conditions for nitrogen availability in the soil that determine the amount of nitrogen [12].

4. Conclusions

The combination of urea, manure of cow fertilizer and Azolla (U3) was the best treatment by showing the highest yields on height of plant, the number of tillers per clump, the weight of dry root and N-uptake in black rice Ominio. The recommended dosage includes 250 kg/ha of urea, 20 ton/ha of cow manure fertilizer and 10 ton/ha of Azolla.

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