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ADMINISTRATION OF EM$_4$ ON GROWTH AND PRODUCTION OF KANGKUNG (*Ipomea reptans* Poir)

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Abstract:
The purpose of this study was to determine the response of growth and production of kale to the administration of EM $_4$ and to get a dose of EM $_4$ suitable for the growth and production of kale . The benefit of the research is that it is expected to provide information about the growth response and production of kale to the administration of EM $_4$ This experiment used a randomized block design (RAK), with three levels of treatment which was repeated 7 times. The treatment levels were: S0 = 0 cc EM $_4$ / l water, S1 = 2 cc/EM $_4$ /l water and S2 = 4 cc EM $_4$ /l water/. Giving EM4 did not affect plant height and leaf number of kale.

Keywords: EM$_4$ and Kangkung

INTRODUCTION

Kangkung (Ipomoea aquatica), also known as *Ipomoea reptans* Poir is a type of plant that belongs to the type of vegetables and is grown as food. The popular kale dish is ca kangkung with tauco or shrimp paste seasoning. Almost all of the young plants are edible. Because old kale has coarse fibers, young shoots are preferred. It can be eaten raw or cooked like spinach. Kangkung is often also fried as cah. Plecing kale is a famous menu from the Lombok area. The nutritional content in 100 grams of kale is Energy 29 cal, Protein 3 g, Fat 0.3 g, Carbohydrates 5.4 g, Fiber 1.0 g, Calcium 73 mg, Phosphorus 50 mg, Iron 2.5 mg, Vitamin A 6,300 IU, Vitamin B1 0.07 mg. Vitamin C 32 mg and Water 89.7g (Wildan Purwadi, 2017)

Kangkung is widely sold in markets. This kale can be called swamp cabbage, water convovulus, water spinach, comes from India. Then spread in various regions to Malaysia, Burma, Indonesia, South China, Australia and parts of African countries. Kale is a fast growing plant that produces results within 4-6 weeks from seed. Kangkung is a very popular vegetable, because there are many fans. Kale, spinach and long beans are the most consumed. Kale production data from 2013 to 2016 are: 308 477 tons, 319 618 tons, 305 080 tons and 297 130 tons (Central Bureau of Statistics, 2017). Vegetable consumption in 2016 was 107 g per capita per day and fruit 67 g per capita per day. Fruit and vegetable consumption is 174 g per capita per day and the recommended is 400 g per capita per day. Vegetable production must be increased if the Indonesian population consumes fruits and vegetables according to recommendations (Anonymous, 2017).

Vegetable production can be increased in three ways, namely by expanding the area where water spinach is planted, planting kale and other crops in one planting area and intensification. One way of intensification is the application of EM $_4$ to water spinach plants.

The formulation of this research is whether there is a response to the growth and production of kale? to the administration of EM4? and is there an appropriate dose of EM $_4$ for growth and production Kale ?

LITERATURE REVIEW

Botany and Morphology

Kale (*Ipomoea reptans* Poir) is a plant that is familiar to us. This kale plant is very easy to find and cultivate both on land and in water and is short-lived (Saidi et al, 2021). The kale plant comes from India which has spread to various continents, especially the Asian continent, namely Indonesia and others. Classification of kale plants: Kingdom: Plantae (Plants), Subkingdom: Tracheobionta (vessels),
Superdivisio :Spermatophyta (producing seeds), Divisio : Magnoliophyta (flowering), Class : Magnoliapsida (Dicotyledons), Sub class : Asteridae, Order : Solanales, Family : Convolvulceae, Genus : Ipomoea and Species : *Ipomoea reptans* Poir

Kangkung is a plant that has a taproot and branches. These roots penetrate to a depth of 60-100 cm, and spread horizontally 150 cm to more, especially water spinach plants. The stems of the kale plant are bulbous and hollow, ribbed, and contain a lot of water. Sometimes the books release fibrous plant roots and are also white and some are dark brown.

Kangkung also has leaf stalks attached to the stems and in the stems there are buds that can grow new branches. The shape of the leaves has a pointed tip and is also blunt, the surface of the leaves is dark green, and also light green. Flowers on kale plants have a trumpet shape and have white or reddish crown leaves. And if it produces round or oval fruit in which it has three seeds. The color of the kale seeds is black when it is old and green when it is easy. Kangkung is a fast-harvesting plant (Nitasari and Wahidah, 2020)

Terms Grow

Water spinach plants can grow well throughout the year, both land and water spinach plants. This plant really needs rainfall of 500-5000 mm/year. Water spinach plants also need open or open land and also get enough sunlight. This plant does very well at normal temperatures and not too hot or cold. Kale plants are very good at using fertile, loose soil media that contains lots of organic matter. The results showed that the use of two different nutritional compositions had a significant effect on the plant height of kale (Nainggolan, 2019). If planting kale plants should not be flooded with water. Can be planted on flat land, has a normal soil pH of 6-7

The height of kale planting is good in the lowlands to a height of 2000 m above sea level. Liquid organic fertilizer from papaya fruit waste and pineapple peel increases plant height and the number of leaves of land kale plants (Parintak, 2018). Administration of biohumate at a dose of 112.5 g/plant has been able to increase the growth of land kangkung production compared to controls and higher doses (Radja, 2021)

2.3. EM - 4 (Effective Microorganisms)

EM- 4 is able to increase the decomposition of waste and organic waste, increase the availability of plant nutrients and suppress the activity of insect pests and pathogenic microorganisms. EM - 4 is applied as an inoculant to increase the diversity and population of microorganisms in soil and plants, which in turn can improve health, growth, quantity and quality of crop production in a sustainable manner. EM - 4 can also be used to accelerate composting of organic waste or animal waste, clean wastewater, and improve water quality in shrimp and fish ponds (Anonymous, 2011).

EM technology was developed to support the development of environmentally friendly agriculture, suppress the use of chemical fertilizers and pesticides with natural systems which can ultimately increase soil productivity, reduce production costs and produce chemical-free food so that it is clean and healthy for consumption. The EM technology that has become familiar to the public is Effective Microorganisms 4, commonly abbreviated as EM- 4 , is a mixed culture of several microorganisms that can be used as microbial inoculants that function as a biological control tool. These microorganisms function in the plant's living environment as a suppressor and control of the development of pests and diseases. EM - 4 contains fermenting bacteria from the genus Lactobacillus, fermenting fungi, Actinomycetes, Photonsynthetic Bacteria and Yeast (Anonymous, 2011).

1. Photosynthetic Bacteria (*Rhodopseudomonas spp.*) These bacteria form beneficial compounds from plant root secretions, organic matter with sunlight and geothermal energy as a source of energy. Beneficial substances formed include amino acids, nucleic acids, bioactive substances and sugars, all of which function to accelerate growth. The results of this metabolism can be directly absorbed by plants and serve as a substrate for other microorganisms so that the number continues to grow.
2. Lactic acid bacteria (*Lactobacillus spp.*) Can suppress the growth of harmful microorganisms; increase the acceleration of the overhaul of organic matter; destroying organic matter such as lignin and cellulose and fermenting it without causing toxic compounds resulting from the decay of organic matter.
3. Yeast (*Saccharomyces spp.*) Through the fermentation process, yeast produces compounds beneficial to plant growth from amino acids and sugars released by photosynthetic bacteria or organic matter and plant roots. Yeast also produces bioactive substances such as hormones and enzymes to increase the number of active cells and root development.
4. *Actinomycetes* Actinomycetes produce antimicrobial substances from amino acids produced by photosynthetic bacteria. These antimicrobial substances suppress the growth of fungi and bacteria. Actinomycetes coexist with photosynthetic bacteria together to improve the quality of the soil environment by increasing soil antimicrobial activity.
5. Fermentation
   Fungi Fermented fungi *(Aspergillus and Penicillium*) decompose materials quickly to produce alcohol, and anti-microbial substances. The growth of this fungus helps eliminate odors and prevent the invasion of harmful insects and caterpillars by eliminating their food supply. (Anonymous, 2011).

Each species of microorganism has its own function but the most important is photosynthetic bacteria which are the most important implementers of EM- 4 activities . These bacteria in addition to supporting the activities of other microorganisms, it also utilizes substances produced by other microorganisms. In general, the benefits of EM - 4 technology in agriculture are :

1. Improving the biological, physical and chemical properties of soil.
2. Increase crop production and maintain production stability.
3. Fermenting soil organic matter and accelerating decomposition
4. Produce quality and quantity of environmentally friendly agricultural products
5. Increase the diversity of beneficial microbes in the soil.

EM - 4 was cultured in the form of a brown liquid medium under dormant conditions. When sprayed into the soil or plant bodies, the EM- 4 inoculation process actively ferments organic matter. The results of fermentation can be absorbed directly by plant roots, such as sugar, alcohol, amino acids, proteins, carbohydrates and other organic compounds. In addition, EM - 4 stimulates the development of microorganisms that benefit plants; protect plants from disease attacks so that in the end it can fertilize the soil, increasing crop productivity with minimal costs (Wididana, 2010).

RESEARCH METHODOLOGY

The research was carried out in the Experimental garden of Klabat University, Airmadidi Bawah Village, North Minahasa Regency, with an altitude of 100 meters above sea level. This research was carried out for 9 month, from April to December 2020.

Materials and tools

1. Ingredients: Kale Seeds , EM 4, ponska, urea, and water.
2. Tools: Rafiah rope, hoe, shovel, machete , meter, ruler, hammer, hand sprayer, wood, plywood, bamboo, and nails.

This experiment used a randomized block design (RAK), with three levels of treatment which was repeated 7 times. The treatment levels were: S0 = 0 cc EM4/l water, S1 = 2 cc EM4/l water and S2 = 4 cc EM4/l water.

In this study the observed variables included: Plant height and number of leaves, calculated at 21 DAP and 28 DAP

Work procedures

1. Land

Before planting, land preparation is done first. Land preparation includes; site surveys and site measurements. Tillage is carried out two weeks before planting with the aim of maintaining air circulation in the soil, neutralizing soil acidity, killing disease seeds in the soil, and making the soil loose. Soil processing was carried out twice , namely, demolition, and plot making. 21 plots were made with a size of 120 cm x 1 20 cm. The plot height is 30 cm. The distance in the test is 40 cm and the distance between the tests is 60 cm

2. Planting

Kale seeds are planted in tubules with a depth of 3 cm. Planting distance 20 cm x 20 cm (Susila, 2006) . Seeds are planted three seeds per hole and covered with soil. Crop reduction was carried out one week after planting by leaving one of the best plants in the planting hole. Embroidery is done to replace plants that grow abnormally, die, or are attacked by pests and diseases. Embroidery is done one week after planting . Weeds or weeds around the plant are weeded or uprooted. Weeding is done in the second week after planting.

3. Fertilization

Fertilization is done by giving phonska fertilizer at a dose of 30 g per plot, given 1 day before planting. Then the second week given urea fertilizer at a dose of 10 g . Giving EM4 according to the treatment dose. Spraying was carried out on the soil at the age of 14 and 21 days after planting.

4. Watering

Kale plants need enough water for growth and production. Watering plants should be done when it is not raining. Watering is done in the morning and evening.

5. Pest and disease control

Pest and disease control is carried out mechanically, namely by hand as needed.

6. Harvest

Kale plants are harvested at the age of 35 DAP or 20-25 cm high by pulling out the roots and then placing them in a cool place so they don't wither. Harvesting should be done in the afternoon.

Observational data were analyzed using analysis of variance, and if there was a significant difference, continued with Duncan's test. Data analysis was carried out using SPSS software

RESULTS AND DISCUSSION

Plant Height

Kangkung plant height was not significantly different at 21 DAP and 28 DAP because the plant did not respond to EM 4 dose treatment. The average plant height at 21 DAP and 28 DAP can be seen in table 1.

Table 1. Average Plant Height at 21 DAP and 28 DAP

TREATMENT (T)	Plant age (HS T)	
	21	28
S0	9.2	12.9
S1	9.1	12.7
S 2	9.2	12.8

Number of Leaves

The number of leaves at the age of 21 DAP and 28 DAP was not significantly different because the plants did not respond to dosing of EM4. Data on the average number of leaves can be seen in table 2.

Table 2. Average Number of Leaves at Age 21 DAP and 28 H ST

TREATMENT (T)	Plant age (HS T)	
	21	28
S0	12 0	15.0
S1	12.1	15.1
S 2	12.0	15.0

CONCLUSION

Giving EM4 did not affect plant height and leaf number of kale.

SUGGESTION

Research _ Giving EM4 to Kangkung plants is done at the end of the rainy season

BIBLIOGRAPHY

Book source:

1. Anonymous. 2017. Food Security Monitoring Bulletin. Ministry of Agriculture, Jakarta.
2. Central Bureau of Statistics. 2017. Indonesian Statistics 2017. Indonesian Central Bureau of Statistics. Jakarta.
3. Nainggolan, Y. 2019. Effect of composition and time of application of different nutrients on kale production. Essay. Faculty of Agriculture, University of North Sumatra.
4. Nitasari and Wahidah. 2020 Comparison of kale plant growth on hydroponic media and soil media. UIN Walisongo. Semarang.
5. Parintak, R. 2018. The effect of giving liquid organic fertilizer from papaya fruit waste and pineapple peel on the growth of land kangkung. Essay. FKIP Sanata Dharma University. Yogyakarta.
6. Radja, FY 2021. Growth and yield of Pakcoy (Brassica rapa subs Chinensis and kale (Ipomoea reptans Poir) at various doses of biohumate. Thesis. Faculty of Agriculture, Tribhuwana TunggalDewi University, Malang.
7. Saidi, I. A; R. Azara and E. Yanti. 2021. Post-harvest and leaf vegetable processing. Umsida Press. Sidoarjo.
8. Susila, AD 2006. Guide to Cultivation of Vegetable Crops. IPB. Bogor.
9. Wildan Purwadi. 2017. Growth and protein content of land kangkung (Ipomoea reptans Poir) with the application of liquid organic fertilizer made from coconut husk and tofu liquid waste. Muhammadiyah University of Surakarta. Surakarta.

Website source:

1. Anonymous . 2011 *Effective Microorganisms 4.* http://www.em4indonesia.com/ Accessed February 10 20 20
2. Anonymous. 2013. Cultivation of land kale. https://www.petanihebat.com/2013/03/budidaya-tanaman-kangkung darat.html Accessed February 23, 2020
3. Wididana, GN 2010. *Technology, EM-4 New Dimensions in Modern Agriculture* http://fortuneowner.wordpress.com/2010/08/03/pembuatan-em-4-effective micro- organism-4/ Retrieved 17 February 20 20