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Growth and production of rice (*oryza sativa* l.) With several application doses of urea fertiliser and cow manure

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***Abstract*: -** Integration of fertilisation using organic and inorganic fertilisers is one of the efforts to increase rice growth and production. This study aims to evaluate and analyse the effect of urea fertiliser and cow manure application on the growth and production of rice plants. This study used a separate plot design with three groups. The main plot was the dose of urea fertiliser including 100 kg ha^{-1}, 200 kg ha^{-1}, and 300 kg ha^{-1}. The subplots were doses of cow manure including 500 kg ha^{-1}, 1000 kg ha^{-1}, 1500 kg ha^{-1}, 2000 kg ha^{-1}, and 2500 kg ha^{-1}. The research data were then analysed by means of variance with BNT test as a further test. The results showed that the interaction of urea 300 kg ha-1 and no manure on panicle length (23.28 cm), urea 100 kg ha^{-1} and 2000 kg ha^{-1} on panicle weight per plant (2.85 g), urea 200 kg ha^{-1} and 2500 kg ha^{-1} manure on the number of filled grains per panicle (101, 67 grains), urea 100 kg ha^{-1} and 2500 kg ha^{-1} manure on the percentage of empty grains per panicle (12.12%), and urea 200 kg ha^{-1} and 2500 kg ha^{-1} manure on the weight of 1000 seeds (26.87 g). The single treatment of urea dose, 200 kg ha^{-1}, gave the best effect on chlorophyll a (234.55), chlorophyll b (96.04) and total chlorophyll (337.27). Based on the results of the study, it can be concluded that the application of urea fertiliser with cow manure has a positive impact on the growth of rice plants.

***Keywords*:** *Cow manure, rice, urea*

1. Introduction

Rice is one of the world's major food crops, and Indonesia is no exception. Rice production worldwide exceeds 4 billion tonnes, with the 4th largest production percentage of all crops cultivated in the world [1]. Rice production in Indonesia in 2022 reached 54.75 tonnes GKG, with a production area of 10.45 million hectares [2]. The data increased when compared to 2021. However, the increase is directly proportional to the expansion of the harvested area, so crop productivity needs to be maintained and even increased.

Increasing rice productivity can be done by various methods, one of which is improving fertiliser techniques in the field, both organic and inorganic fertiliser inputs. Fertilisation is an important process in crop cultivation activities. One of the important elements in the growth of rice plants is nitrogen. Nitrogen is an important element for rice cultivation, when compared to other nutrients [3]; [4]. According to MOA N0.40 of 2007, to increase the rice production target by 3.5 t/ha, an input of 375 kg/ha of urea is required. In fact, farmers apply higher doses, exceeding the recommendations given by the government.

Given the scarce availability of urea fertiliser in the market and its high price, it is important to pay attention to its use in the field. Continuous application of inorganic fertilisers in large volumes can have negative effects on the environment, especially as pollutants [5]. Therefore, inorganic fertiliser inputs must be carefully considered. One of the efforts to overcome this is the use of organic materials as additional fertilisers that can reduce the use of inorganic fertilisers.

Organic fertiliser is important in rice cultivation. Cow manure is one of the organic materials that can be used, because it is cheap and tends to be easy to obtain. In addition, cow manure is a good source of nutrients, especially essential macro nutrients [6]. Research conducted by Atman et al 2018 found a linear relationship between increasing the application of cow manure and rice production. This study revealed that with the addition of 1 t/ha of cow manure, it will increase 0.097 t/ha of rice production [7]. Research conducted by Iqbal et al 2020 found that the combination of manure and inorganic fertiliser can increase rice productivity [8]. In addition, the combination of manure and inorganic fertiliser can increase N absorption after anthesis and activate several enzymes that support the seed filling process.

The combination of organic and inorganic fertiliser has good potential to increase rice production. Organic fertiliser in the form of animal manure can improve soil physical quality, while inorganic fertiliser can directly provide nutrients in a form available to plants. The integration of organic and inorganic fertilisers not only plays a role in providing nutrients but also increases absorption efficiency and reduces negative impacts on the environment [9]. In addition, Khatun et al 2015 also found positive results, by combining urea fertiliser and organic matter in the form of animal manure in rice crops [10]. Based on some of the positive impacts of fertiliser integration with organic and inorganic fertilisers, it is necessary to conduct research that evaluates and studies the effect of the application of urea fertiliser and cow manure at various doses on rice plants.

II. Research Methods

Place and Time

This research was conducted in Batara Village, Labakkang District, Pangkajene and Islands Regency. The research was conducted from April to July 2022.

Research Design

The research was arranged in a separate plot design (RPT) consisting of two treatment factors. The main plot was the dose of urea fertiliser (u) consisting of 100 kg ha^{-1} (u1), 200 kg ha^{-1} (u2), and 300 kg ha^{-1} (u3). The sub-plot was the dose of cow dung (k) consisting of control (k0), 500 kg ha^{-1} (k1), 1000 kg ha^{-1} (k2), 1500 kg ha^{-1} (k3), 2000 kg ha^{-1} (k4), and 2500 kg ha^{-1} (k5). The two treatment factors resulted in 18 treatment combinations, which were repeated three times, resulting in 54 research plots.

Research Implementation

The nursery is prepared 20 days before planting in the form of a wet nursery. Before the seeds are sown in the nursery, the seeds are first soaked in water for 24 hours, then matured using a cloth for 1 day. The germinated rice seeds are then sown in the nursery bed. The land to be used is first processed using a tractor in 2 stages. The first stage is crushing the soil and turning the soil. The second stage is levelling. Next, make experimental plots with a size of 2.5 m × 4 m as many as 18 units of each replication which were repeated 3 times so that 54 experimental plots were obtained. The distance between each experimental plot in one replication unit was 50 cm and the distance between replications was 70 cm. Planting seedlings that were 20 days old were moved to the prepared field. Planting was done with a spacing of 20 cm × 20 cm so that the number of clumps per plot was 364 clumps.

Maintenance of rice plants includes replanting, weeding, and fertilisation. Replanting is done after 3 or 5 days after transplanting by replacing plants that do not grow with new seedlings. Weeding is done twice using a sickle, one week after flooding and repeated three weeks after flooding. Rice fertilisation was done by applying urea and NPK Pelangi. Doses of urea according to the treatment were (U1) as much as 100 kg ha^{-1} (100 g $plot^{-1}$), (U2) as much as 200 kg ha^{-1} (200 g $plot^{-1}$) and (U3) as much as 300 kg ha^{-1} (300 g $plot^{-1}$). While the dose of NPK Pelangi was 300 kg ha^{-1} (300 gr $plot^{-1}$) with three stages of fertilisation each. The first fertilisation was conducted at 7 HST by applying urea fertiliser at 30 gr ha^{-1} (U1), 60 gr ha^{-1} (U2), 90 gr ha^{-1} (U3), and NPK Pelangi at 60 gr ha^{-1}, The second fertilisation was carried out 21 HST by applying urea fertiliser of 70 gr $plot^{-1}$ (U1), 140 gr $plot^{-1}$ (U2), 210 gr $plot^{-1}$ (U3) and NPK Pelangi of 150 gr $plot^{-1}$, and the third fertilisation was carried out 35 HST by applying NPK Pelangi of 90 gr $plot^{-1}$.

Inundation was carried out at the beginning of planting, namely after the first fertiliser. While when entering the primordial phase, inundation is not carried out. Harvesting is done after the plants show the harvest criteria, namely 85% of the rice panicles are golden yellow, 90% of the flag leaves and rice grains have turned yellow, and the rice panicles are bowed, and the grains are hard when pressed with a finger.

Parameters and Data Analysis

Parameters observed included plant height (cm), number of tillers per clump, panicle length (cm), panicle weight per plant (g), number of filled grains per panicle, percentage of empty grains per panicle (%), 1000 seed weight (g), production per hectare (t), chlorophyll a, b and total chlorophyll content, stomatal density and stomatal opening area. The data collected were analysed using ANOVA and if there was a significant effect, it was further tested with the BNT test with α = 0.5.

III. Results

Plant Height

Based on the analysis of variance, it shows that both treatment factors and singly do not give a significant effect on the height of rice plants. The highest average 60 HST plant height was found in the treatment of 300 kg ha^{-1} urea fertiliser and 1000 kg ha^{-1} cow manure (u3k2) which was 101.33 cm, while the lowest average 60 HST plant height was found in the treatment of 200 kg ha^{-1} urea fertiliser and 1500 kg ha^{-1} cow manure (u2k3) which was 87.33 cm.

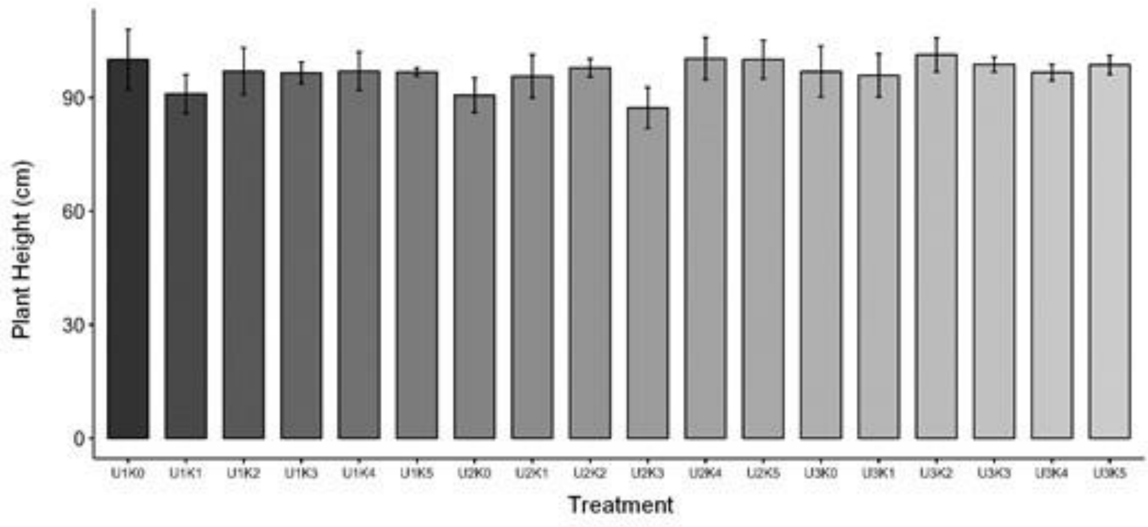

Figure 1: Bar diagram of plant height for each treatment

Number of Tillers

Based on the analysis of variance, it showed that both treatment factors and singly did not give a significant effect on the height of rice plants. The highest average number of tillers 60 HST was found in the treatment of 100 kg ha^{-1} urea fertiliser and 500 kg ha^{-1} cow manure (u1k1) which was 20.67 tillers, while the lowest average plant height 60 HST was found in the treatment of 300 kg ha^{-1} urea fertiliser and no cow manure (u3k0) which was 15.56 tillers.

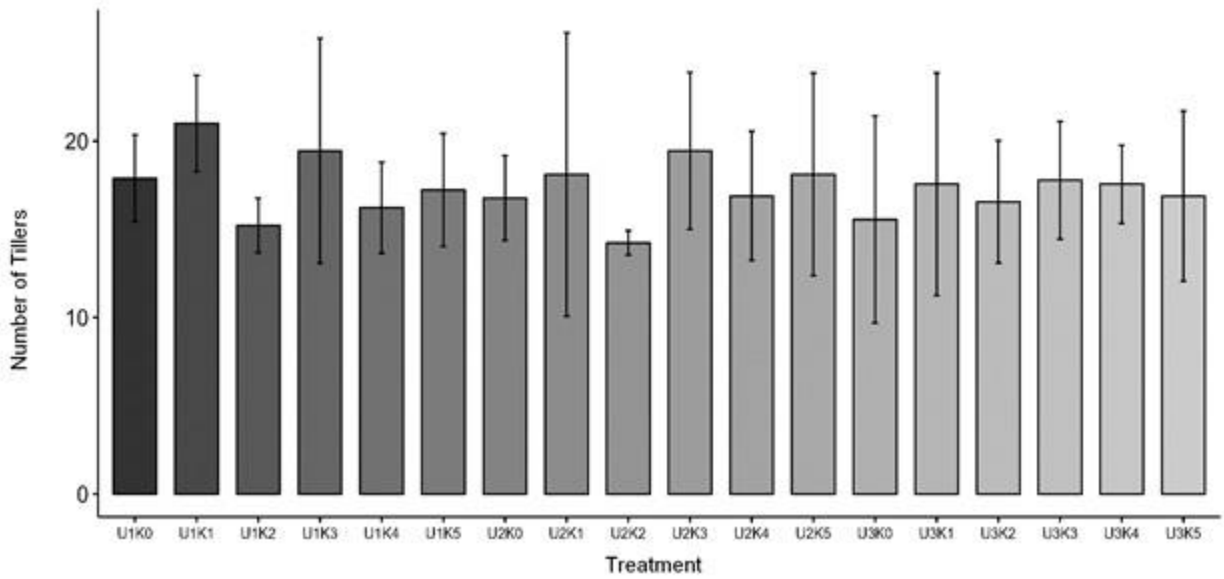

Figure 2. Bar diagram of the number of tillers for each treatment

Panicle Length

The analysis of variance showed that the treatment of urea dose and dose of cow manure had no significant effect, while their interaction had a significant effect on panicle length. The highest average panicle length was found in the treatment of 300 kg ha^{-1} urea fertiliser at no cow manure application (u3k0) which was 24.28 cm, but not significantly different from the treatment of 100 kg ha^{-1} urea fertiliser, and significantly different from the treatment of 200 kg ha^{-1} urea fertiliser. The highest average panicle length was also found in the treatment without cow manure at 300 kg ha^{-1} urea fertiliser (u3k0) which was 24.28 cm, but not significantly different from the other treatments.

Table 1. Panicle Length (cm)

Urea Dosage	Dosage of Cow Manure						NP BNT
	k0	k1	k2	k3	k4	k5	
u1	$22.68\frac{a}{pq}$	$20.04\frac{a}{pq}$	$21.20\frac{a}{pq}$	$24.02\frac{a}{p}$	$23.09\frac{a}{p}$	$18.57\frac{b}{q}$	
u2	$16.09\frac{b}{q}$	$24.07\frac{a}{p}$	$23.18\frac{a}{p}$	$23.16\frac{a}{p}$	$21.91\frac{a}{p}$	$23.83\frac{a}{p}$	4.68
u3	**$24.28\frac{a}{p}$**	$20.91\frac{a}{p}$	$24.16\frac{a}{p}$	$21.13\frac{a}{p}$	$21.99\frac{a}{p}$	$23.02\frac{ab}{p}$	
NP BNT	4.48						

Notes: Numbers followed by the same letter in column (a, b) and row (p, q) are not significantly different in the 95% BNT further test

Panicle Weight per Plant

Variance analysis showed that the treatment of urea dose had a significant effect, the dose of cow manure had no significant effect, while the interaction had a very significant effect on panicle weight. The highest average panicle weight was found in the treatment of 100 kg ha^{-1} urea fertiliser at 2000 kg ha^{-1} cow manure (u1k4) which was

2.85 g, and significantly different from other treatments. The highest average panicle weight was also found in the treatment of 2000 kg ha^{-1} cow manure at 100 kg ha^{-1} urea fertiliser (u1k4) which was 2.85 g and significantly different from other treatments.

Table 2: Panicle Weight per Plant (g)

Urea Dosage	Dosage of Cow Manure						NP BNT
	k0	k1	k2	k3	k4	k5	
u1	$2.11\frac{a}{q}$	$2.00\frac{ab}{q}$	$2.22\frac{a}{q}$	$1.84\frac{b}{q}$	**2.85**$\frac{a}{p}$	$2.22\frac{ab}{q}$	
u2	$1.99\frac{a}{q}$	$2.27\frac{a}{pq}$	$2.12\frac{ab}{pq}$	$2.34\frac{a}{pq}$	$2.02\frac{b}{q}$	$2.49\frac{a}{p}$	0.39
u3	$2.20\frac{a}{p}$	$1.88\frac{b}{pq}$	$1.74\frac{b}{q}$	$2.03\frac{a}{pq}$	$1.71\frac{b}{q}$	$1.88\frac{b}{pq}$	
NP BNT	0.38						

Notes: Numbers followed by the same letter in column (a, b) and row (p, q) are not significantly different in the 95% BNT further test.

Number of Contained Grain per Panicle

The analysis of variance showed that the treatment of urea dose had a significant effect, the dose of cow manure had no significant effect, while the interaction had a very significant effect on the number of filled grains per panicle. The highest average number of filled grains per panicle was found in the treatment of 200 kg ha^{-1} urea fertiliser at 2500 kg ha^{-1} cow manure (u2k5) which was 101.67 grains, and significantly different from other treatments. The highest average number of filled grains per panicle was also found in the treatment of 2500 kg ha^{-1} cow manure at 200 kg ha^{-1} urea fertiliser (u2k5) which was 101.67 grains, but not significantly different from the treatments of 1500 kg ha^{-1} and 2000 kg ha^{-1} cow manure, and significantly different from no cow manure, 500 kg ha^{-1} and 1000 kg ha^{-1} cow manure.

Table 3. Number of Contained Galls per Panicle (grains)

Urea Dosage	Dosage of Cow Manure						NP BNT
	k0	k1	k2	k3	k4	k5	
u1	$83.00\frac{a}{qr}$	$77.33\frac{b}{r}$	$84.67\frac{a}{q}$	$82.67\frac{b}{qr}$	$80.00\frac{b}{qr}$	$92.33\frac{b}{p}$	
u2	$77.67\frac{ab}{r}$	$92.00\frac{a}{q}$	$83.67\frac{a}{r}$	$98.00\frac{a}{pq}$	$97.67\frac{a}{pq}$	**101.67**$\frac{a}{p}$	6.67
u3	$76.00\frac{b}{q}$	$83.00\frac{b}{p}$	$88.33\frac{a}{p}$	$83.33\frac{b}{p}$	$85.67\frac{b}{p}$	$82.00\frac{c}{pq}$	
NP BNT	6.52						

Notes: Numbers followed by the same letter in columns (a, b, c) and rows (p, q, r) are not significantly different in the 95% BNT further test.

Percentage of Empty Grain per Panicle

The analysis of variance showed that the treatment of urea dose, cow manure dose, and their interaction had a very significant effect on the percentage of hollow grain per panicle. The lowest average percentage of hollow grain was found in the treatment of 100 kg ha^{-1} urea fertiliser at 2500 kg ha^{-1} cow manure (u2k3) which was 12.12%, and significantly different from other treatments. The lowest average number of hollow grain was also found in the treatment of 1500 kg ha^{-1} cow manure at 200 kg ha^{-1} urea fertiliser (u2k3) which was 12.46%, but not significantly different from the treatment of 2000 kg ha^{-1} and 2500 kg ha^{-1} cow manure, and significantly different from no cow manure, 500 kg ha^{-1} and 1000 kg ha^{-1} cow manure.

Table 4. Number of Empty Grain (grains)

Urea Dosage	Dosage of Cow Manure						NP BNT
	k0	k1	k2	k3	k4	k5	
u1	$31.05\frac{a}{p}$	$28.64\frac{a}{pq}$	$23.03\frac{a}{qr}$	$20.77\frac{a}{r}$	$27.91\frac{a}{pq}$	$\mathbf{12.12}\frac{b}{s}$	
u2	$22.09\frac{b}{qr}$	$23.94\frac{a}{pq}$	$28.65\frac{a}{p}$	$12.46\frac{b}{s}$	$16.33\frac{b}{rs}$	$14.99\frac{b}{s}$	5.79
u3	$33.66\frac{a}{p}$	$27.78\frac{a}{q}$	$25.31\frac{a}{qr}$	$23.33\frac{a}{q}$	$26.28\frac{a}{q}$	$27.41\frac{a}{q}$	
NP BNT	6.08						

Notes: Numbers followed by the same letter in column (a, b) and row (p, q, r, s) are not significantly different in the 95% BNT further test.

1000 Seed Weight

The analysis of variance showed that the treatment of urea dose had no significant effect while the dose of cow manure and its interaction had a very significant effect on the weight of 1000 seeds. The highest average 1000 seed weight was found in the treatment of 200 kg ha^{-1} urea fertiliser at 2500 kg ha^{-1} cow manure (u2k5) which was 26.87 g, and significantly different from other treatments. The highest average 1000 seed weight was also found in the treatment of 2500 kg ha^{-1} cow manure at 200 kg ha^{-1} urea fertiliser (u2k5) which was 26.87 g, and significantly different from other treatments.

Table 5. 1000 Seed Weight (g)

Urea Dosage	Dosage of Cow Manure						NP BNT
	k0	k1	k2	k3	k4	k5	
u1	$20.27\frac{a}{p}$	$22.33\frac{a}{p}$	$21.37\frac{a}{p}$	$22.43\frac{b}{p}$	$20.53\frac{b}{p}$	$21.17\frac{b}{p}$	
u2	$22.14\frac{a}{qr}$	$19.13\frac{b}{rs}$	$22.83\frac{a}{q}$	$20.17\frac{b}{r}$	$17.67\frac{c}{s}$	$\mathbf{26.87}\frac{a}{p}$	2.26
u3	$16.67\frac{b}{r}$	$18.87\frac{b}{r}$	$17.73\frac{b}{r}$	$25.73\frac{a}{p}$	$23.53\frac{a}{pq}$	$22.47\frac{b}{q}$	
NP BNT	2.30						

Notes: Numbers followed by the same letter in column (a, b) and row (p, q, r) are not significantly different in the 95% BNT further test.

Production per Hectare

Based on the analysis of variance showed that both treatment factors or singly did not give a significant effect on production per hectare of rice plants. The highest average production was found in the treatment of 200 kg ha^{-1} urea fertiliser and 2500 kg ha^{-1} cow manure (u2k5) at 5.28 tonnes, while the lowest average production was found in the treatment of 300 kg ha^{-1} urea fertiliser and no cow manure (u3k0) at 3.42 tonnes.

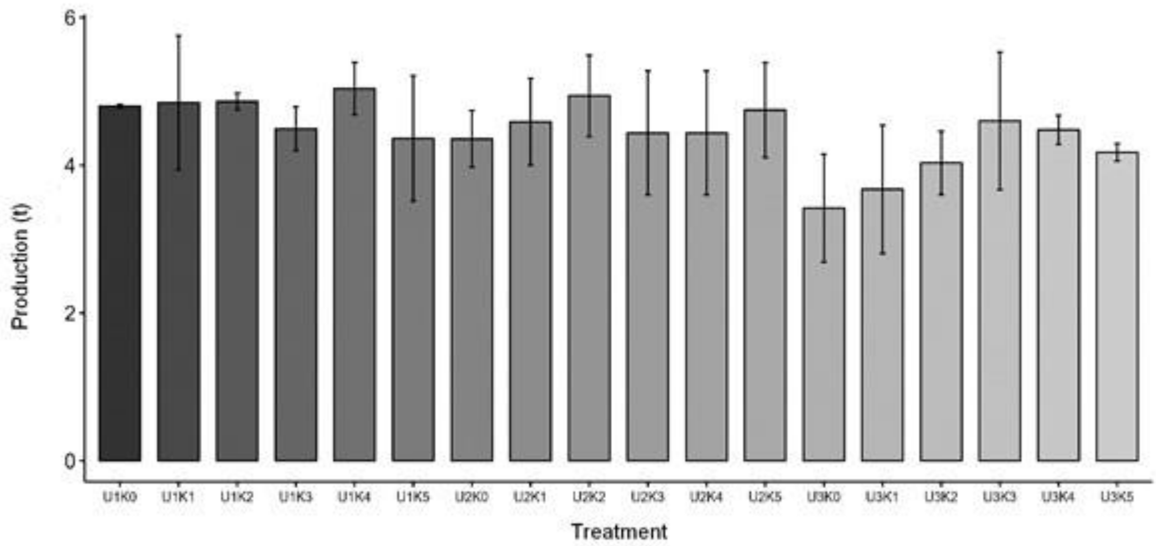

Figure 3. Diagram of production per hectare for each treatment

Stomatal Density

Based on the analysis of variance showed that both treatment factors and singly did not give a significant effect on the density of stomata of rice plants. The highest average stomatal density was found in the treatment of 200 kg ha^{-1} urea fertiliser and 2500 kg ha^{-1} cow manure (u2k5) which was 317.62 stomata/mm^2, while the lowest average stomatal density was found in the treatment of 100 kg ha^{-1} urea fertiliser and 2000 kg ha^{-1} cow manure (u1k4) and 300 kg ha^{-1} urea fertiliser and 500 kg ha^{-1} cow manure (u3k1) which was 173.25 stomata/mm^2.

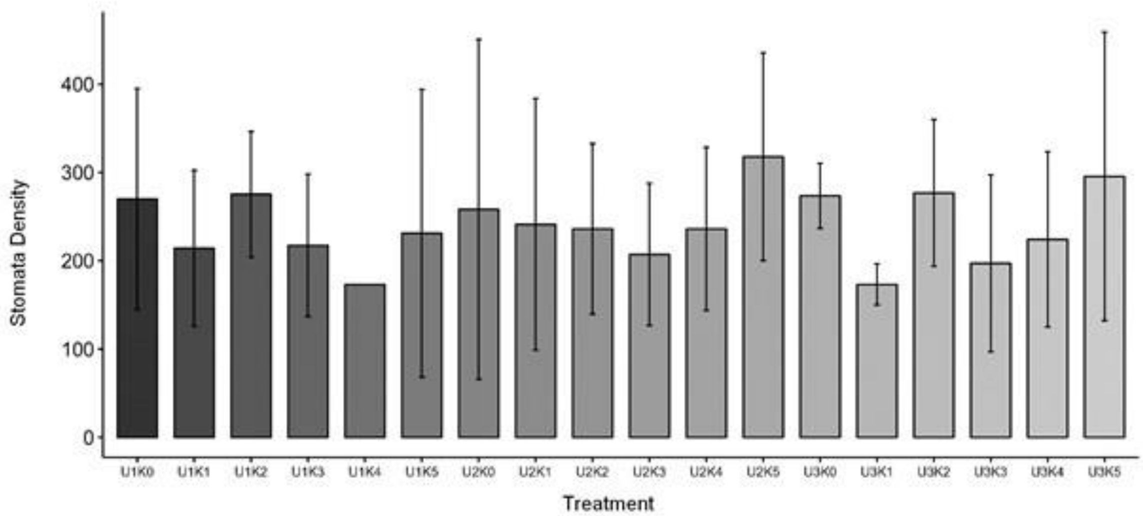

Figure 4. Diagram of stomatal density of each treatment

Stomatal Aperture Area

Based on the analysis of variance, it showed that both treatment factors and singly did not give a significant effect on the area of stomatal openings of rice plants. The highest average stomatal opening area was found in the treatment of 100 kg ha^{-1} urea fertiliser and 1000 kg ha^{-1} cow manure (u1k2) which was 496.12 µm2, while the lowest average stomatal opening area was found in the treatment of 200 kg ha^{-1} urea fertiliser and 2500 kg ha^{-1} cow manure (u2k5) and 300 kg ha^{-1} urea fertiliser and 1000 kg ha^{-1} cow manure (u3k2) which was 98.39 µm2.

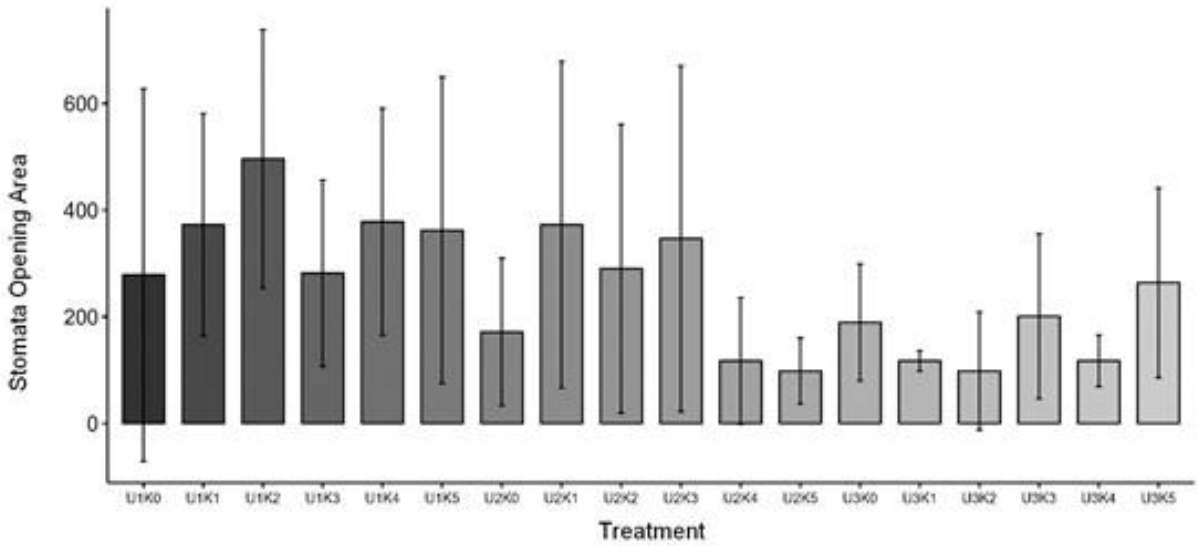

Figure 5. Diagram of stomatal aperture area for each treatment

Chlorophyll A, B and Total Levels

The variance analysis showed that the urea dose treatment had a significant effect, while the dose of cow manure and its interaction did not significantly affect chlorophyll a, b and total chlorophyll. The highest average chlorophyll a was found in the treatment of 200 kg ha^{-1} urea fertiliser (u2) which was 234.55 µmol m^{-2}, but not significantly different from the treatment of 300 kg ha^{-1} urea fertiliser (u3), and significantly different from the treatment of 100 kg ha^{-1} urea fertiliser (u1). Chlorophyll b was highest in the treatment of 200 kg ha^{-1} urea fertiliser (u2) at 96.04 µmol m^{-2}, but not significantly different from the treatment of 300 kg ha^{-1} urea fertiliser (u3), and significantly different from the treatment of 100 kg ha^{-1} urea fertiliser (u1). Overall, the highest average total chlorophyll was found in the treatment of 200 kg ha^{-1} urea fertiliser (u2) which was 96.04 µmol m^{-2}, but not significantly different from the treatment of 300 kg ha^{-1} urea fertiliser (u3), and significantly different from the treatment of 100 kg ha^{-1} urea fertiliser (u1).

Table 5. 1000 Seed Weight (g)

Treatment	Chlorophyll a	Chlorophyll b	Total Chlorophyll
u1	211.55b	85.80b	298.69b
u2	234.55a	96.04a	337.27a
u3	230.37a	93.97a	331.22a
NP BNT 95%	15.44	5.07	5.07

Notes: Numbers followed by the same letter in column (a, b) and row (p, q, r) are not significantly different in the 95% BNT further test.

IV. DISCUSSION

The use of urea fertiliser and cow manure generally affects various parameters, including the growth and production of rice plants. The application of urea at a dose of 300 kg ha^{-1} and 1000 kg ha^{-1} cow manure was able to increase plant height. However, statistically the treatment was not significantly different from the other treatments. Likewise, the number of tillers showed different results. The treatment of 100 kg ha^{-1} urea fertiliser and 500 kg ha^{-1} cow manure recorded the highest number of tillers. This is because rice plants have a limited ability to absorb NH4+ and NO3- elements in their growth. In this case, plants need to get fertilisation with the right dose and in accordance with the needs of plants so that there is a balance of nutrients in the soil that can support plants to grow and develop. This is in accordance with the opinion of Edi 2018, which states that rice plants have the capacity to absorb a limited amount of nitrogen (N), so that the remaining nitrogen that is not absorbed will undergo volatilisation, denitrification, and leaching [11]. Therefore, the provision of nitrogen supply that is sufficient and in accordance with the needs of plants is needed to minimise yield losses in plants.

The results showed that there was an interaction between urea fertiliser and cow manure on several yield components, such as panicle length, panicle weight, number of filled grains, number of empty grains, and 1000 seed weight. This is due to the application of cow manure which is believed to have a relatively high organic matter content. With sufficient organic matter in the soil, it can increase yield potential, especially in terms of grain formation. The formation of grains is also supported due to the ability of cow manure in maintaining the availability of nutrients from urea fertiliser in the soil to be released slowly according to the needs of plants in the generative phase optimally, especially in terms of the formation of flowers and grain seeds of rice plants. This is supported by the statement of Mastur 2015, which states that the potential yield of a plant can increase if it is supported by the ability of a plant in the pattern of distribution and accumulation of photosynthate to economically valuable parts (parts to be harvested) [12].

The observation of panicle length recorded a significant effect caused by the interaction between the dose of urea fertiliser and manure. Application of 300 kg ha^{-1} urea fertiliser significantly increased panicle growth. Similarly, Amenyogbe and Dzomeku 2023 also recorded a positive effect of 125 kg ha^{-1} urea fertiliser application on panicle length of rice plants [13]. Panicle weight per plant was significantly affected by the application of urea and cow manure. Doses of 100 kg ha^{-1} urea fertiliser and 2000 kg ha^{-1} recorded the heaviest panicle weight per plant. The increase in panicle weight per plant is certainly influenced by the fertiliser itself. Nitrogen is an important element in plant growth.

From the results obtained, it can also be seen that the application of cow manure can reduce the dose of inorganic fertiliser use, especially urea fertiliser. Urea fertiliser 200 kg ha^{-1} with cow manure 2500 kg ha^{-1} can produce the number of filled grains and at the same time reduce the number of empty grains compared to other treatments including control. This proves that with a high dose of organic fertiliser, it can increase the efficiency of maximum nutrient absorption so that the dose of inorganic fertiliser given can be minimised. The efficiency of nutrient absorption can also be achieved due to the addition of nitrogen elements from urea fertiliser which can reduce the C/N ratio so that it has an impact on the speed of decomposition of organic matter to be immediately utilised by plants. This statement is in accordance with the results of research by Sari et al 2014, which shows that the element nitrogen is very closely correlated with the C / N ratio which has an impact on increasing the speed of decomposition of organic matter so that the faster the organic matter decomposes, the faster the provision of nutrients for plants [14].

The application of manure at a high dose with optimal nutrient sufficiency from the minimum dose of urea was able to increase panicle weight and 1000 seed weight significantly different from the control treatment and the treatment with too high a dose between the two treatments. This condition indicates that the application of fertiliser at the appropriate dose can support plants to meet the carbohydrate needs needed during the transitional phase. This is in accordance with the research of Laurenze 2021, which shows that seed weight is a reflection of photosynthesis results measured based on the amount of energy capture by plants [15]. Dry seed weight when dependent on plant physiological processes because optimal physiological conditions accompanied by even light absorption will have an impact on creating a perfect distribution pattern in a larger storage network within the plant tissue.

In general, the integration of urea fertiliser application with manure can improve the production characteristics of rice plants and also increase production in general. Several studies have also shown the importance of urea application in rice cultivation. Research conducted by Gewaily et al 2018, found that the application of 220 kg ha^{-1} urea was able to increase the growth and production of rice plants [16]. Research conducted by Bah et al 2009 also found a significant effect of urea application on rice plant biomass, increasing the number of filled grains, 1000 seed weight and overall production [17].

The increase in production is also influenced by chlorophyll levels in plants. The application of 200 kg ha^{-1} urea fertiliser produced the highest chlorophyll. In addition, when viewed as a trend, the higher the dose of urea fertiliser applied, the better the effect on leaf chlorophyll levels. The difference in leaf chlorophyll that occurs is related to the level of sunlight intensity that can be transmitted to the leaf surface due to the addition of nitrogen nutrients from urea fertiliser. This high N content will be followed by the amount of chlorophyll which causes the leaves to become greener. This statement is supported by the opinion of Tumewu et al 2019, which states that N concentration in leaves is closely correlated with the speed of photosynthesis and biomass production [18]. Totong et al 2015, also supports that the provision of N nutrients causes the plant's need for other nutrients such as P and K to increase to compensate for the optimal plant growth rate [19].

V. Conclusions

Based on the results and discussion, it can be concluded that there is an interaction between the dose of urea fertiliser and cow manure that gives the best effect on several observation parameters. The interaction of urea 300 kg ha^{-1} and no manure on panicle length (23.28 cm), urea 100 kg ha^{-1} and 2000 kg ha^{-1} on panicle weight per plant (2.85 g), urea 200 kg ha^{-1} and 2500 kg ha^{-1} manure on the number of filled grain per panicle (101.67 grains), urea 100 kg ha^{-1} and 2500 kg ha^{-1} manure on the percentage of empty grain per panicle (12.12%), and urea 200 kg ha^{-1} and 2500 kg ha^{-1} manure on the weight of 1000 seeds (26.87 g). Application of urea at a dose of 200 kg ha^{-1} gave the best effect on chlorophyll a (234.55), chlorophyll b (96.04) and total chlorophyll (337.27). Single application of manure at various doses was not recorded to give significant effect on all observation parameters.

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