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Applying Fermented Rice Washing Water and Organic NPK to Increase Plant Growth and Production Caisim Mustard Greens (*Brassica juncea* L)

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Abstract

The demand for vegetables, particularly mustard greens, in Riau Province continues to rise alongside the overall increase in vegetable consumption. However, current production levels are insufficient to meet this demand, necessitating imports from neighboring regions such as West Sumatra and North Sumatra. Therefore, there is a pressing need to enhance local production. This study aimed to evaluate the effects of varying concentrations of fermented rice washing water and organic NPK on the growth and yield of mustard greens (*Brassica juncea* L.). The research employed a Factorial Completely Randomized Design, which included two factors. The first factor was the concentration of fermented rice washing water, with four treatment levels: 25%, 50%, 75%, and 100%. The second factor was the application of organic NPK, also with four treatment levels: no organic NPK, 2.25 g/plant, 4.5 g/plant, and 6.75 g/plant. The parameters observed included the number of leaves, wet weight, economic weight, dry weight, net assimilation rate, and relative growth rate. The results indicated that the combination of fermented rice washing water and organic NPK had a significant effect on all observed parameters except for dry weight, with the optimal treatment being a concentration of 100% and 6.75 g of organic NPK per plant. The application of rice washing water significantly influenced all observed parameters, with the best treatment being fermented rice washing water at a concentration of 100%. Additionally, the effect of organic NPK was significant across all observed parameters, with the optimal treatment being 6.75 g per plant. The combination of fermented rice washing water and organic NPK effectively enhanced the growth and production of mustard greens, resulting in a production yield of 20.2 tons per hectare.

Keywords: Fermented rice washing water, Growth, Organic NPK, Production of Caisim Mustard Greens

1. Introduction

Caisim (*Brassica juncea* L.) is a vegetable plant with significant potential for commercial cultivation. A comprehensive review of the climatological, technical, economic, and social factors supports the cultivation of Caisim in Indonesia. A variety of culinary preparations that incorporate Caisim as a primary ingredient have been identified, including Lodeh soup, capcay, and boiled noodles, among others.

The production of mustard greens in Riau Province has shown a consistent upward trend over the past five years. The data on mustard greens production in the last five years is as follows: in 2020, it was 1,423 tons; in 2021, it was 1,673 tons; in 2022, it was 2,249 tons; in 2023, it was 3,062 tons; and in 2024, it was 3,370 tons. Badan Statistik Indonesia (2024) has reported an increase in annual production; however, domestic demand for mustard greens remains unmet. Consequently, the region must rely on external suppliers, particularly those in West Sumatra, to meet this demand. This point underscores the imperative for a renewed focus on increasing production to meet the growing demand for mustard greens.

Efforts to cultivate plants in Riau generally still face many obstacles because the existing agricultural land is still dominated by land that is poor in nutrients, has chemical characteristics such as low pH (acidic), low organic matter content, and low macronutrient content (N, P, K, S) and micronutrients (Zn, Mg), so that special treatment is needed

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so that plants can grow and produce optimally.

Efforts to increase soil fertility can be made through fertilization, allowing plants to grow well and maximizing harvest yields. One effort to improve soil fertility is to reduce the application of inorganic fertilizers and then supplement it with organic fertilizers. The organic material used in this study is rice washing water. Besides being easy to obtain, rice washing water also contains many nutrients needed by plants. Rice-washing water can serve as a valuable nutrient supplement for plants, optimizing growth and development (Murdaningsih et al., 2020). The utilization of rice washing water as a soil conditioner requires a fermentation process to maximize its effectiveness, as noted by Ujiatul (2013). According to Ujiatul, fermentation is a process of aerobic or anaerobic respiration carried out by microorganisms that aims to accelerate the process of nutrient absorption in plants. Through the fermentation process, the decomposition of the material is faster and easier. The fermentation process for making liquid organic fertilizer can be conducted either aerobically or anaerobically.

Research by Fadilah et al. (2020) shows that watering fermented rice washing water for 15 days with a concentration of 100% has an effect on increasing plant height, number of leaves, leaf area, fresh weight, and dry weight of plants. The growth of green mustard plants (Brassica juncea L.) was best achieved in the treatment with fermented rice washing water for 15 days at a concentration of 100%. The research of Atoilah et al. (2021) on the provision of fermented rice washing water to Caisim plants (Brassica juncea L.) of the Tosakan variety still did not show a good response. Meanwhile, the results of this study showed that the application of fermented rice washing water had a positive effect on the growth and production of Caisim mustard plants.

Plants need nutrients, including N, P, and K, to grow and develop well. One of the fertilizers containing these elements is Organic NPK. Susetya (2018) Organic NPK fertilizer is an artificial fertilizer that contains macro-nutrients such as Nitrogen (N). Phosphorus (P), Potassium (K). Providing organic NPK can enhance soil fertility, leading to increased plant growth and production. The Organic NPK used in this study is an HPA International product containing 3.5% N, 4.8% P, and 5.13% K. According to Kustiawan et al. (2024), the treatment with organic NPK fertilizer at a dose of 4.5 g/plant significantly affected the growth and production of mustard greens with the best dose of 4.5 g/plant. The results of this study, which involved the application of organic NPK with a dose of 6.75 g/plant, equivalent to 750 kg/ha, indicate that this treatment is the best for the growth and production of Caisim mustard greens.

2. Material and Methods

This research was conducted in the experimental garden of the Faculty of Agriculture, Riau Islamic University, located at coordinates (0.44736° N, 101.45732° E) with an altitude of 40.1 meters above sea level. The research lasted for three months, from January to March 2025.

There are also ingredients used in the study of Caisim mustard greens var. Tosakan, including rice washing water, HPA International Organic NPK, poly bags, Kawi, Pame, seng plat, cat, plastic rope, and others. The tools utilized in this research include culture equipment, gem drills, metering devices, scissors, hand sprayers, cameras, digital cameras, drums, buckets, scoops, measuring cups, and writing tools.

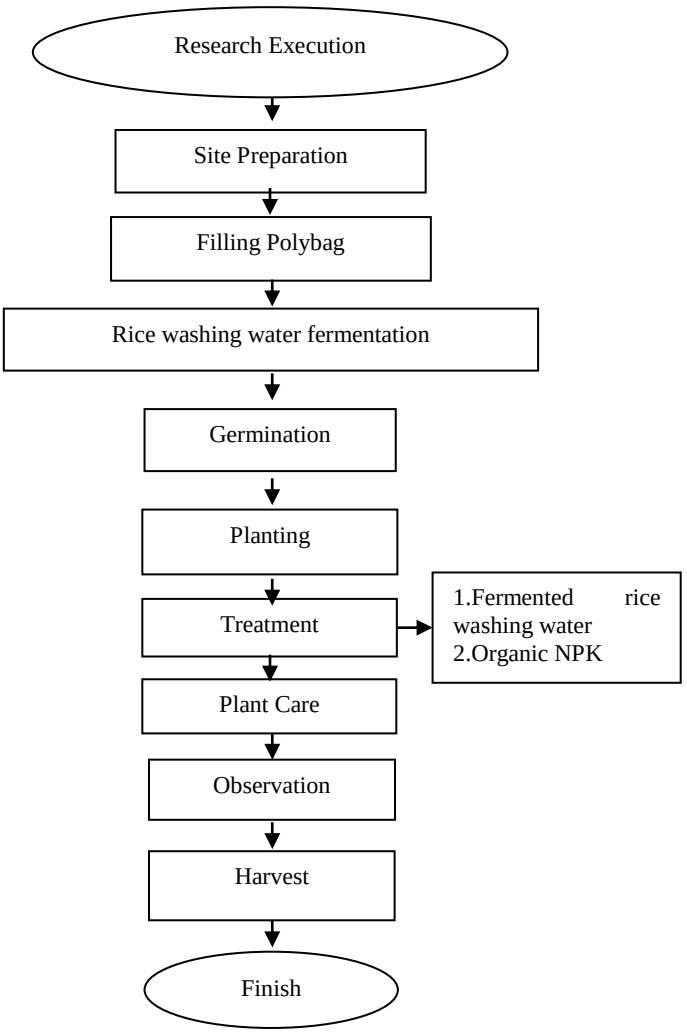

Figure 1. Research flow diagram

This study employed a Completely Randomized Design (CRD) Factorial consisting of two factors. The first factor, fermented rice washing water (A), had four levels: 25%, 50%, 75%, and 100%. The second factor is Organic NPK (N), consisting of four levels of treatment: 0, 2.25, 4.5, and 6.75 g per plant. Thus, 16 treatment combinations were obtained. Each treatment combination was repeated three times, resulting in 48 experimental units. Each

repetition consisted of 8 plants, and six plants were used as samples. The implementation of the study included land preparation, i.e., clearing the land of weeds and garbage. The land was leveled using a hoe to make it easier to arrange polybags. Then, 3 kg polybags were filled with mineral topsoil. After filling the polybags, they were placed in each experimental unit, with a distance of 20 x 30 cm between them. Fermentation of rice washing water was carried out for 15 days. Sowing of Caisim seeds is done 10 days before planting using rock wool media. Planting is done after the seedlings are 10 days old by moving the Caisim mustard seedlings from the nursery to polybags. Each polybag is planted with one seedling. Application of rice washing water 4 times, namely at planting, 7, 14, and 21 days after sowing (DAS). Given according to the concentration, and from each concentration, 200 ml per plant. Application of Organic NPK is given at planting according to the treatment dose, namely without Organic NPK, 2.25, 4.5, and 6.75 g/plant by being buried in the soil 10 cm from the plant.

Plant maintenance includes watering, weeding, and controlling pests and diseases. The parameters observed were net assimilation rate, relative growth rate, number of leaves, wet weight, and dry weight. The data from the observation results were statistically analyzed using the Honestly Significant Difference Test (HSD) at a 5% significance level, as implemented in SPSS version 27.

3. Results and Discussion

3.1. Net Assimilation Rate/LAB

The results of observations of the net assimilation rate of Chinese cabbage plants showed that both the combination and the main effect of fermented rice washing water and organic NPK significantly affected the net assimilation rate of Chinese cabbage both at 14-21 and 21-28 days after planting. The average results of observations on the net assimilation rate, following further testing of BNJ at the 5% level, are presented in Table 1.

Table 1. Average net assimilation rate (mg/cm2 / day) of Chinese cabbage plants treated with fermented rice washing water and organic NPK.

HST	Water Fermented Rice Wash (%)	Organic NPK (g/plant) 0	2.25	4.5	6.75	Average
14-21	25	0.009±0.000 g	0.012±0.001 fg	0.015±0.001 de	0.016±0.000 cde	0.013 d
	50	0.011±0.000 fg	0.013±0.000 ef	0.016±0.001 cde	0.018±0.000 bc	0.015 c
	75	0.013±0.000 ef	0.014±0.000 ef	0.017±0.000 bcd	0.020±0.000 ab	0.016 b
	100	0.016±0.000 cde	0.018±0.000 bc	0.019±0.001 bc	0.022±0.000 a	0.019 a
	Average	0.012 d	0.014 c	0.017 b	0.019 a	
21-28	25	0.015±0.001 g	0.020±0.001 f	0.024±0.000 de	0.027±0.000 cd	0.021 d
	50	0.020±0.000 f	0.023±0.000 e	0.027±0.001 cd	0.030±0.000 bc	0.025 c
	75	0.024±0.001 de	0.026±0.001 d	0.029±0.000 cd	0.032±0.000 ab	0.028 b
	100	0.027±0.000 cd	0.030±0.001 bc	0.032±0.000 ab	0.034±0.000 a	0.031 a
	Average	0.021 d	0.025 c	0.028 b	0.031 a	

The numbers in the rows and columns followed by the same lowercase letter show no significant difference according to the BNJ follow-up test at the 5% level.

Table 1 shows that the average data of net assimilation rate observations at 14-21 and 21-28 hst produced a standard error value of 0.000 to 0.001, indicating that the data in the sample tended to be homogeneous and representative of the population so that the average value was quite accurate. This highlight suggests a positive effect of adding fermented rice washing water and organic NPK.

The application of fermented rice washing water, with a concentration of 100%, combined with 6.75 g of Organic NPK, is a combination that produces the highest net assimilation rate in Caisim mustard plants, as observed in both 14-21 and 21-28 hst. The lowest net assimilation rate is achieved with the combination of fermented rice washing water at a concentration of 25% and without Organic NPK.

The net assimilation rate is the result of assimilation per unit leaf area and time. Leaf area affects the net assimilation rate and the relative growth rate of the plant. The wider the leaves of a plant, the greater the net assimilation.

According to Gardner et al. (1991), the net assimilation rate is the rate of dry weight accumulation per unit leaf area per unit time. The net assimilation rate is a measure of the average efficiency of leaf photosynthesis in a cultivated plant community. According to Buntoro et al. (2014), the net assimilation rate will increase in line with the increase in the leaf area ratio to a specific limit and then decrease because, in the canopy with a high leaf area ratio, young leaves can absorb the lightest, have a high photosynthesis rate, and translocate most of the photosynthate to other parts of the plant including the lower leaves. While the upper leaves shade the lower leaves, their photosynthesis rate is slower.

The results of the study showed that as the age of the mustard greens plant increased, the net assimilation rate value continued to increase. This result indicates that at this phase, the growth of the mustard greens plant is still at its maximum, and the leaves of the plant are in a young condition, allowing the photosynthesis process to continue

effectively.

The results of previous research by Kustiawan et al. (2024) showed that the application of a 75% concentration of rice washing water combined with 4.5 g/plant of Organic NPK affected the net assimilation rate of Caisim mustard plants both in

In the study by Wardiah et al. (2014), the optimal dose for the growth of pakchoy plants was 100% rice-washing water across all parameters. Therefore, it can be concluded that rice washing water has the potential to replace chemical fertilizers in increasing pakchoi growth. In line with the results of this study, the application of fermented rice washing water at a concentration of 100% produced the highest net assimilation rate in mustard greens. This yield is attributed to the provision of fermented rice washing water at that concentration, which has a positive impact on soil conditions, making the soil more fertile. With the addition of Organic NPK, it will increase the availability of N, P, and K elements in the soil.

Increasing the elements N, P, and K in the soil in an available form can be easily absorbed by plant roots, which ultimately supports better plant growth, thereby enhancing the net assimilation rate of plants.

N, P, and K are the main elements that must be available for plants. Because, as a former nucleic acid, protein, bioenzyme, and chlorophyll. Phosphorus is a component of nucleic acids, phospholipids, bioenzymes, proteins, and metabolic compounds, including ATP, which is essential for energy transfer. Potassium is used as a regulator of the balance of cell ions, which are necessary for regulating several metabolic mechanisms, including photosynthesis. For this reason, applying a dose of N, P, and K fertilizers will have a positive effect on plant growth (Firmansyah et al., 2013).

3.2. Relative growth rate / LPR

The results of observations of the relative growth rate of Chinese cabbage plants showed that both the interaction and the main effect of fermented rice washing water and Organic NPK were significant on the relative growth rate of Chinese cabbage. The average results of observations on the relative growth rate, following further testing of BNJ at the 5% level, are presented in Table 2.

Table 2. Average relative growth rate (g/day) of Chinese cabbage plants treated with rice washing water and organic NPK.

HST	Fermented Rice Washing Water (%)	Organic NPK (g)				Average
		0	2.25	4.5	6.75	
14-21	25	0.09±0.006 h	0.13±0.003 fg	0.15±0.003 ef	0.18±0.003 cd	0.14 d
	50	0.12±0.006 g	0.15±0.003 ef	0.17±0.003 de	0.20±0.003 bc	0.16 c
	75	0.14±0.003 fg	0.17±0.003 de	0.18±0.003 de	0.22±0.003 ab	0.18 b
	100	0.17±0.003 de	0.19±0.006 cd	0.22±0.000 ab	0.24±0.003 a	0.20 a
	Average	0.13 d	0.16 c	0.18 b	0.21 a	
21-28	25	0.13±0.000 i	0.17±0.006 h	0.20±0.009 fg	0.23±0.003 def	0.18 d
	50	0.16±0.007 h	0.20±0.003 fg	0.22±0.003 ef	0.26±0.003 cd	0.21 c
	75	0.18±0.006 gh	0.22±0.003 ef	0.26±0.006 cd	0.30±0.006 ab	0.24 b
	100	0.20±0.007 fg	0.24±0.003 de	0.28±0.006 bc	0.33±0.003 a	0.26 a
	Average	0.17 d	0.21 c	0.24 b	0.28 a	

The numbers in the rows and columns followed by the same lowercase letter show no significant difference according to the BNJ follow-up test at the 5% level.

Table 2 shows that the observation data for the relative growth rate of Chinese cabbage plants at 14-21 and 21-28 days after planting are very consistent, with slight variation between samples. This result is supported by the standard error, which ranges from 0.000 to 0.007. The smaller the standard error, the more homogeneous the data produced. This result means that the sample average is very close to the population average. These results indicate that treating fermented rice washing water and organic NPK has a measurable effect on the growth of Chinese cabbage plants.

The relative growth rate of Caisim mustard plants, as observed in 14-21 and 21-28 days after planting, was best produced in fermented rice washing water with a concentration of 100% combined with 6.75 g of Organic NPK per plant. This point is because the provision of rice washing water at this concentration can improve the soil structure, which is more effective than the addition of Organic NPK, increasing the availability of N, P, and K elements in the soil and Thus the metabolic process will increase and the translocation of assimilates to the maximum plant organs which is reflected in the dry weight of the plant.

Relative growth rate describes the capacity of a plant to increase biomass in a specific period at each dry weight produced. According to Rahmah et al. (2014), the increase in biomass of a plant that can describe the relative growth rate of a plant in its growth phases is because the plant absorbs more water and nutrients, nutrients stimulate the development of organs in plants such as roots so that plants can absorb more nutrients and water. Photosynthesis activity will increase, affecting both the increase in wet weight and dry weight.

The combination of fermented rice washing water and Organic NPK is thought to enhance plant growth, affecting the relative growth rate of mustard greens. Increased plant growth is related to the absorption of nutrients, especially

nitrogen, phosphorus, and potassium. Wulandari et al. (2011) Rice washing water is one of the sources of liquid organic fertilizer that can be applied and absorbed by plants. The content of this waste includes carbohydrates, nitrogen, phosphorus, potassium, magnesium, sulfur, iron, and Vitamin B1.

The study's results showed that increased plant growth occurred in proportion to the increase in the concentration of fermented rice washing water administered. The smaller the concentration of rice washing water, the greater the decrease in plant growth, which affected the relative growth rate.

Suwardani & Purb (2019) explained that the provision of liquid organic fertilizer from rice washing water waste with a low dose is insufficient to supply enough macro-nutrients for plant growth, resulting in slow plant growth. This result aligns with the statement by Himayana and Aini (2018) that if the dose of rice washing water given to plants is less than what is needed, then the nutrients supplied will also be limited to certain parts of the plant.

3.3. Number of leaves

Analysis of variance results shows that both the combination and the main effect of fermented rice washing water and organic NPK are significant in terms of the number of leaves. The average results of observations on the number of leaves of Chinese cabbage plants are presented in Table 3.

Table 3. Average number of leaves of Chinese cabbage plants (strands) with fermented rice washing water and organic NPK treatment.

Fermented Rice Washing Water (%)	Organic NPK (g)				Average
	0	2.25	4.5	6.75	
25	5.50 ±0.58 h	6.17 ±0.17 gh	6.67 ±0.17 fgh	7.50 ±0.17 defg	6.46 d
50	6.17 ±0.17 gh	6.67 ±0.17 fgh	7.17 ±0.33 efg	8.50 ±0.29 cde	7.13 c
75	6.83 ±0.17 fgh	7.50 ±0.00 defg	8.00 ±0.29 def	9.67 ±0.17 abc	8.00 b
100	7.00 ±0.29 fgh	8.83 ±0.17 bcd	10.17 ±0.17 ab	10.50 ±0.29 a	9.13 a
Average	6.38 d	7.29 c	8.00 b	9.04 a	

The numbers in the rows and columns followed by the same lowercase letter show no significant difference according to the BNJ follow-up test at the 5% level.

Table 3 shows that the provision of fermented rice washing water and organic NPK together produces a synergistic effect, increasing the number of leaves on the mustard greens plant. Although the standard error varies slightly, ranging from 0.00 to 0.58, it remains relatively small and quite accurate.

The best combination of fermented rice washing water and Organic NPK, namely fermented rice washing water with a concentration of 100% and Organic NPK 6.67 g/plant with an average number of leaves of 10.50 strands, was not significantly different from the combination of 75% rice washing water and 4.5 g organic NPK/plant with an average number of leaves of 10.17 strands and the combination of 100% rice washing water and 6.75 g organic NPK/plant with an average number of 9.67 strands, significantly different from other treatments. The treatment that produced the lowest average number of leaves was 25% rice washing water, without the provision of organic NPK, with an average number of leaves of 5.50 strands.

Water has great potential in increasing plant growth, where the application of rice washing water, in addition to the water needed by the mustard greens plant, also adds nutrients to the plant. The results of the study by Sulfianti et al. (2021) indicate that the highest NPK content in rice washing water was obtained through anaerobic fermentation treatment. In line with the survey by Hairuddin et al. (2018), some of the contents of rice washing water include carbohydrates, nitrogen, phosphorus, potassium, magnesium, sulfur, iron, and Vitamin B1. The results of Bahar's (2016) study show that applying rice washing water can increase the number of leaves on the mustard greens plant. Further research by Dewi et al. (2021) shows that the provision of rice washing water waste can increase the number of leaves on the mustard greens plant.

The increasing number of Caisim mustard leaves produced is also due to the addition of Organic NPK, which can contribute the necessary nutrients N, P, and K needed by plants. The addition of nutrients, especially nitrogen, can trigger the growth of plant leaves. Nitrogen is an essential component in the formation of amino acids, proteins, and protoplasm in plant cells, which plays a crucial role in stimulating plant growth. Plants use the absorbed N nutrients to produce chlorophyll, which can accelerate plant growth. Albari et al. (2018) noted that the element nitrogen plays a crucial role in the formation of proteins, the process of chlorophyll synthesis, and the metabolism that supports plant growth.

3.4. Plant wet weight

Results of the analysis of variance show that both the combination and the main effect of fermented rice washing water and Organic NPK are significant on the wet weight of the Caisim mustard plant. The average results of observations on the wet weight of the Caisim mustard plant, following further testing of BNJ at the 5% level, are presented in Table 4.

Table 4. Average wet weight of plants (g) with fermented rice washing water and organic NPK treatments.

Fermented Rice Washing Water (%)	Organic NPK (g)				Average
	0	2.25	4.5	6.75	
25	109.86±1.85 i	125.12±3.02 h	137.77±4.25 fgh	152.90±1.80 de	131.41 d
50	136.53±2.25 gh	147.37±2.64 efg	158.58±2.35 cde	166.50±2.74 bc	152.25 c
75	150.18±2.63 ef	157.57±1.87 cde	164.65±2.22 bcd	173.59±0.68 ab	161.50 b
100	158.61±1.82 cde	167.15±2.61 bc	177.52±2.87 ab	182.41±2.10 a	171.42 a
Average	138.80 d	149.30 c	159.63 b	168.85 a	

The numbers in the rows and columns followed by the same lowercase letter show no significant difference according to the BNJ follow-up test at the 5% level.

Based on Table 4, the relatively small standard error range (0.68 to 4.25) indicates that the data obtained is quite consistent and the average estimate is reliable. Therefore, the use of Fermented Rice Washing Water with Organic NPK has the potential to increase plant wet-weight production effectively.

The combination of fermented rice washing water with a concentration of 100% and 6.75 g/plant of Organic NPK produced the heaviest wet weight of the mustard greens plant. This result is due to the provision of fermented rice washing water, which can increase soil fertility by enhancing the physical, chemical, and biological properties of the soil.

Rice washing water can increase soil fertility because it contains essential nutrients that plants need. These nutrients can increase the availability of nutrients in the soil and improve soil structure, allowing plants to grow more healthily.

Providing the right fertilizer with a nutrient content tailored to plant needs is believed to maximize growth results. The results of the analysis showed that the higher the concentration of rice washing water used, namely 100%, the better the effect on the growth of mustard greens.

In red spinach plants, a significant increase in growth was also observed after treatment with rice washing water. The effectiveness of fermented rice washing water was 60% in increasing the development of red spinach plants (Wahyuni et al., 2021).

The addition of organic NPK can increase the availability of nitrogen (N), phosphorus (P), and potassium (K) nutrients in the soil, resulting in a positive impact on plant growth. Syifa et al. (2020) stated that N helps in the synthesis of proteins and the formation of inseparable chlorophyll components. With sufficient N, the vegetative phase of growth will be fertile.

The P nutrient plays a crucial role in the process of cell mitosis in plants, which is essential for the development of plant organs. Additionally, the P nutrient is also vital for root development during the early stages of plant growth. Potassium nutrient content can stimulate the growth of plant shoots (Setyorini et al., 2020).

By fulfilling the nutrients, it can support plant growth in a better direction, the photosynthesis process will take place optimally, and the plants will produce more assimilates, which will have an impact on plant growth, especially in the vegetative phase, which will increase the number of leaves so that it affects the wet weight of the plant.

Purnami et al. (2014) state that plants require nutrients in optimal amounts to support plant growth. Providing sufficient nutrients will increase the genetic potential of plants, such as the shape, size, and weight of the organs produced.

The wet weight of the plant is closely related to the number of leaves; the more leaves there are, the greater the wet weight also becomes. Nurdi (2018) stated that the number of leaves can affect the increase in the wet weight of plants because leaves are where the photosynthate results of plants accumulate.

Figure 2. Caisim mustard greens in 25% fermented rice washing water and organic NPK levels

Figure 3. Caisim mustard greens in 50% fermented rice washing water and organic NPK levels

Figure 4. Caisim mustard greens in 75% fermented rice washing water and organic NPK levels

Figure 5. Caisim mustard greens in 100% fermented rice washing water and organic NPK levels

3.5. Dry weight.

The results of observations on the dry weight of mustard green plants showed that the combination of fermented rice washing water and organic NPK was not significant; however, the main effect of fermented rice washing water and organic NPK was substantial on the dry weight of the plants. The average results of dry weight observations following further BNJ testing at the 5% level are presented in Table 5.

The standard error values between 0.27 and 0.41 in Table 5 indicate low to moderate data variation, meaning that the research results are quite reliable and consistent. The smaller the standard error, the more consistent the results between repetitions, meaning that the data is more homogeneous and less varied. This result indicates that the provision of rice washing water significantly affects the dry weight of plants, as well as the provision of Organic NPK, with a standard error value ranging from 0.37 to 0.48.

The main effect of fermented rice washing water at a concentration of 100% resulted in a higher dry weight of Caisim mustard plants compared to other treatment levels. This result suggests that this concentration may increase soil fertility, allowing nutrients to be absorbed by the roots of Caisim mustard plants.

Fermented rice washing water is a liquid organic fertilizer. The addition of organic fertilizer to the soil increases the activity of microorganisms, improves soil structure, and enhances the availability of macro- and micro-nutrients through the mineralization process. Hairuddin et al. (2018) reported that some of the contents of rice washing water include carbohydrates, nitrogen, phosphorus, potassium, magnesium, sulfur, iron, and Vitamin B1.

Table 5. Average dry weight (g) of Caisim mustard plants treated with fermented rice washing water and organic NPK.

Fermented Rice Washing Water (%)	Organic NPK (g)				Average
	0	2.25	4.5	6.75	
25	5.15	6.28	7.30	8.93	6.92±0.41 d
50	7.36	8.23	8.46	9.71	8.44±0.27 c
75	8.28	9.03	10.19	10.99	9.62±0.35 b
100	9.45	10.55	11.37	12.01	10.84±0.32 a
Average	7.56±0.48 d	8.52±0.38 c	9.33±0.49 b	10.41±0.37 a	

The numbers in the rows and columns followed by the same lowercase letter show no significant difference according to the BNJ follow-up test at the 5% level.

The availability of macro- and micro-nutrients will affect plant growth, which will also impact the dry weight of the plant. Research by Ratnadi et al. (2014) indicates that rice-washing wastewater increases the growth and dry weight of watercress plants. Research by Wijiyanti et al. (2019) suggests that rice without incubation has a significant effect on the number of leaves, leaf area, wet weight, and dry weight of green mustard. Furthermore, the study by Kustiawan et al. (2024) indicates that the application of 75% rice washing water combined with Organic NPK affects the dry weight of Caisim mustard.

The dry weight of Chinese cabbage plants is related to vegetative growth, which is influenced by nutrient absorption by the roots, especially N, P, and K nutrients provided through organic NPK fertilizer.

The dry weight of plants is influenced by leaf development and the intensity of sunlight. As demonstrated by Simanullang et al. (2019), wider leaves enable greater absorption of sunlight, thereby facilitating enhanced photosynthesis and, consequently, increased photosynthate production.

As demonstrated in the research by Fadilah et al. (2020), the application of fermented rice washing water at a concentration of 100% for 15 days has been shown to have a positive impact on various aspects of plant growth and development. This result includes enhancements in plant

height, an increase in the number of leaves, an expansion in leaf area, an increase in the fresh weight of plants, and an increase in the dry weight of green mustard plants.

4. Conclusion

The combination of fermented rice washing water and organic NPK significantly influenced the net assimilation rate, relative growth rate, number of leaves, and wet weight. The most effective treatment was the combination of 100% fermented rice washing water and 6.75 g of organic NPK per plant. The main effect of rice washing water was significant across all observed parameters, with the most effective treatment being 100% fermented rice washing water. The effect of organic NPK was significant on all observed parameters. The most effective treatment was the application of an organic NPK dose of 6.75 grams per plant.

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