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# Response of Red Fountain Grass (*Pennisetum setaceum* var. rubrum) to the Frequency of Ecoenzyme Application and Dosage of Chicken Manure Fertilizer

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***Abstract*— *Red fountain grass is an ornamental plant commonly used in residential areas and city parks. As the number of residential areas and city parks increases, so does the demand for this plant. However, the increase in market demand is not in line with the availability of the plant. This imbalance is caused by various factors, one of which is fertilization. Continuous use of inorganic fertilizers will cause a decline in soil quality. Reducing the use of inorganic fertilizers can be balanced by using organic fertilizers combined with ecoenzyme application to ensure adequate nutrient supply. The experimental design used was a Randomized Block Design arranged in a factorial layout. The first factor was ecoenzyme application frequency (no ecoenzyme, once a week, and once every two weeks). The second factor was the dose of chicken manure fertilizer (0 tons ha$^{-1}$, 10 tons ha$^{-1}$, and 20 tons ha$^{-1}$). The results showed that the frequency of ecoenzyme application interacted with the dose of chicken manure fertilizer on the variables of plant height, number of leaves, leaf area, number of shoots, root volume, fresh plant weight, dry plant weight, and number of flowers. The optimal dosage of chicken manure fertilizer for promoting the growth and flowering of red fountain grass is 8.56 tons ha-1 and 9.28 tons ha-1 when applied with ecoenzyme. The appropriate application frequency of ecoenzyme is once every two weeks to enhance the growth and flowering of red fountain grass.*

***Keywords*— *Red Fountain Grass, landscape, Chicken Manure, Ecoenzyme***

## I. INTRODUCTION

Red fountain grass (*Pennisetum setaceum* var. rubrum) is an ornamental grass plant whose aesthetic value stems from the uniqueness of its flower shape and leaf color, making it popular and widely sought after as a landscape plant in residential areas and city parks for use as a border, guide, and roadside decoration. The increasing growth in population and high rates of urbanization have led to an increase in the development of residential areas and urban parks. According to data from the Central Statistics Agency (BPS, 2021), Indonesia's population increased to 270.2 million in 2020, while the percentage of the population living in urban areas is estimated to rise to 66.60% by 2035. This trend indicates that the demand for residential areas and urban parks as green open spaces in Indonesia will continue to grow. The increase in the development of residential areas and urban parks has led to an increase in the demand for red fountain grass as a landscaping plant. However, there is a problem where the increase in market demand for red fountain grass is not in line with the availability of production of this plant. This problem is caused by various factors, including cultivation techniques that are still not appropriate, especially in terms of fertilization.

Fertilization of red fountain grass plants generally uses inorganic fertilizers. However, the continuous use of inorganic fertilizers will certainly result in a decline in soil quality. The use of inorganic fertilizers can increase soil acidity, and if used continuously, this can lead to increased soil acidity, which can disrupt the balance of soil microorganism activity and reduce the availability of nutrients for plants (Liu *et al*., 2023). Given the adverse effects of inorganic fertilizer use, efforts should be made to reduce its use by combining organic fertilizer with ecoenzyme application to ensure adequate nutrient supply for plants.

Organic fertilizers have been proven to be beneficial for improving soil quality in a sustainable manner. One type of organic fertilizer that is commonly used is manure. Manure fertilizer is derived from the waste of livestock and poultry, such as cows, buffaloes, goats, and chickens. Among various sources of manure fertilizer, chicken manure is known to contain higher levels of nitrogen (N), phosphorus (P), and potassium (K) compared to other types of manure fertilizer (Fitrah, 2022). Additionally, the organic matter content in chicken manure has a higher percentage of organic matter compared to some other types of manure. Furthermore, the C/N ratio of chicken manure falls into the low category, indicating that chicken manure decomposes more quickly (Romadhon *et al*., 2024). Based on research conducted by Simon (2023), the application of chicken manure has a significant effect on the growth and yield of corn plants. The variables observed that have a significant effect are plant height, number of leaves, and fresh weight of corn without cobs.

The performance of manure in improving soil quality can be optimized through the use of ecoenzymes. Ecoenzymes are solutions produced through the fermentation of complex organic compounds derived from organic waste, which have high utility value in various fields such as agriculture, health, livestock, and household applications (Hidayat *et al*., 2022). In the agricultural sector, ecoenzymes are used as biocatalysts and botanical pesticides (Hasanah, 2021). The application of ecoenzyme is closely related to microbial activity. Ecoenzyme contains various microorganisms such as bacteria and fungi that play a role in the ecoenzyme fermentation process, particularly in producing various enzymes such as protease, amylase, lipase, and cellulase (Gu *et al*., 2021). These enzymes have roles, one of which is related to the decomposition of organic matter by soil microorganisms. The organic matter present in the growing medium serves as a nutrient source for soil microorganisms, and this process is catalyzed by the enzymes present in ecoenzymes (Kaneko *et al*., 2002).

Enzyme activity in ecoenzymes can decrease over time, especially if the decomposition process is ongoing. Therefore, in order for enzyme performance to remain stable under continuous conditions, it is necessary to apply ecoenzymes periodically. Based on research by Nisa and Sitawati (2024), applying ecoenzyme once a week to potted chrysanthemum plants can produce optimal growth and flowering results. However, applying ecoenzyme once a week can trigger a possible imbalance in the nutrients released (Paillat *et al*., 2020). Therefore, to prevent such risks, ecoenzyme application was adjusted to an appropriate frequency, specifically every two weeks in this study. Differences in application frequency result in varying doses received by the plants. The more frequent the application, the higher the ecoenzyme dose received by the plants. By applying chicken manure fertilizer at various doses and ecoenzyme at the appropriate frequency, it is hoped that this will enhance the growth and flowering of red fountain grass. This study aims to provide recommendations for the optimal dose of chicken manure fertilizer and the appropriate frequency of ecoenzyme application to improve growth and flowering in red fountain grass.

## II. MATERIALS AND METHODS

### 2.1 Research Site

The experiment was conducted from October 2024 to January 2025 at the Jatimulyo Experimental Garden located in Jatimulyo Village, Lowokwaru District, Malang City, East Java. The research site is situated at an elevation of 440 meters above sea level, with an average air temperature ranging from 22.7–25.1°C and relative humidity ranging from 79%–86% (Pemerintah Kota Malang, 2022).

### 2.2 Experimental Design and Treatments

The experimental design used in this study was a factorial experiment consisting of two factors using a Randomized Block Design (RBD). The first factor is the frequency of ecoenzyme application (no ecoenzyme, ecoenzyme once a week, ecoenzyme once every two weeks), and the second factor is the dose of chicken manure fertilizer (0 tons $ha^{-1}$, 10 tons $ha^{-1}$, and 20 tons $ha^{-1}$). The resulting treatment combinations were 9 combinations, and each treatment combination was replicated 3 times, resulting in a total of 27 treatment combinations. Each treatment unit contained 10 plants, so the total number of plants required in this experiment was 270 plants. The observations conducted included growth measurements such as plant height, number of leaves, leaf area, number of tillers, root volume, fresh weight, and dry weight. Flowering observations included flowering time, flower stalk length, flower spike length, and number of flowers.

### 2.3 Data Collection and Analysis

Data analysis was performed using ANOVA at the 5% level. If the test results show a real efferc then at the Least Significant Difference test is continued at the 5%.

## III. RESULT AND DISCUSSION

The application of ecoenzyme frequency and chicken manure fertilizer had an effect on the growth and flowering of red fountain grass plants. Based on the analysis of variance, it was found that there was an interaction between the application of ecoenzyme frequency and chicken manure fertilizer on plant length, number of leaves, leaf area, number of tillers, root volume, fresh plant weight, dry plant weight, and number of flowers.

### 3.1 Plant Length (cm)

The analysis of variance conducted on plant length showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between plant length due to the application frequency of ecoenzyme and chicken manure can be seen in Table 1.

Application of ecoenzyme once a week with a chicken manure fertilizer dose of 10 tons $ha^{-1}$ could increase plant length by up to 35.54% compared to the control treatment, which was plants without ecoenzyme application and without chicken manure fertilizer. Chicken manure fertilizer at a dose of 10 tons $ha^{-1}$ can provide balanced macro and micro nutrients for vegetative plant growth. According to Rengga *et al.* (2022), chicken manure fertilizer contains nitrogen, phosphorus, potassium, magnesium, and manganese required by plants. During the vegetative phase, plants require nitrogen nutrients to stimulate growth, particularly of stems, branches, and leaves (Pramitasari *et al*., 2016).

The nitrogen content in chicken manure cannot be directly absorbed by plants because it is still in the form of organic nitrogen in the form of protein (Makenova *et al*., 2024). Nitrogen can be absorbed by plants if it is in the form of inorganic nitrogen in the form of nitrate. Ecoenzyme contains protease enzymes that play a crucial role in accelerating nitrogen mineralization. Protease enzymes break down proteins in manure to produce amino acids and urea (Rukmi *et al*., 2019). Then, amino acids and urea are converted into nitrate through the nitrification process, which is ready to be absorbed by plants for vegetative growth.

### 3.2 Number of Leaves (leaves $clump^{-1}$) and Leaf Area ($cm^2$ $clump^{-1}$)

Analysis of variance conducted on the number of leaves and leaf area showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between the number of leaves and leaf area due to the application frequency of ecoenzyme and chicken manure fertilizer can be seen in Table 2 and Table 3.

Application of ecoenzyme once a week with a chicken manure fertilizer dose of 10 tons $ha^{-1}$ can increase the number of leaves by up to 42.59% and leaf area by up to 92.56% compared to the control treatment. The nitrogen content in chicken manure is one of the essential macronutrients that plays a role in leaf growth. Nitrogen is involved in the photosynthesis process as a component of chlorophyll (Pérez-Molina *et al*., 2020). An increase in chlorophyll content enhances photosynthesis rates, thereby increasing photosynthates for vegetative plant growth (Fathi, 2022). Meanwhile, ecoenzymes accelerate nitrogen mineralization, enabling its absorption by plants through the assistance of protease enzymes and microorganisms (Fadlilla *et al.,* 2023). If nitrogen mineralization can occur optimally and quickly, it can cause nitrate availability to increase, making nutrients easier to absorb and enhancing the formation of vegetative organs such as plant leaves.

In this experiment, the number of leaves had a positive correlation with leaf area. The positive correlation created between these two variables is that the greater the number of leaves, the greater the total leaf area. The leaf area variable is related to the capacity to absorb sunlight for photosynthesis (Mathur *et al*., 2018). The larger the leaf area, the more light is absorbed, resulting in higher photosynthetic activity (Setyanti *et al*., 2013).

### 3.3 Number of Tillers (tiller $clump^{-1}$)

Analysis of variance conducted on the number of tillers showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between the number of tillers due to the application frequency of ecoenzyme and chicken manure fertilizer can be seen in Table 4.

The number of tillers is a variable related to the plant's ability to reproduce. Based on the results of the analysis of variance, it is known that the application of ecoenzyme once a week with a dose of chicken manure fertilizer of 10 tons $ha^{-1}$ can increase the number of offspring by up to 49.44% compared to the control treatment. The interaction between the application of ecoenzyme once a week with a chicken manure dose of 10 tons $ha^{-1}$ can increase the number of seedlings due to sufficient nutrients and the role of ecoenzyme in enhancing the decomposition process of organic matter.

*Table 1. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Plant Length of Red Fountain Grass Plants*

| **Ecoenzyme Application Frequency** | **Plant Length (cm)** | | |
|---|---|---|---|
| | **Chicken Manure Fertilizer Dosage (ton ha$^{-1}$)** | | |
| | **0** | **10** | **20** |
| **Without Ecoenzyme** | 51,57 a | 55,53 ab | 65,47 ab |
| **Once a week** | 62,47 ab | 69,90 b | 56,33 ab |
| **Once of two week** | 64,13 ab | 67,33 ab | 54,53 ab |
| HSD 5%: 17,93 | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.

*Table 2. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Number of Leaves of Red Fountain Grass Plants*

| **Ecoenzyme Application Frequency** | **Number of Leaves (leaves clump$^{-1}$)** | | |
|---|---|---|---|
| | **Chicken Manure Fertilizer Dosage (ton ha$^{-1}$)** | | |
| | **0** | **10** | **20** |
| **Without Ecoenzyme** | 114,77 a | 126,67 a | 148,23 ab |
| **Once a week** | 136,47 ab | 176,43 b | 129,53 a |
| **Once of two week** | 140,90 ab | 159,23 ab | 122,90 a |
| HSD 5%: 46,37 | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.

*Table 3. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Leaf Area of Red Fountain Grass Plants*

| **Ecoenzyme Application Frequency** | **Leaf Area (cm$^2$ clump$^{-1}$)** | | |
|---|---|---|---|
| | **Chicken Manure Fertilizer Dosage (ton ha$^{-1}$)** | | |
| | 0 | 10 | 20 |
| **Without Ecoenzyme** | 1926,41 a | 2418,10 ab | 2944,08 bcd |
| **Once a week** | 2669,07 abc | 3709,50 d | 2589,39 ab |
| **Once of two week** | 2791,93 abcd | 3613,11 cd | 2319,59 ab |
| HSD 5%: 988,29 | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.

*Table 4. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Number of Tillers of Red Fountain Grass Plants*

| **Ecoenzyme Application Frequency** | **Number of Tillers (tiller clump$^{-1}$)** | | |
|---|---|---|---|
| | **Chicken Manure Fertilizer Dosage (ton ha$^{-1}$)** | | |
| | **0** | **10** | **20** |
| **Without Ecoenzyme** | **22,53 a** | **26,57 ab** | **31,33 ab** |
| **Once a week** | **28,67 ab** | **33,67 b** | **27,00 ab** |
| **Once of two week** | **29,77 ab** | **32,23 ab** | **26,10 ab** |
| **HSD 5%: 9,88** | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.

Chicken manure fertilizer contains nitrogen and phosphorus nutrients that are related to plant growth. Nitrogen is needed in vegetative growth for the formation of leaves, roots, stems, and shoots. Nitrogen plays a role in the formation of chlorophyll for leaf photosynthesis. According to Zhang *et al*. (2022), the greater the number of leaves, the greater the effect on the photosynthates produced by the plant. These photosynthates are processed to form plant organs during the vegetative phase. The vegetative phase of a plant begins with the formation of roots and leaves, followed by the formation of shoots (Suaria *et al*., 2017). Meanwhile, phosphorus can stimulate root development and promote tiller growth. This is because phosphorus is a core component of cells that plays a crucial role in cell division within meristematic tissue. Healthy root growth enhances nutrient absorption (Awliya *et al.,* 2022). In plants of the Poaceae family, new tillers emerge from axillary buds at the base of the stem (George and Rice., 2020). Phosphorus accelerates meristem activity in the axillary bud area, resulting in more buds developing into tillers (Zhua and Wagner., 2020). Phosphorus in manure fertilizer is still in the form of organic phosphorus, which is not yet available to plants. Organic phosphorus must be broken down by microorganisms into phosphate to become available to plants (García-Berumen *et al*., 2025). Ecoenzymes can accelerate the breakdown process with the help of organic acids that bind aluminum and iron ions (Drábek *et al*., 2015).

### 3.4 Root Volume ($cm^3$)

Analysis of variance conducted on the root volume showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between the root volume due to the application frequency of ecoenzyme and chicken manure fertilizer can be seen in Table 5.

Roots are part of the vegetative organs that absorb available nutrients for plants. Based on the results of the analysis of variance, it is known that the application of ecoenzyme once a week with a dose of chicken manure fertilizer of 10 tons $ha^{-1}$ can increase root volume by up to 100.01% compared to the control treatment. The interaction between the application of ecoenzyme once a week with a dose of 10 tons $ha^{-1}$ of chicken manure per hectare can increase root volume because chicken manure provides nutrients while ecoenzyme helps nutrient absorption and stimulates root development.

Chicken manure contains macro and micro nutrients needed for root growth. Nitrogen is an essential macro nutrient that plays a crucial role in root growth. Nitrogen contains amino acids, proteins, and enzymes necessary for DNA and RNA synthesis. Nitrogen forms amino acids such as glutamine and asparagine, which constitute structural proteins and DNA polymerase enzymes required for cell elongation in root cells (Ohayam, 2010). Additionally, nitrogen supports the growth of secondary roots. Secondary roots are branches of the primary root that function to expand the root system (Suryo and Rixa, 2016). Nitrogen influences secondary root growth through auxin hormone synthesis. Nitrogen is required to produce tryptophan, which serves as an auxin precursor. Auxin stimulates the initiation of lateral roots and the branching of secondary roots (Aprinda *et al.,* 2022). Furthermore, phosphorus plays a crucial role in the development of early roots and the formation of root hairs (Ruiz *et al.,* 2020). Thus, balanced nutrient availability, such as at a dose of 10 tons $ha^{-1}$, can support root cell elongation, lateral root branching, and root hair formation, thereby increasing root volume.

Ecoenzymes can influence root growth by increasing nutrient availability. Enzymes in ecoenzyme help accelerate the breakdown of nutrients in manure, such as nitrogen and phosphorus, for root development. Additionally, regular application of ecoenzyme can influence soil microbial communities and increase the production of root-stimulating phytohormones such as auxin (Timofeeva *et al.,* 2024). Organic compounds in ecoenzyme can serve as a carbon and energy source for microbes. Microbes cannot synthesize their own food and thus depend on organic compounds for their energy source (Song *et al*., 2024). Some microbial groups that are activated by ecoenzyme application produce phytohormones that stimulate root development. Microbes such as Azospirillum, Pseudomonas, and Bacillus produce auxin from the precursor tryptophan (Rahayu *et al.,* 2024). The auxin produced can trigger root cell elongation and lateral root initiation. The formation of lateral roots directly increases root volume by enhancing root surface area and root system biomass (Wang *et al.,* 2023).

### 3.5 Fresh Weight of Plants

Analysis of variance conducted on the fresh weight of plants showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between the fresh weight of plants due to the application frequency of ecoenzyme and chicken manure fertilizer can be seen in Table 6.

Fresh weight of plants reflects the nutrient composition and plant tissue, including water. Fresh weight is influenced by the water content in plant tissue because most of the fresh weight of plants is water (Reski *et al*., 2021). The combination of applying ecoenzyme once a week and chicken manure fertilizer at a dose of 10 tons ha-1 synergistically increases plant fresh weight. Chicken manure fertilizer, as a nutrient source, contains nitrogen that supports chlorophyll synthesis. According to Filstrup and Dowing (2017), nitrogen is a key component of chlorophyll structure. Nitrogen is required as a basic component and builder of chlorophyll in the photosynthesis process. Sufficient chlorophyll can enhance photosynthetic efficiency in converting light energy into chemical energy to produce glucose. Optimal glucose production maintains balance between source and sink organs, so the more effective glucose distribution to sink organs, the greater biomass accumulation (Osorio *et al.,* 2014). Additionally, nitrogen can influence water absorption by increasing the synthesis of aquaporin transporter proteins in root cell membranes (Sun *et al.,* 2024). Aquaporins are integral membrane proteins that form selective water channels in the plasma membrane and vacuoles of root cells (Adeoye *et al.,* 2022). Aquaporin channels facilitate the passive flow of water from the roots to other plant organs without requiring energy, based on the principle of osmosis (Kudiyarova *et al.,* 2022). The role of ecoenzymes in this treatment combination is that regular application can accelerate the decomposition of chicken manure fertilizer, thereby releasing nutrients more quickly.

*Table 5. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Root Volume of Red Fountain Grass Plants*

| **Ecoenzyme Application Frequency** | **Root Volume (cm$^3$)** | | |
|---|---|---|---|
| | **Chicken Manure Fertilizer Dosage (ton ha$^{-1}$)** | | |
| | **0** | **10** | **20** |
| **Without Ecoenzyme** | 63,33 a | 76,63 abc | 97,80 bcd |
| **Once a week** | 88,37 abc | 126,67 d | 84,43 abc |
| **Once of two week** | 90,00 abc | 105,57 cd | 71,67 ab |
| **HSD 5%: 31,88** | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.

*Table 6. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Fresh Weight of Plants of Red Fountain Grass Plants*

| **Ecoenzyme Application Frequency** | **Fresh Weight of Plants (g clump$^{-1}$)** | | |
|---|---|---|---|
| | **Chicken Manure Fertilizer Dosage (ton ha$^{-1}$)** | | |
| | **0** | **10** | **20** |
| **Without Ecoenzyme** | **142,77 a** | **171,23 ab** | **230,27 abc** |
| **Once a week** | **207,80 abc** | **275,03 c** | **188,47 abc** |
| **Once of two week** | **221,40 abc** | **259,80 bc** | **164,03 a** |
| **HSD 5%: 89,65** | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.

### 3.6 Dry Weight of Plants

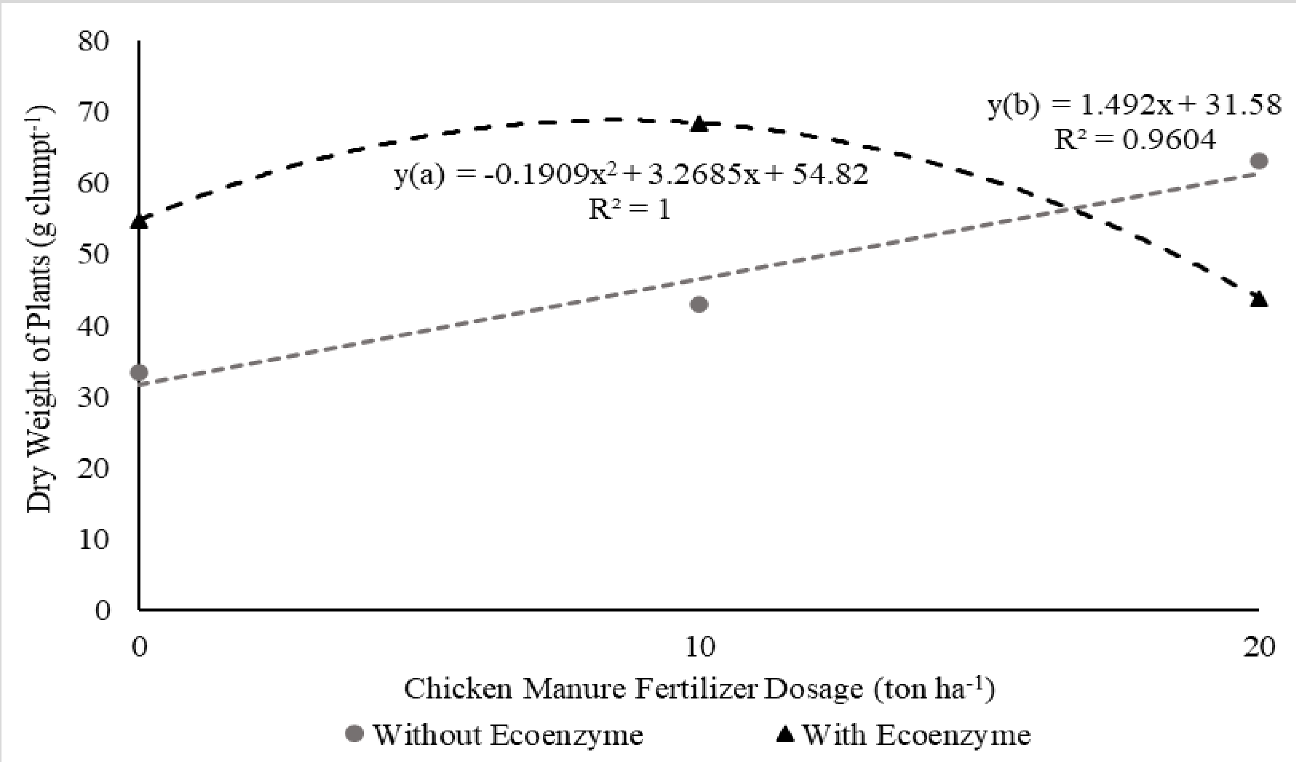
Analysis of variance conducted on the dry weight of plants showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between the dry of plants due to the application frequency of ecoenzyme and chicken manure fertilizer can be seen in Table 7.

Dry weight of plants is a growth indicator related to the results of plant assimilate accumulation obtained from the total growth and development of the plant during its life. The greater the dry weight of the plant, the better the growth and development of a plant (Kartika *et al.,* 2023). The effect of chicken manure doses on plant dry weight at each ecoenzyme frequency is presented in Figure 1.

*Table 7. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Dry Weight of Plants of Red Fountain Grass Plants*

| Ecoenzyme Application Frequency | Dry Weight of Plants (g clump$^{-1}$) | | |
|---|---|---|---|
| | Chicken Manure Fertilizer Dosage (ton ha$^{-1}$) | | |
| | 0 | 10 | 20 |
| Without Ecoenzyme | 33,33 a | 43,00 abc | 63,17 bcd |
| Once a week | 53,17 abcd | 70,37 d | 48,20 abcd |
| Once of two week | 56,47 abcd | 66,47 cd | 39,50 ab |
| HSD 5%: 24,37 | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.




**Note:** (a): Application of ecoenzyme; (b): Without application of ecoenzyme

*Fig 1. Effect of Manure Dose on Plant Dry Weight at Each Frequency of Ecoenzyme Application*

Based on Figure 1, application of ecoenzyme, every additional 1 point of chicken manure dose causes the dry weight of the plant to increase by approximately 57.89 g clump$^{-1}$ (y (a) = -0.1909x2 + 3.2685x + 54.82 with R2 = 1). However, when the dose of chicken manure increases to 20 tons ha$^{-1}$, the dry weight of the plant begins to decrease. The treatment of 10 tons ha$^{-1}$ chicken manure produces better dry weight and then decreases when the dose of manure increases to 20 tons ha$^{-1}$. In the treatment of ecoenzyme application, the dry weight of the plant has the highest weight with an R2 value of 1 so that the optimum dose of chicken manure is sought using the equation y (a) = 0.1909x2 + 3.2685x + 54.82 and the results of the optimum dose of chicken manure for dry weight are 8.56 tons ha$^{-1}$.

The dose of chicken manure of 8.56 tons ha$^{-1}$ is the optimum fertilizer dose for the dry weight of red fountain grass plants. At this dose, the addition of nutrients reaches the highest efficiency without excess nutrients. Through the assistance of ecoenzyme once a week, the mineralization of nutrients in chicken manure becomes faster so that nutrients are more quickly available to plants. At a dose of 20 tons $ha^{-1}$ of manure, the dry weight of the plant is lower. This can happen because the higher the dose of chicken manure, the higher the nitrogen content. At excessive doses, ammonia accumulation can poison the roots and interfere with the absorption of water and nutrients (Pan *et al.*, 2016). In addition, excess nitrogen can also inhibit the absorption of potassium and phosphorus. The inhibition of absorption of these two elements is due to competition for ion absorption. Ammonium competes directly with $K^+$ because both of these ions are positively charged and use the same ion transporter in the root membrane (Hoopen *et al.*, 2010). Then excess ammonium causes a decrease in the pH of the rhizosphere so that the P element precipitates as an insoluble compound (Grandgirard *et al.*, 2002).

### 3.7 Number of Flower

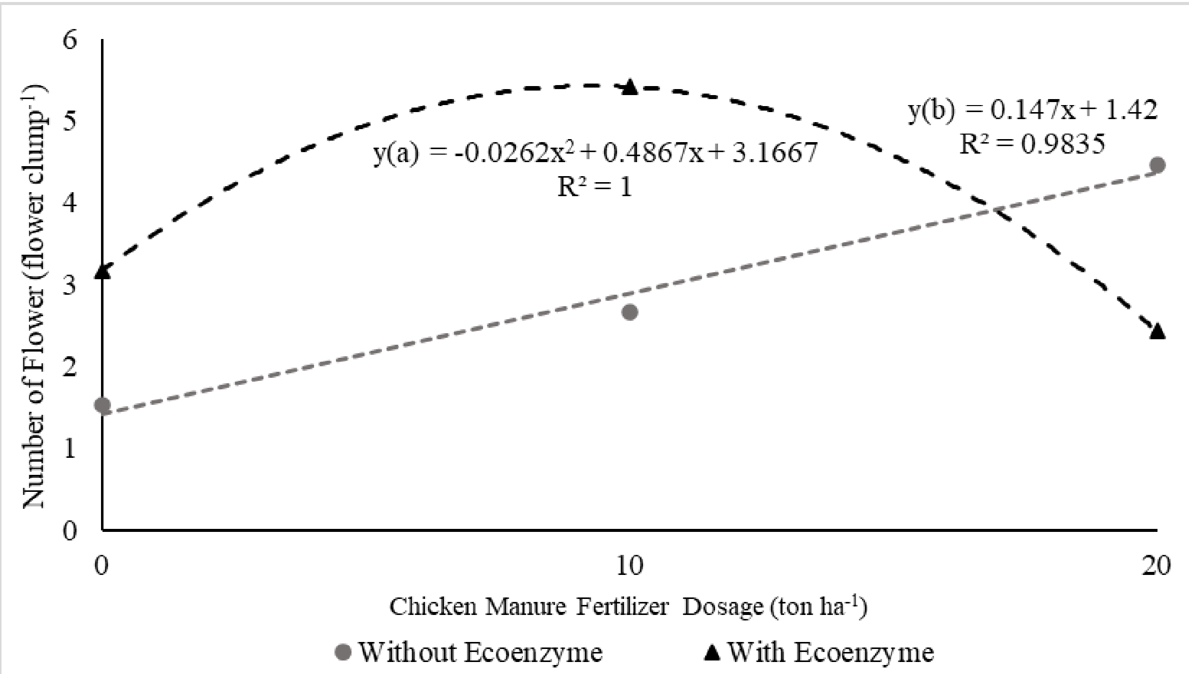
Analysis of variance conducted on the number of flower showed a significant interaction between the application frequency of ecoenzyme and chicken manure. The interaction between the number of flower due to the application frequency of ecoenzyme and chicken manure fertilizer can be seen in Table 8.

Flowers are part of the generative organs of plants. Red fountain grass flowers are in the form of long, striking purple-red feathers which are the attraction of this plant. Based on the results of the analysis of variance, it is known that the application of ecoenzyme once a week with a dose of 10 tons of chicken manure $ha^{-1}$ can increase the number of flowers by 279.08% compared to the control treatment. The effect of the dose of chicken manure on the number of flowers at each frequency of ecoenzyme is presented in Figure 2.

*Table 8. Effect of Ecoenzyme Frequency and Chicken Manure Fertilizer Dosage on the Dry Weight of Plants of Red Fountain Grass Plants*

| Ecoenzyme Application Frequency | Number of Flower (flower $clump^{-1}$) | | |
|---|---|---|---|
| | Chicken Manure Fertilizer Dosage (ton $ha^{-1}$) | | |
| | 0 | 10 | 20 |
| **Without Ecoenzyme** | 1,53 a | 2,67 ab | 4,47 bcd |
| **Once a week** | 2,90 ab | 5,80 d | 2,77 ab |
| **Once of two week** | 3,43 abc | 5,03 cd | 2,10 a |
| HSD 5%: 2,00 | | | |

**Note:** Mean values with the same notation in columns and rows have no significant difference based on the 5% HSD follow-up test.




**Note:** (a): Application of ecoenzyme; (b): Without application of ecoenzyme

*Fig 2. Effect of Manure Dose on Number of Flower at Each Frequency of Ecoenzyme Application*

Based on Figure 2. shows that in the application of ecoenzyme, each additional 1 point of chicken manure dose causes the number of flowers to increase by approximately 3.62 flowers clump$^{-1}$ (y (a) = -0.0262x2 + 0.4867x + 3.1667 with R2 = 1). However, when the dose of chicken manure increases to 20 tons ha$^{-1}$, the number of flowers begins to decrease. The treatment of 10 tons of chicken manure ha$^{-1}$ produced a better number of flowers and then decreased when the dose of manure increased to 20 tons ha$^{-1}$. In the treatment of ecoenzyme application, the number of flowers was the highest with an R2 value of 1 so that the optimum dose of chicken manure was sought using the equation y(a)= -0.0262x2 + 0.4867x + 3.1667 and the optimum dose of chicken manure for the number of flowers was 9.28 tons ha$^{-1}$.

The frequency of ecoenzyme once a week and the optimal dose of chicken manure create an interactive relationship with the number of flowers. The availability of phosphorus from chicken manure can trigger flower differentiation. Phosphorus is the main component of ATP which acts as an energy source for the cell division process at the flower growth point (Khan *et al*., 2023). Without sufficient phosphorus, plants will have difficulty forming flower primordia (Brukhin and Morozova, 2011). Phosphorus in the soil is often bound to minerals such as aluminum, iron, and potassium to form insoluble compounds. With the help of organic acid ecoenzyme, phosphorus binding can be prevented because organic acid will maintain phosphorus in the form of $H_2PO_{4-}$ which is easily absorbed by the roots (García-Berumen *et al*., 2025).

## IV. CONCLUSION

Treatment of ecoenzyme frequency (without ecoenzyme, once a week, and once every two weeks) and chicken manure dosage (0 tons ha$^{-1}$, 10 tons ha$^{-1}$, and 20 tons ha$^{-1}$) on red fountain grass plants, it was concluded that there was an interaction on growth (plant length, number of leaves, leaf area, number of shoots, root volume, fresh plant weight, and dry plant weight) and flowering (number of flowers). The chicken manure dosage of 8.56 tons ha$^{-1}$ and 9.28 tons ha$^{-1}$ in the provision of ecoenzyme is the optimal chicken manure dosage to increase the growth and flowering of red fountain grass plants. The ecoenzyme frequency of once every two weeks is the right frequency of ecoenzyme application in increasing the growth and flowering of red fountain grass plants.

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