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# Increasing the Growth and Product of Red Spinach and Study of it's Benefits as a Source of Nutrition Fe for Body Health

Bambang Gunawan[1], Sri Purwanti[2*], Nurlina[3], Nurul Huda[3]

[1]Faculty of Health, Surabaya Institute of Health and Business;
[2]Faculty of Agriculture, Mayjen Sungkono University, Mojokerto;
[3]Faculty of Agriculture, Merdeka University, Surabaya, East Java, Indonesia
[*]Corresponding Author

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***Abstract***— *The purpose of this research to determine the effect of the combination of manure and EM-4 on the growth and yield of red spinach and to study its benefits as a source of Fe nutrients for health. This study was an experimental study using a randomized block design (RBD) in the combined treatment of manure with EM-4. The manure (P) was at three levels, namely: $P_1$ = 5 tons/ha of manure dose; $P_2$ = Dose of manure 10 tons / hectare; $P_3$ = Dose of manure 15 tons / hectare; while giving the concentration of EM-4 (K) with three levels, namely: K1 = 5 ml EM-4 / liter of water; $K_2$ = 10 ml EM-4 / liter of water; $K_3$ = 15 ml EM-4 / liter of water. There was a significant effect of the combination treatment of manure with EM-4 studied, namely on the variables of plant height, number of leaves and fresh weight. Consuming fresh red spinach regularly according to the Nutrition Adequacy Rate is very beneficial for body health because the content of iron, calcium, copper, thiamine, fiber, zinc and water including high and quite high.*

***Keywords***— ***Manure, EM-4, Red Spinach. Nutrition, health.***

## I. INTRODUCTION

Vegetables are commodities that have a very high development, because they are needed daily and their demand tends to increase. Just like other horticultural crops, most vegetable crops have high commercial value. This fact can be understood because vegetables are always consumed at any time. In addition, vegetables are vegetable commodities that are needed by the community because they contain many nutrients needed by the body (Paeru et al., 2015).

Red spinach must be cultivated organically, so that the resulting product is of higher quality. One of the ways to cultivate plants organically is by applying organic fertilizers. The use of organic matter in the form of manure has been carried out by farmers for a long time, but its use in large quantities creates difficulties in the source of supply, transportation and application. Organic material from animal manure can be in the form of chicken, goat, cow and buffalo manure. Manure can come from the farm itself, from around the location of agricultural land or imported from other locations.

Manure is a source of several nutrients such as nitrogen, phosphorus, potassium, and others. However, nitrogen is one of the main nutrients for most plants that can be obtained from manure. Potassium deficiency in certain locations cannot be corrected with a general dose of manure. The use of manure is a nutrient cycle that is very useful in optimizing the use of renewable natural resources, on the other hand the use of manure can reduce nutrients that are toxic to plants (Hartatik & Widowati, 2006).

To improve the nutritional quality of plants, it is necessary to add Effective Microorganisms (EM-4). EM-4 is a brownish liquid and has a sweet-sour (fresh) aroma which contains a mixture of several living micro organisms that are beneficial for the absorption/supply of nutrients in the soil. And it is expected to provide higher production, in

the form of broad leaves, high number of leaves, healthy and large plant crowns and healthy roots. Vegetable plant products that have healthy and large crowns have a higher selling value (Suwahyono & PS, 2014).

The benefits of EM-4 in agriculture include improving the physical, chemical and biological properties of the soil, increasing crop production and maintaining production stability, providing the nutrients needed by plants, increasing the diversity of beneficial microbes in the soil. The purpose of this research to determine the effect of the combination of manure and EM-4 on the growth and yield of red spinach and to study its benefits as a source of Fe nutrients for health.

## II. MATERIAL AND METHODS

The materials used include: Alluvial planting soil, manure, red spinach seeds, and EM-4. The tools used include: Hoes, shovels, knives, polybags measuring 5 kg (35x35 cm), plant variable measuring equipment and stationery.

This study was an experimental study using a randomized block design (RBD) in the combined treatment of manure with EM-4. As for manure (P) with three levels, namely: $P_1$ = Dosage of 5 tons of manure / hectare; $P_2$ = Dose of manure 10 tons / hectare; $P_3$ = Dose of manure 15 tons / hectare; while giving the concentration of EM-4 (K) with three levels, namely: $K_1$ = 5 ml EM-4 / liter of water; $K_2$ = 10 ml EM-4 / liter of water; $K_3$ = 15 ml EM-4 / liter of water.From the two treatments, 9 treatment combinations were obtained which were then repeated 3 times, so that 27 experimental units were obtained.The statistical analysis of this study was carried out with the help of the SPSS program. Data collection methods used during the implementation include direct practice through research activities, observation of variables and observations of plants as well as through literature studies. To find out the extent of the influence between treatments, Analysis of Variance (ANOVA) was used, while Duncan's test was used to test the mean difference between treatments with a level of 5% (Hanafiah, 2005).

## III. RESULTS AND OBSERVATION

1. Plant Height

The results of the statistical analysis showed that the combined treatment with manure and EM-4 had a significant effect on all observed ages, namely 10, 17, 24 and 31 days after planting on the red spinach plant height variable (Table 1).

Based on table 1 below, the $P_3K_2$ and $P_3K_3$ treatments from the beginning to the end of the observation showed a tendency to give a better value compared to other combination treatments, and statistically up to the end of the observation (31 days after planting) the effect of the difference was not significant, namely the highest yield achieved by the $P_3K_3$ treatment of 30.20 cm while the $P_3K_2$ treatment was 29.37 cm.

*Table 1. The Mean Value of Plant Height in the Combination Treatment of Manure and EM-4 at Various Ages Observations with a 95% confidence level.*

| Combination Treatment | Mean Plant Height (cm) | | | |
|---|---|---|---|---|
| | 10 AAP | 17 AAP | 24 AAP | 31 |
| $P_1K_1$ | 3.40 a | 5.53 a | 14.30 a | 18.43 a |
| $P_1K_2$ | 3.47 a | 6.67 a | 15.33 a | 18.27 a |
| $P_1K_3$ | 3.83 ab | 6.70 a | 17.17 b | 21.33 b |
| $P_2K_1$ | 4.30 bc | 7.87 b | 17.97 bc | 20.90 b |
| $P_2K_2$ | 4.40 bcd | 8.40 bc | 18.57 bc | 22.33 bc |
| $P_2K_3$ | 4.47 bcd | 8.83 bc | 19.67 cd | 24.03 c |
| $P_3K_1$ | 4.73 cd | 9.37 c | 21.07 | 26.73 d |
| $P_3K_2$ | 5.00 cd | 10.53 d | 21.87 and | 29.37 and |
| $P_3K_3$ | 5.13 d | 10.97 d | 22.63 and | 30.20 and |

*Note: Numbers followed by the same letter in the same column are not significantly different on Duncan's 5% test*

As for the visualization in graphical form, the combination treatment of manure and EM-4 gave a significant

effect on the variable plant height at the age of observation 10, 17, 24 and 31 days after planting, presented in Figure 1 below

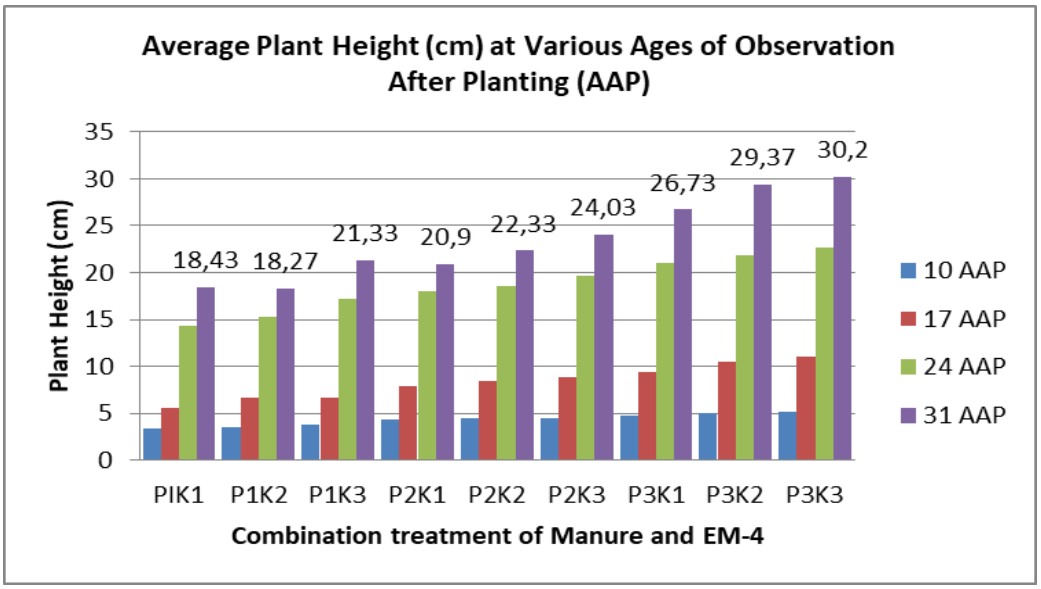


*Fig.1. Graph of Average Plant Height (cm) Due to the Combination Treatment of Manure and EM-4 at Various Ages of Observation.*

Nitrogen (N) in manure mainly functions to stimulate overall plant growth, especially stems, branches and leaves. The formation of green leaves is also closely related to the element nitrogen. In addition, this element is influential in the formation of proteins, fats, and various other organic compounds. The nutrient element phosphorus (P) for plants functions more to stimulate root growth, especially the roots of young plants. Certain types of protein require the element phosphorus as a raw material. Phosphorus also functions to help assimilation and respiration, as well as accelerating the ripening of seeds and fruit. The nutrient element potassium (K) is primarily used to help form proteins and carbohydrates. Giving this element will strengthen the plant so that leaves, flowers and fruit do not fall easily. In addition, potassium also makes plants resistant to disease and drought (Simanungkalit et al., 2006).

According to Amin (2015), that some of the beneficial effects of EM-4 are as follows: improving germination, flower formation, fruit, and maturity of crop yields, improving the physical, chemical and biological environment of the soil and suppressing the growth of pests and diseases in the soil, increasing plant photosynthetic capacity, guaranteeing better plant germination and growth by increasing the benefits of organic matter as fertilizer.

**2. Number of Leaves**

The results of the statistical analysis showed that the combined treatment with manure and EM-4 had a significant effect on all observed ages, namely 10, 17, 24 and 31 days after planting (Table 2).

*Table 2. The Mean Value of the Number of Leaves in the Combination Treatment of Manure and EM-4 at Various Ages Observations with a 95% confidence level.*

| Combination Treatment | Mean Number of leaves | | | |
|---|---|---|---|---|
| | 10 AAP | 17 AAP | 24 AAP | 31 |
| $P_1K_1$ | 2.00 a | 4.00 a | 8.33 a | 10.33 a |
| $P_1K_2$ | 2.00 a | 4.50 ab | 8.17 a | 10.87 a |
| $P_1K_3$ | 2.00 a | 4.93 bc | 9.20 ab | 11.87 ab |
| $P_2K_1$ | 2.00 a | 5.77 cd | 9.53 ab | 12.53 bc |
| $P_2K_2$ | 2.00 a | 5.60 cd | 10.37 bc | 13.87 c |

| | | | | |
|---|---|---|---|---|
| $P_2K_3$ | 2.27 a | 6.00 d | 11.53 c | 14.03 c |
| $P_3K_1$ | 2.60 b | 7.00 and | 13.87 d | 15.87 d |
| $P_3K_2$ | 2.83 b | 7.60 if | 14.10 of | 16.50 d |
| $P_3K_3$ | 2.83 b | 8.03 f | 15.53 and | 16.53 d |

*Note: Numbers followed by the same letter in the same column are not significantly different on Duncan's 5% test*

Based on table 2 above, it shows that there is also a tendency for the $P_3K_2$ and $P_3K_3$ treatments from the beginning to the end of the observation to give a better value compared to the other combination treatments, and statistically up to the end of the observation (31 days after planting) the effect of the difference is not significant, namely the highest yield achieved by the $P_3K_3$ treatment of 16.53 while the $P_3K_2$ treatment was 16.50 for the variable number of leaves of the red spinach plant.

As for visualization in graphical form, the combination treatment of manure and EM-4 gave a significant effect on the variable number of leaves of the red spinach plant at the age of observation 10, 17, 24 and 31 days after planting, presented in Figure 1 below.

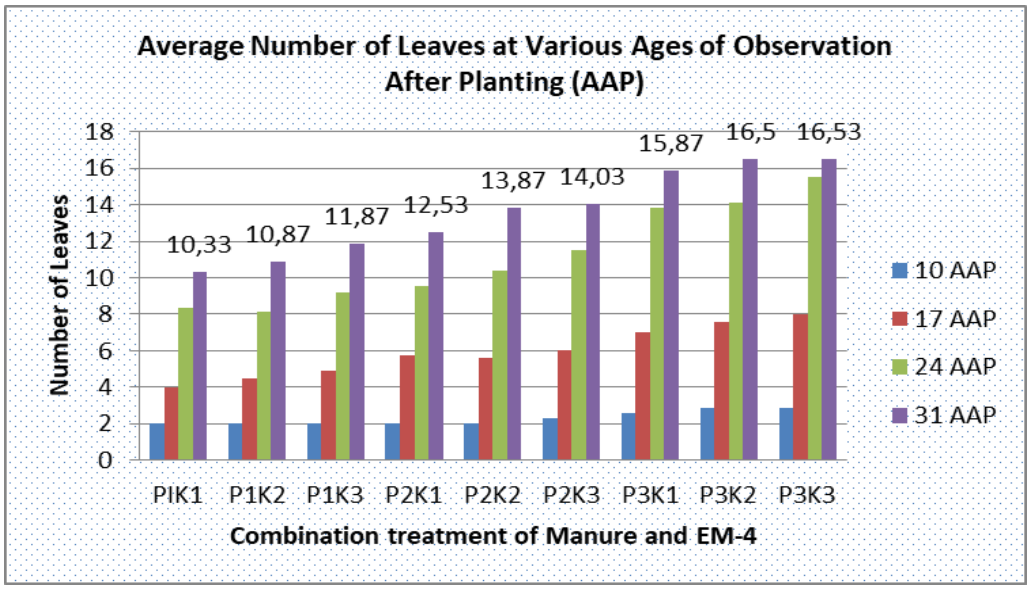


*Fig.2. Graph of Average Number of Leaves Due to the Combination Treatment of Manure and EM-4 at Various Ages of Observation.*

Manure besides containing nutrients and minerals can also improve soil structure like compost. The advantage of manure is that it facilitates the absorption of rainwater, can increase humus, improve soil structure and increase the life of decomposing microorganisms. The most important nutrients in manure for plants include nitrogen (N), phosphorus (P) and potassium (K). These three nutrients are most needed by plants. The three types of nutrients are very important because each has a very important function for plant growth (Agromedia, 2007).

EM-4 is able to play a role in fermenting organic matter in the soil into organic elements quickly, and is able to increase soil fertility and plant productivity because EM-4 (*effective microorganisms 4*) contains fermenting bacteria of the genus *Lactobacillus*, fermented mushrooms, *Actinomycetes* photosynthetic bacteria, phosphate solubilizing bacteria and yeast (Daeli, 2020).

Based on the results of the above study, the combination treatment of manure and EM-4 was proven to be able to increase the growth of red spinach plants which can be shown in the variable increase in plant height by 63.86% and number of leaves by 60.02% in the P3K3 treatment compared to the $P_1K_1$ combination treatment.

**3. Fresh Weight per Plant**

The results of the statistical analysis showed that the combined treatment with manure and EM-4 had a significant effect on the variable fresh weight per plant at the age of 31 days after planting (Table 3).

*Table 3. Value of Mean Fresh Weight per Plant in the Combination Treatment of Manure and EM-4 Observation at 31 Days After Planting with a Confidence Level of 95%.*

| Combination Treatment | Fresh Weight per Plant (gram) | Percentage of Increase in Fresh Weight per Plant Against P1K1 |
|---|---|---|
| $P_1K_1$ | 63.70 a | 00 |
| $P_1K_2$ | 63.60 a | 00 |
| $P_1K_3$ | 68.83 ab | 8,05 |
| $P_2K_1$ | 71.27 bc | 11,88 |
| $P_2K_2$ | 74.00 bc | 16,17 |
| $P_2K_3$ | 77.80 cd | 22,14 |
| $P_3K_1$ | 82.37 of | 29,31 |
| $P_3K_2$ | 88.10 if | 38,30 |
| $P_3K_3$ | 94.13 f | 47,77 |

Based on table 3 it shows that at the end of the observation, the highest yield was achieved by the $P_3K_3$ treatment of 94.13 grams or giving a percentage increase in fresh weight per plant of 47.77% which was not significantly different from the $P_3K_2$ treatment of 88.10 grams or the percentage increase in fresh weight per plant of 38 .30% compared to the $P_1K_1$ combination treatment.

Plant growth is an irreversible measure where the indicator can be known from the increase in size and the number of plant vegetative and generative growth parameters (Harjadi, S. 1991). Based on the results of the above study, the combination treatment of manure and EM-4 was proven to be able to increase the yield of red spinach which could be shown in an increase in fresh weight per plant variable of 47.77% compared to the $P_1K_1$ combination treatment.

The photosynthetic bacteria present in EM-4 form useful substances which produce nucleic acids, amino acids and bioactive substances which function to bind nitrogen from the air. Lactic acid bacteria function to ferment organic matter into lactic acid, accelerate the breakdown of organic matter, lignin and cellulose and suppress pathogens. Actinomycetes produce antimicrobial substances from amino acids. Yeast produces antibiotic substances, produces enzymes and hormones, yeast secretions become substrates for effective microorganisms lactic acid bacteria actinomycetes. Fermented fungi are able to quickly decompose organic matter which produces anti-microbial alcohol esters, eliminates bad smells, prevents harmful insects and caterpillars.

## IV. DISCUSSION

Red spinach is a vegetable plant that has a fairly high nutritional content. In several developing countries, spinach is promoted as a source of vegetable protein, because it has a double function to meet nutritional needs and public health services. This plant contains lots of protein, fat, carbohydrates, potassium, amarantin, purines and vitamins (A, B and C), while the richest nutrient content in spinach is iron (Fe). This nutrient is what the body needs to stimulate the formation of red blood cells. Consuming spinach is synonymous with protecting oneself from the symptoms of anemia which makes the body weak. Red spinach leaves are good for the kidneys and digestive organs; because the fiber content is high enough so that it can overcome constipation and smooth bowel movements. The nutritional content in red spinach can lower cholesterol, blood sugar, improve blood circulation and reduce excessive blood pressure. Red spinach can also sweep away dirty blood residue (Jumiati, 2009).

Anemia is a condition in which red blood cells do not meet the physiological needs of the body. These physiological needs are different for each person, which can be influenced by gender, place of residence, smoking behavior, and stage of pregnancy. Based on WHO, anemia in pregnancy is established when the hemoglobin (Hb) level is <11 g/dL. Meanwhile, the Center for Disease Control and Prevention defines anemia as a condition with Hb levels <11 g/dL in the first and third trimesters, Hb <10.5 g/dL in the second trimester, and <10 g/dL in postpartum. The incidence of anemia or lack of blood in pregnant women in Indonesia is still relatively high, namely as much as 48.9% (according to the Indonesian Ministry of Health in 2019). This condition explains that anemia is quite high in

Indonesia and shows rates approaching severe public health problems (*severe public health problem*) with an anemia prevalence limit of more than 40% (Ministry of Health RI, 2013). Anemia does not only have an impact on the mother, but also on the baby being born. Babies who are born are likely to have little or no iron reserves at all, so that it will cause anemia in babies who are born. The impact of anemia on pregnant women can be observed from the magnitude of maternal morbidity and mortality, increased fetal morbidity and mortality, and increased risk of low birth weight (Mirantika & Asi, 2018).

Nutritional anemia is very common in Indonesia. From a public health perspective, nutritional anemia is mainly caused by iron deficiency, so nutritional anemia is often referred to as iron deficiency anemia. Anemia due to iron deficiency is the main cause of anemia in pregnant women compared to other nutritional deficiencies. The high prevalence of iron deficiency anemia can have negative consequences such as low physical work ability and work productivity, low intellectual ability and low immunity, causing high morbidity rates. Thus the functional consequence of iron deficiency anemia causes a decrease in the quality of human resources. Ideally to overcome the problem of iron deficiency anemia is by supplementing or administering iron preparations in the form of syrup or pills as medicine, but this program is still felt to be ineffective, especially due to distribution problems; Therefore it is necessary to intake Fe nutrients through the consumption of red spinach which is proven to have a high content of Fe nutrients.

Based on data from the RI Ministry of Health, that every 100 grams of fresh red spinach contains 7.0 mg iron, 520 mg calcium, 0.20 mg copper, 0.20 mg thiamine, 2.2 grams fiber, 0.8 mg zinc and 88. 5 grams of water. This shows that the content of iron, calcium, copper, thiamine, fiber, zinc and water including high and quite high. Consuming fresh red spinach regularly according to the RDA (Nutrition Adequacy Rate) or according to the nutritional needs per day from the Indonesian Ministry of Health, is very beneficial for health (Pane et al., 2020), including:

a. Preventing the occurrence of stroke, is the benefit of the high content of calcium, copper and zinc.
b. Supports the production of hemoglobin, as a benefit of the high iron content.
c. Balances the level of blood acidity, as a benefit of the high calcium content.
d. Overcome and prevent the risk of anemia, as a benefit of the high iron content.
e. Reducing bad cholesterol (LDL) and increasing good cholesterol (HDL) in the blood, are the benefits of quite high fiber content.
f. Reducing the risk of hypertension, as a benefit of the high content of water, calcium and copper.
g. Keep blood sugar stable, as the benefits of quite high content of fiber and zinc.
h. Minimizes the risk of diseases of the cardiovascular system, due to the high content of calcium, copper and thiamine.
i. Strengthens blood clotting, as a benefit of high calcium content.

Another benefit is as an ingredient in traditional medicine, and also for beauty. Red spinach root can be used as a cure for dysentery. Red spinach leaves and flowers are efficacious for treating asthma and eczema. Even to some extent, red spinach can overcome various types of internal diseases. For external medicinal purposes, red spinach can be used as a cosmetic ingredient (beauty). Red amaranth seed extract is efficacious as a remedy for vaginal discharge and excessive bleeding in women who are menstruating.

## V. CONCLUSION

Based on the research results, it can be concluded as follows:

a). There was a significant effect of the combination treatment of manure with EM-4 studied, namely on the variables of plant height, number of leaves and fresh weight per plant; and statistically, the $P_3K_2$ treatment, namely the dose of 15 tons/Ha and 10 ml EM-4 per liter of water, gave a better value for all of these variables because it was considered more effective and efficient than the $P_3K_3$ treatment, where the two combination treatments showed no significant difference.

b). Consuming fresh red spinach regularly according to the Nutrition Adequacy Rate is very beneficial for health, especially for preventing anemia because based on a study by the Indonesian Ministry of Health that every 100 grams of fresh red spinach contains 7.0 mg iron, 520 mg calcium, 0.20 mg copper, 0.20 mg of thiamine, 2.2 grams of fiber, 0.8 mg of zinc and 88.5 grams of water. This shows that the content of iron, calcium, copper, thiamine, fiber, zinc and water including high and quite high.

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