

ORIGINAL ARTICLE

THE EFFECT OF JAKABA FERTILIZER ON THE GROWTH OF SPINACH PLANTS (*Amaranthus viridis*)

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Abstract Green spinach is a vegetable with vitamin, protein, fat, carbohydrates, potassium, and important minerals such as calcium, phosphorus, and iron. Jakaba is one of the organic fertilizers. Jakaba fertilizer made from the fermentation of the first rice washing water, is a promising alternative to inorganic fertilizer. Rice washing water contains nutrients such as N, P₂O₅, K₂O, and C-organic which play a role in plant growth. This study aims to determine the effect of Jakaba fertilizer on the growth of spinach (*Amaranthus viridis*). The method used in this study is the experimental method. By using a non-factorial Completely Randomized Design (CRD) consisting of 5 treatments, with 4 replications. The results of the study showed that Jakaba fertilizer has a major impact on the growth of spinach because it contains macronutrients as well as other micronutrients. The best spinach plant growth was shown in P3, which is 60 ml Jakaba/500 ml water.

Keywords: Fertilizer • Growth • Jakaba • Spinach



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Introduction

Green spinach is a popular vegetable that contains vitamins A, B, C, protein, fat, carbohydrates, potassium, amaranthine, and important minerals such as calcium, phosphorus, and iron. The high iron content in spinach makes it useful for people with anemia (Nurmas, 2011). Green spinach contains 39.9 g protein, 358 mg calcium, 2.4 mg iron, 0.8 mg zinc, 18 mg vitamin A, 62 mg vitamin C in every 100 g spinach leaves (Zuryanti et al., 2016). The Central Bureau of Statistics (BPS) noted that spinach production in Indonesia was 170,688 tons in 2023. This number decreased compared to 170,821 tons in 2022 and 171,706 tons in 2021. Therefore, efforts need to be made to increase spinach production in order to meet the needs of spinach consumption in Indonesia.

One way to optimize the growth of green spinach so as to increase its productivity is by applying organic fertilizer. Organic fertilizers are not only available in solid form, but also in liquid form. This liquid form has many advantages, one of which is its ability to accelerate the formation of chlorophyll in leaves and root nodules in legumes. This has a positive impact on plant photosynthesis and increases their ability to fix nitrogen from the air (Marpaung, 2018). Liquid organic fertilizer is easily absorbed by the leaves and directly used for photosynthesis. This fertilizer is made from the remains of living organisms, both plants and animals, and is rich in micro and macro nutrients (Winarni, 2013).

Jakaba is one of the organic fertilizers. Jakaba liquid organic fertilizer, made from fermented first rice washing water or leri water, is a promising alternative to inorganic fertilizers. Leri water contains phosphorus which can enhance plant growth. Jakaba fertilizer is rich in carbohydrates (90%), minerals, vitamins, starch



and protein. This high carbohydrate content helps trigger the emergence of plant hormones such as gibberellin, auxin, and alanine (Khoiroh, et al., 2023). Jakaba fertilizer was chosen because it utilizes organic materials such as rice washing water, bamboo roots, bean sprouts, bran, whiting, and sugar in its manufacture, making it environmentally friendly and reducing the use of inorganic fertilizers. Rice washing water contains nutrients such as N, P₂O₅, K₂O, and C-organic which play a role in plant growth (Ariyanti, 2021).

Leri water contains vitamin B1 (*thiamine*) and vitamin B12, and contains P, C, K, N and other nutrients. The results of the analysis of vitamin and nutrient content, leri water contains vitamin B1 and elements of nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur which are important nutrients in increasing plant growth (Wulandari et al., 2012). The benefits of leri water for plants are very diverse, including increasing fruit weight, plant height and number of leaves (Sifaunajah et al., 2022). Milawati in her research showed that the potential of rice washing water as a liquid organic fertilizer for celery plant growth (Milawati, 2018).

The potential of rice washing water (leri water) as a good fertilizer is well-known, as it contains *Pseudomonas fluorescens* bacteria, pectolytic pectin, and *Xanthomonas maitophilia*, which can aid in the synthesis of carbohydrates, amino acids, growth hormones, and metabolites that inhibit pathogens (Risman, 2022). However, there are no scientific reports on its use for spinach plants. Therefore, this study aims to investigate the effect of Jakaba fertilizer on the growth of spinach (*Amaranthus viridis*).

Materials and Methods

The research was conducted in the Wire House, Department of Biology, Faculty of Mathematics and Natural Sciences, Padang State University. In May-June 2024.

The materials used were spinach seeds (*Amaranthus viridis*), Jakaba fertilizer, garden soil, and water. While the tools used are stationery, polybags, shovels, scales, measuring cups, glass beakers, filter paper, oven, ruler, calipers, and camera.

Research Design

The method used in this research is the experimental method. The study used a non-factorial Completely Randomized Design (CRD) consisting of 5 treatments with 4 replicates, namely:

- P0: control
- P1: 20 ml jakaba / 500 ml water
- P2: 40 ml jakaba / 500 ml water
- P3: 60 ml jakaba/500 ml water
- P4: 80 ml jakaba/500 ml water

Preparation of Jakaba Fertilizer

The tools and materials required were first prepared. Rice washing water was poured into two separate containers, followed by the alternating addition of rice bran to both containers. A few grains of uncooked rice were also added to each container. The containers were then covered with a piece of cloth and secured with rubber bands to allow for aerobic fermentation. The fermentation process was allowed to continue for approximately 14–30 days, after which the Jakaba (Jadam Indigenous Microorganism) fungi were visibly grown and ready to be harvested.

Application of Jakaba Fertilizer Treatment

All necessary tools and materials were prepared. Two kilograms of soil were placed into each polybag, and one spinach (*Amaranthus*) seed was planted per polybag. Plants were watered once daily. Jakaba fertilizer was applied at three different time intervals: 7, 14, and 21 days after planting. The volume of Jakaba fertilizer administered was 100 mL per treatment unit at each application time.

Observation

In this study, observations were conducted to evaluate the effect of Jakaba fertilizer on the growth of spinach (*Amaranthus*) plants. The growth parameters observed included the number of leaves, plant height, stem diameter, fresh weight, and dry weight of the plants (Rahmawati et al., 2023).



Results and Discussion

This study was conducted to see the effect of Jakaba fertilizer on the growth of spinach plants (*Amaranthus viridis*) by measuring various parameters such as plant height, number of

leaves, stem diameter, wet weight, and dry weight. The application of jakaba fertilizer was carried out when the spinach was 7, 14, 21 Days After Planting with a dose of 100 ml for each treatment.

Table 1. Average Results of the Effect of Jakaba Fertilizer on Plant Height, Number of Leaves, and Stem Diameter of Spinach Plants (*Amaranthus viridis*)

Treatment	Average Parameters		
	Plant Height (cm)	Stem Diameter (mm)	Number of Leaves
P0	7,2	0,015	4,5
P1	8,5	0,022	5
P2	9,02	0,058	5,75
P3	9,9	0,060	6
P4	8,9	0,070	6

Based on Table 1, it can be seen the effect of applying Jakaba fertilizer with different concentrations on the growth of spinach plants (*Amaranthus viridis*). The data presented shows the average plant height, number of leaves, and stem diameter in each treatment. In the control treatment (without Jakaba fertilizer), the average plant height was 7.2 cm, the number of leaves was 4.5, and the stem diameter was 0.015 mm. After being treated with increasing concentrations of Jakaba fertilizer, there was an increase in the three parameters observed. The P3 treatment (60 ml jakaba/500 ml water) showed the best results, with an average plant height of 9.9 cm, number of leaves 6, and stem diameter 0.060 mm. This indicates that the optimal concentration of jakaba fertilizer for spinach plant growth in this experiment is 60 ml/500 ml of water. However, in treatment P4 with a higher concentration of jakaba fertilizer (80 ml/500 ml water), there was a decrease in the average plant height to 8.9 cm, although the number of leaves remained at 6 and the stem diameter increased to 0.070 mm. This indicates that too high a concentration of jakaba fertilizer can inhibit the growth of plant height, although it still supports the growth of the number of leaves and stem diameter.

Plant growth can be influenced by several factors, namely genetic factors, and

environmental factors, one of these environmental factors is the fulfillment of nutrients, if nutrients are fulfilled in sufficient and balanced amounts, plants will grow well (Apriyanto et al., 2023). The increase in the number of leaf blades in plants is thought to be influenced by the need for high enough nutrients from fertilizers for plants to affect the photosynthesis process of plants. The rich nutrient content in jakaba fertilizer, such as nitrogen (N), phosphorus (P), potassium (K), and beneficial microorganisms, work together to encourage optimal plant growth. The nutrient element needed by plants in the photosynthesis process is the element N. This is in accordance with the opinion of Zulkifli et al. (2022), the results of photosynthesis formed in plants are used as food reserves and energy sources to encourage the process of cell division cell differentiation which is closely related to the increase in plant organs including the number of leaves.

Providing fertilizer with a dose that is in accordance with the needs of plants will increase growth and provide better growth, and regular and routine fertilizer application will also support plant growth (Chairani et al., 2017). Giving liquid organic fertilizer with a very high concentration will slow plant growth and vice versa if the

concentration given is very low, plant growth is inhibited or both do not increase plant growth in both the vegetative and generative phases (Ralahalu et al., 2013). The increase in plant height and number of leaves is due to the influence of jakaba content. Jakaba fertilizer

comes from rice washing water (leri water) which contains phosphorus, vitamin B1 (thiamine), and vitamin B12, and contains nutrients such as N, P, K, and C.

Table 2. Average Results of the Effect of Jakaba Fertilizer on the Wet Weight and Dry Weight of Spinach Plants (*Amaranthus viridis*)

Treatment	Average Parameters	
	Wet Weight (gram)	Dry Weight (gram)
P0	0,53	0,2
P1	1,01	0,13
P2	1,61	0,13
P3	1,80	0,11
P4	1,39	0,06

Table 2 shows the effect of applying jakaba fertilizer with different concentrations on the wet weight and dry weight of spinach (*Amaranthus viridis*) plants. In wet weight compared to the control treatment (without jakaba fertilizer), all treatments with jakaba fertilizer showed an increase in plant wet weight. The P3 treatment (60 ml jakaba/500 ml water) produced the highest wet weight, which was 1.80 grams. For dry weight parameter, the dry weight of P1 (20 ml jakaba/500 ml water) and P2 (40 ml jakaba/500 ml water) treatments were lower than the control. Meanwhile, treatment P3 (60 ml jakaba/500 ml water) produced even lower dry weight compared to P1 and P2. A significant decrease in dry weight occurred in treatment P4 (80 ml jakaba/500 ml water), which was only 0.06 gram. Applying jakaba fertilizer at the right concentration (in this case P3) can increase the wet weight of spinach plants, which indicates an increase in plant growth and development. However, increasing the concentration of jakaba fertilizer decreased the dry weight of the plants, which could be caused by the accumulation of excess water in the plant tissues or other side effects of the active ingredients in jakaba fertilizer. Overall, the data showed that the optimal concentration of jakaba fertilizer for spinach plant growth was 60 ml

jakaba/500 ml water (P3), which produced the highest wet weight and good dry weight.

Plants that grow and develop optimally will have maximum yields in quantity and quality. The use of jakaba fertilizer treatment has a good effect on plant production. The content in jakaba fertilizer such as the hormones gibberellin, auxin, and alanine can provide a positive response to the fresh weight of plants (Apriyanto et al., 2023). Gibberalin is a hormone that can stimulate leaf growth because gibberellin can accelerate the process of cell division and growth, thus causing plant growth to increase. The dry weight of a plant is the result of the increase in protoplasm due to the increase in cell size and number. Dry weight accumulated in plants indicates that the plant has a high growth rate. This is because plant dry weight is the result of photosynthetic assimilation which is transferred to the roots and all parts of the plant (Rahmawati et al., 2023).

The positive effect of jakaba fertilizer on plant growth directly affects the increase in yield. Plants treated with jakaba fertilizer generally show an increase in plant height, number of leaves, and plant weight, which in turn results in a more abundant harvest. Microorganisms in jakaba fertilizer play a role in suppressing the

growth of pests and plant diseases. Jakaba fertilizer can help plants build natural resistance to pests and diseases, thereby reducing the need for chemical pesticides and preserving the environment. Jakaba fertilizer is easy to apply to

Conclusion

The conclusion from the results of the study shows that jakaba fertilizer has a major impact on the growth of spinach plants (*Amaranthus viridis*) because it contains macro nutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K), as well as other micro nutrients. The raw materials used include rice washing water, rice bran, and rice flour. The best growth of spinach plants was shown in P3, which is 60 ml Jakaba/500 ml water.

Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

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