

# UTILIZATION OF RIM TECHNOLOGY (Refresh Microorganism) AND WASTE PULP TOFU TO INCREASE THE GROWTH OF MUSTARD PLANTS (*Brassica juncea*, L.)

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## Abstract

This research is an experimental study with the aim to find out the best dose of application of organic fertilizer pulp tofu and RIM to the results of mustard plant growth. The experimental plan in this study used a Complete Randomized Plan (RAL) with 2 treatment factors, there are 3 levels of treatment in each factor. A0 without pulp, A1 (200gr/plant), A2 (300gr/plant), and the addition of RIM Bioactivator with 3 treatment levels namely B0 (without RIM), B1 (RIM 10 cc/L water), B2 (RIM 20 cc/L water). The results of the analysis showed that there is a real interaction in the provision of organic fertilizer pulp tofu and bioactivator technology RIM (Refresh Microorganism) against variable observation of plant length, the area of mustard leaves age 4 mst, wet weight of mustard plants, and dry weight of mustard plants. In the variable observation of the number of leaves of mustard plants and the area of leaves of mustard plants age 2 mst shows that there is a very real influence on the provision of fertilizer pulp tofu and solution RIM (Refresh Microorganism). The effect of giving tofu pulp fertilizer and bioactivator of RIM technology (Refresh Microorganism) is best on all observation variables, namely on the treatment of A2B2 (Tofu Pulp Fertilizer 200 gr and RIM 20 ml / liter of water).

**Keywords:** *Fertilizer, Organic, Bioactivator, RIM, Mustard.*

## INTRODUCTION

The amount of polluted land caused by excessive use of chemicals makes crop production decrease. The use of organic materials in crop cultivation in addition to improving the quality of land can also have a positive impact on the environment. Sutanto (2002) said that organic farming system is based on an activity that concept of feeding on land or soil, then the soil provides food for plants (Feeding the soil that feeds the plant). Organic fertilizer is a fertilizer derived

from living things. Based on the form of organic fertilizer can be solid or liquid, and has benefits to improve the physical, chemical, and biological properties of soil (Hamidah, 2012). Liquid fertilizer usually comes from animal manure such as urine, and so forth in the form of liquid, as well as liquid waste from the tofu industry can also be used as a material for making liquid organic fertilizer. Tofu pulp is a type of waste that is easy to obtain and rarely to be used so that it can damage the environment. In the pulp of tofu there is a high protein content of 43.8%, and there are other

# UTILIZATION OF RIM TECHNOLOGY (Refresh Microorganism) AND WASTE PULP TOFU TO INCREASE THE GROWTH OF MUSTARD PLANTS (*Brassica juncea*, L.)

content such as fat 0.9%, coarse fiber 6%, calcium (Ca) 0.32%, phosphorus (P) 0.67%, Magnesium (Mg) 32.3mg/kg (Anggoro, 1985). Tillman (1998) said that tofu pulp has an average N content of 16% of the amount of protein contained in the pulp of tofu.

Utilization of industrial waste tofu as organic fertilizer takes a long time, one way in accelerating the process of decomposition of tofu pulp is to utilize microorganisms as decomposer agents. Bioactivator is a mixed inoculum of various types of microorganisms that can be useful to accelerate the process of decomposition of fertilizers. RIM (Refresh Microorganism) technology is a bioactivator technology consisting of a group of beneficial microbes that have been selected naturally and derived from Indonesian natural microbes that have many benefits. RIM technology can be useful in the decomposition process of organic matter, and can be useful to improve soil fertility and health (Prihandarini and Sudiarso, 2018). Mustard plants originated from China and East Asia Philippines, in 1976 Taiwan has managed to collect 640 varieties of mustard plants consisting of 488 types of plants (Cahyono, 2003). With the increasing consumer demand on mustard plants and the increasing demands of market fulfillment of mustard plants, there needs to be appropriate efforts to cultivate mustard so that it can produce maximum mustard crop production. Cultivation of mustard plants by using organic fertilizer can have a positive impact on the environment. The content of nutrients contained in the waste pulp tofu can be used to increase the growth of mustard plants, because it contains the sharing of nutrients needed by mustard plants.

## RESEARCH METHODS

### Tools and Materials

The tools used in this study were hoe/shovel, knife, ground sieve, drill, ruler, scale, calculator, sieve, meter, bottle, petri dish, and

stationery. The materials used in this study were polybags, green mustard seeds (*Brassica juncea*, L.), soil, water, tofu pulp, bran, molasses, and RIM technology bioactivators, basins, plastics, rubber/ropes.

### Trial Plan

This research method uses factorial RAL (Complete Randomized Design) method. The first factor is the provision of tofu pulp (A) consisting of 3 levels of treatment, while the second factor is the provision of bioactivators rim technology (B) consists of 3 levels of treatment, as well as with 3 times the test. Factor I is the pulp of tofu (A), namely: A<sub>0</sub> = without pulp tofu A<sub>1</sub> = pulp tofu dose 200gr / plant A<sub>2</sub> = pulp tofu dose 300gr / plant Factor II is bioactivator technology RIM (B), namely: B<sub>0</sub> = without RIM B<sub>1</sub> = RIM 10 cc / L water (at a dose of 60 ml) B<sub>2</sub> = RIM 20 cc / L water (at a dose of 60 ml)

### Table of Combination Treatment in the Study

A \ B	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
B <sub>0</sub>	A <sub>0</sub> B <sub>0</sub>	A <sub>1</sub> B <sub>0</sub>	A <sub>2</sub> B <sub>0</sub>
B <sub>1</sub>	A <sub>0</sub> B <sub>1</sub>	A <sub>1</sub> B <sub>1</sub>	A <sub>2</sub> B <sub>1</sub>
B <sub>2</sub>	A <sub>0</sub> B <sub>2</sub>	A <sub>1</sub> B <sub>2</sub>	A <sub>2</sub> B <sub>2</sub>

Data obtained from the research were analyzed by analysis of the diversity level of the test  $\alpha = 5\%$ . If there is a significant value or a real difference then do the test further by using the analysis BNJ (the Real Difference, to be Honest) or Tukey test with significance level of the test  $\alpha = 5\%$ .

### The Parameters Of The Observation

The parameters of the observation in this study is the length of plants, number of leaves, leaf area, wet weight or weights of fresh, dry weight or dry weight.

## RESULTS AND DISCUSSION

Plant length (cm)

Treatment	The length of the Plant 1 DAP (cm)	The length of the Plant 2 DAP (cm)	The length of the Plant 3 DAP (cm)	The length of the Plant 4 DAP (cm)
A0B0	08.2330 a	11.7330 a	14.9000 a	22.4670 a
A0B1	08.7000 ab	12.0330 ab	16.6000 b	24.6000 b
A0B2	09.1330 ab	12.4670 b	17.1330 b	25.1330 b
A1B0	09.2000 b	12.2000 ab	16.5330 b	24.5330 b
A1B1	09.5000 bcd	12.5000 b	19.1330 c	27.1330 c
A1B2	10.1700 cd	13.1330 c	19.9330 cd	28.6000 d
A2B0	09.3000 bc	12.3000 b	17.1000 b	25.2330 b
A2B1	10.3300 d	13.3000 c	20.6670 de	28.6000 d
A2B2	11.0000 e	14.5000 d	21.7000 e	30.2330 e

Description: numbers followed by the same letter means no real difference to the Tukey test ( $\alpha = 5\%$ ).

The results of the analysis of the variety show the interaction between the factors treatment A (Fertilizer tofu) and treatment factors B (Solution of the RIM) on the variables in the observation of the length of the mustard plant age 1 – 4 mst (weeks after plants). Test results comparison map using the Tukey Test (HSD) showed that the length of the best plants mustard plant age 1 – 4 mst contained in the A2B2 treatment i.e. treatment of the mustard plant with fertilizer tofu 300 gr and RIM 20 ml/l of water. The length of the plant lowest in treatment A0B0 the treatment of mustard plant without fertilizer tofu and without RIM.

Lestari et al. (2016) said, that the higher the granting of the elements of N (Nitrogen) then the sooner sintesi carbs that are turned into protein and protoplasm which is part of the substance of the constituent organs of the plant. Sutoro (2010) said that the use of bioactivator very positive impact on the addition of nutrients in the soil, and can improve the soil structure. During the process of composting organic material is then added

bioactivator that contain microorganisms that reduce the lignin, cellulose, protein, starch, lipid, and microorganisms that fixates nitrogen (N). The microorganisms contained in the bioactivator can also accelerate the rate of composting organic material, so that the content of the phosphate contained in the organic material can be used directly by plants. Wahyono (2010) said that one of the benefits of the use of bioactivator RIM technology is to help the plant in the process of absorption and distribution of nutrients from the roots to the leaves. The microorganisms contained in the bioactivator RIM technology provides benefits in increased growth of plant height of mustard.

Nutrient content is higher and the addition of bioactivator that the higher the give a real influence on the ability of plants to absorb nutrients in the soil, as well as the provision of bioactivator give a positive impact on the quality of the soil so that crops cultivation be increased.

UTILIZATION OF RIM TECHNOLOGY (Refresh Microorganism) AND WASTE PULP TOFU TO INCREASE THE GROWTH OF MUSTARD PLANTS (*Brassica juncea*, L.)

The number of plant Leaves (strands)

The average Number of Leaves (strands)	Week 1	Week 2	Week 3	Week 4
Treatment	Tofu	Tofu	Tofu	Tofu
A0	2.3333 a	3.1111 a	4.6667 a	6.3333 a
A1	2.8889 b	3.2222 a	5.3333 ab	7.6667 b
A2	2.8889 b	3.5556 a	5.6667 b	8.0000 b
Treatment	Bioactivator	Bioactivator	Bioactivator	Bioactivator
B0	2.4444 a	3.1111 a	4.6667 a	6.7778 a
B1	2.7778 ab	3.3333 a	5.1111 a	7.3333 b
B2	2.8889 b	3.4444 a	5.8889 b	7.8889 c

Description: numbers followed by the same letter means no real difference to the Tukey test ( $\alpha = 5\%$ ).

The results of the analysis range showed no interaction between treatment factors A (Fertilizer tofu) and treatment factors B (Solution of the RIM) on the variables in the observation of the number of leaves of the mustard plant from the age of 1 – 4 mst, and variables observations of the number of leaves of the mustard plant age 1 – 4 mst showed that the factor A (Fertilizer tofu) or factor B (Solution of RIM) does not give a real influence on the number of leaves of the mustard plant.

Treatment A2 (tofu 300 gr) and the treatment B2 (RIM 20 ml/l of water) is a treatment that produces the number of leaves is highest.

The difference in the results of the anova test the number of leaves that are not real in the age of the plant 1 mst and 2 mst allegedly because it is still less than optimal nutrient absorption of plants at that age, because organic fertilizers take longer than in inorganic fertilizer in the parse the content of nutrients such as N, P, and K. Leaf formation is also influenced by the amount of nutrients contained in the soil so that the results of treatment A2B2 higher than A0B0.

Increased growth of plants on the parameters of the observation of the number of leaves look real difference in the age of the plant 3 mst and 4 mst. One of the causes of the high growth of leaves on the plant, i.e., the number

of leaves contained in the plant, as well as the content of nutrient elements contained in the growing place.

Broad Leaf Plants (cm<sup>2</sup>)

Treatment	The broad Leaves of the Mustard Plant 4 DAP (Days After Planting) (cm <sup>2</sup> )
A0B0	251.4233 a
A0B1	301.4667 ab
A0B2	336.3067 abc
A1B0	324.8000 abc
A1B1	373.4833 bc
A1B2	540.7733 de
A2B0	347.1067 abc
A2B1	429.2833 cd
A2B2	633.8233 e

Description: numbers followed by the same letter means no real difference to the Tukey test ( $\alpha = 5\%$ ).

The results of the analysis of the variety show the interaction between the factors treatment A (Fertilizer tofu) and treatment factors B (Solution of the RIM) on the variables in the observation of broad leaf mustard plant age 4 mst. Test results comparison map using the Tukey Test (HSD) showed that the leaf area best mustard plant age 4 mst contained in the A2B2 treatment i.e. treatment of the mustard plant with fertilizer tofu 300 gr and RIM 20 ml/l of water. The broad leaves of the lowest in the treatment A0B0 the treatment of

mustard plant without fertilizer tofu and without RIM.

The leaves are producing photosynthate major on the plants, number of leaves that many will give effect to the results of photosynthate plants because the process of photosynthesis that occurs in plants getting bigger. The broad leaves of the plant showed the ability of leaves to absorb sunlight, which then can be utilized by plants in the process of plant growth. The growth parts of the plants fabric the faster it will influence the growth of other plant parts (Irmayanti, 2013).

Fitriyanto et al. (2011) said the development of leaf area will affect the growth of the leaf to the other. So with the increasing number of leaves will also improve the results of the leaf area of the plant. Nutrient content owned by waste tofu is also an important part in the increase in the size of the leaf area of the plant, because of the higher nutrient received, the faster the growth process that takes place. The content of N (Nitrogen) fertilizer tofu is not too high, but increased the amount of fertilizer tofu gives the impact of the fulfilled the need of N in the plant mustard greens.

The content of microorganisms in the soil also becomes important role in the process of decomposition of organic materials that exist in the soil in the process of absorption of elements of haranya. The high number of microorganisms in the soil will give a positive impact on the ground so that can improve the growth of plants. Wahyono (2010) said that one of the benefits of the use of bioactivator RIM technology is to help the plant in the process of absorption and distribution of nutrients from the roots to the leaves.

#### Wet Weight Of The Plant (gr)

Treatment	Wet Weight Of The Mustard Plant (gr)
A0B0	08.4467 a
A0B1	14.4667 b
A0B2	17.5267 bc
A1B0	09.9900 a
A1B1	18.5333 c
A1B2	30.2400 e
A2B0	17.5000 bc
A2B1	25.8600 d
A2B2	40.4167 f

Description: numbers followed by the same letter means no real difference to the Tukey test ( $\alpha = 5\%$ ).

The results of the analysis range showed an interaction between treatment factors A (Fertilizer tofu) and treatment factors B (Solution of the RIM) on the variable observation of the wet weight of the mustard plant age 4 mst. Test results comparison map using the Tukey Test (HSD) showed that the wet weight best mustard plant contained in the A2B2 treatment i.e. treatment of the mustard plant with fertilizer tofu 300 gr and RIM 20 ml/l of water. Wet weight lowest in treatment A0B0 the treatment of mustard plant without fertilizer tofu and without RIM.

Differences in the results significantly between the treatment that occurs on the weight of the fresh plant in tune with the comparison of the results of plant length, leaf area, and leaf number. The higher the result of the length of the plant as well as leaf area and leaf number then it will give a high yield also against the wet weight of the plant. The high nutrient content that is a source of plant nutrients will provide an increase in the development of plants better in plant height or leaf number and leaf area of the plant.

In the bioactivator RIM technology there are a wide variety of microbes that can give you the advantage on the ground and also play a role

# UTILIZATION OF RIM TECHNOLOGY (Refresh Microorganism) AND WASTE PULP TOFU TO INCREASE THE GROWTH OF MUSTARD PLANTS (*Brassica juncea*, L.)

in helping the plant to absorb nutrients available in the soil. Sutoro (2010) said that the use of bioactivator very positive impact on the addition of nutrients in the soil, and can improve the soil structure. Wahyono (2010) said that one of the benefits of the use of bioactivator RIM technology is to help the plant in the process of absorption and distribution of nutrients from the roots to the leaves. The microorganisms contained in the bioactivator RIM technology provides benefits on the improvement of the results of the wet weight of the mustard plant.

The Dry weight of the plant (gr)

Treatment	The weight of Dry mustard plant (gr)
A0B0	0.6500 a
A0B1	1.2767 bc
A0B2	1.5833 c
A1B0	0.8033 ab
A1B1	1.6567 c
A1B2	2.5367 d
A2B0	1.4233 c
A2B1	2.2167 d
A2B2	3.3100 e

Description: numbers followed by the same letter means no real difference to the Tukey test ( $\alpha = 5\%$ ).

The results of the analysis of the variety show the interaction between the factors treatment A (Fertilizer tofu) and treatment factors B (Solution of the RIM) on the variables of the observation the weight of dry mustard plant age 4 mst. Test results comparison map using the Tukey Test (HSD) showed that the wet weight best mustard plant contained in the A2B2 treatment i.e. treatment of the mustard plant with fertilizer tofu 300 gr and RIM 20 ml/l of water. Dry weight lowest in treatment A0B0 the treatment of mustard plant without fertilizer tofu and without RIM.

Differences in the results significantly between the treatment that occurs on the dry weight of plants in harmony with the

comparison of the results of plant length, leaf area, and leaf number. The high yield plant length, leaf area, and leaf number and fresh weight of the plant then it will give a high yield also against the dry weight of the plant.

The high nutrient content that is a source of plant nutrients will provide an increase in the development of plants better in plant height or leaf number and leaf area of the plant, and the fresh weight of the plants, so that the results of the dry weight showed that the results are aligned. In the bioactivator RIM technology there are a wide variety of microbes that can give you the advantage on the ground and also play a role in helping the plant to absorb nutrients available in the soil. Sutoro (2010) said that the use of bioactivator very positive impact on the addition of nutrients in the soil, and can improve the soil structure. Wahyono (2010) said that one of the benefits of the use of bioactivator RIM technology is to help the plant in the process of absorption and distribution of nutrients from the roots to the leaves. The microorganisms contained in the bioactivator RIM technology provides benefits on the improvement of the results of the wet weight and in harmony with the dry weight of the mustard plant.

Root Length (cm)

The average Length of the Roots of the Plants (cm)	
Treatment	Tofu
A0	4.9890 a
A1	6.4780 a
A2	6.8780 a
Treatment	Bioactivator
B0	5.5670 a
B1	5.9000 a
B2	6.8780 a

Description: numbers followed by the same letter means no real difference to the Tukey test ( $\alpha = 5\%$ ).

The results of the analysis range showed no interaction between treatment factors A (Fertilizer tofu) and treatment factors B (Solution of the RIM) on the variables in the observation of the length of the root of the mustard plant, as well as factor A (Fertilizer tofu) and factor B (Solution of RIM) does not give a real influence on the length of the root of the mustard plant.

Treatment A2 (tofu 300 gr) and the treatment B2 (RIM 20 ml/l of water) is a treatment that produces root length high.

The root has the function to absorb water and nutrients in the soil and serves to strengthen the establishment of the plant (Heru and Yovita, 2003). On the results of the research of the mustard plant with the fertilizer treatment tofu and bioactivator RIM technology show that the best results are on treatment A2B2. Fitter et al. (1998) says that the growth of the root system is the response of an influence on the amount of the concentration of nutrients in the soil, so that more nutrients obtained by the plant, the higher root growth occurs.

The roots of experience the development with the growth of the root-lateral roots intensively on areas that are rich in nutrients such as elements of K that are at the tip of the root stimulates the process of elongation of the root. Root length was also influenced by the amount of microorganisms that are on the ground. On the solution of bioactivator RIM technology there are a wide variety of microbes that can give you the advantage on the ground and also play a role in helping the plant to absorb nutrients available in the soil. Sutoro (2010) said that the use of bioactivator very positive impact on the addition of nutrients in the soil, and can improve the soil structure. Salisbury and Ross (1998) said that the form of rooting was more influenced by genetic factors than environmental factors, so it is possible the result of the length of the root of the mustard plant showed no real difference

in the anova table due to the influence of the genetic makeup of cultivated plants such.

## CONCLUSION

Based on the results of the research can be concluded that the :

1. There is interaction between fertilizer tofu with a solution of the RIM to the variable observations of plant length, leaf area plant mustard 4 mst, wet weight, and dry weight of the mustard plant.
2. Combination treatment most recommended contained in the A2B2 treatment with fertilizer tofu 300 gr and RIM 20 ml/l of water.
3. In the variable observations of the number of leaves of the mustard plant and leaf area of the plant mustard 2 mst showed, that there is the influence of the very real fertilizer tofu and a solution of RIM against variables such observations.

## Reference

- Anggoro, R. 1985. Food Science Poultry. The Progress Of The Cutting-Edge. UI Press. Jakarta.
- Cahyono, B. 2003. Techniques and Strategies Cultivation of Mustard Greens (Pai-Tsai). It 12-62. Yoyakarta: Yayasan Pustaka Nusantara.
- Fitter, A. 1998. Environmental Physiology of Plants. Department of Biology appears to be a flavoprotein in Arabidopsis.
- Fitriyanto. 2012. Test liquid organic fertilizer from waste market on the growth of lettuce plants with hydroponic media [Thesis] Surakarta: Faculty of Teacher training and Education. Muhammadiyah University Of Surakarta.
- Heru J, Yovita. 2003. The Cultivation Of Horticultural Crops. Jakarta: Bina Aksara.

UTILIZATION OF RIM TECHNOLOGY (Refresh Microorganism) AND WASTE PULP TOFU TO INCREASE  
THE GROWTH OF MUSTARD PLANTS (*Brassica juncea*, L.)

- Heru, P., and Yovita, H., I. 2003. Hydroponic Vegetables Annuals For Hobby and Business. Gramedia. Jakarta. /2010/06/bioactivator-kmpostingapakah-it.html. accessed on April 17, 2013.
- Lestari, W., Syaiful, A., Febrymansyah, S. 2016. The effectiveness of the use of solid waste amapsa know as organic fertilizer on the growth and production of plants red spinach (*Amaranthus Tricolor* L.). Program studi Agroteknologi. High School Of Agricultural Sciences Labuhanbatu. Sumatra.
- Prihandarini, R., 2019. Technology Microorganisms RIM. Maporina. (<http://ririenuwg.blogspot.com/2012/02/dr.html>)
- Sallisbury, F. and Ross U. C. 2017. Plant Physiology. Uploaded by Public Resource on January 25, 2017. Book Source: Digital Library of India Item 2015.271835
- Sudiarso and Ririen Prihandarini. 2018. "The effect of biofertilizer and inorganicfertilizer on the vegetative growth of sugarcane (*Sacccharum officinarum*). Journal of Applied and Physical Sciences JAPS 2018. 4 (1) : 8-13.
- Sutanto, R., 2002. The Application Of Organic Farming. Community'sl and Development. Yogyakarta: Kanisius.
- Sutoro, 2010. "Mold Preduksi Phosphate from a Variety of Bioactivator (Reducing Phosphates. Mold From Various Bioactivator)". Sepuluh November Institute Of Technology. Surabaya.
- Tillman, A.D., H. Hartadi, S. Reksohadiprojo, S. Prawirokusumo, and S. Lebdosoekojo. 1998. Food Science Basic Livestock. Sixth Edition. Gadjah Mada University Press. Yogyakarta.
- Wahyono, S., 2010, Bioactivator Composting, <http://sriwahyono.blogspot.com>