Effect of AB Mix and Bokashi Fertilizer on the Growth of Mustard Green Plant (Brassica Juncea L. Var. Tosakan) with Deep Flow Technique (DFT) Hydroponic System

Joshua H. L. Tobing
Biology Study Program, Faculty of Mathematics and Natural Sciences, Universitas Advent Indonesia, Jl. Kolonel Masturi No. 288, Cihanjuang Rahayu, Parongpong, Bandung Barat 40559

jtobing@unai.edu

ABSTRACT

Hydroponic planting provides opportunities for anyone and anywhere for people to grow plants. This study uses the Deep Flow Technique (DFT) hydroponic where water and nutrients are circulated. This research determines the effect of various types of fertilizer and their concentration level on the growth of the Mustard Green plant, particularly on the number and weight of leaves. Fertilizers fermented are Cauliflower leaves bokashi fertilizer, cow dung bokashi fertilizer, and a mixture of both with Effective Microorganisms 4 (EM4), and Hydroponic cultivation of leafy vegetables commonly used hydroponic nutrient solution in the form of a standard solution (AB mix). The concentrations of fertilizer are 400, 600, 800, 1000, and 1200 ppm. Two analytical data were used, the Friedman test for the variety of concentrations and One-way ANOVA for the effect of the fertilizer. The results show that the concentration variations of AB Mix and mixed bokashi fertilizer give significant differences in the growth, and in the number of leaves, and all concentration variations show significant differences. The results also show that the types of fertilizer influences significantly the growth of the Mustard Green plant based on the number and weight of leaves.

***Keywords*: Bokashi, AB Mix, Mustard Green Plant, DFT, and Hydroponics.**

INTRODUCTION

Hydroponics is an alternative way of farming in a limited area of urban. It is Easy, controlled, and can be done on media without soil, even in a house. In hydroponic watering system is done automatically and the environment can be controlled to prevent the plant from pests, it is suitable for people who do more routine work in the office than at home. Hydroponic farming can be done by anyone and anywhere. The benefits are not only for business activities but also for personal consumption because hydroponic plants produce high-quality results compared to plants growing in the ground. Hydroponics is an agricultural method where water

is used instead of soil. The word "hydroponics" comes from Latin, where "hydro" means water and "phonos" means work, so it can be interpreted as "working water". In terms, hydroponics refers to agricultural activities where water is the main medium that replaces soil (Khotmi et al., 2022). One type of hydroponic system is the Deep Flow Technique (DFT), where water and nutrients are circulated through the inundation method. In DFT, water and nutrients are pumped from the tank to the plant roots and back again to the tank to be circulated back to the plant roots. The purpose of this puddle is for the roots of the plant that are submerged in the water to get balanced nutrients and oxygen.

Bokashi stands for organic materials rich in Biological Resources, as the name implies Bokashi comes from the fermentation of organic waste that originated around the farmland. Bokashi require quite a long time to decompose into nutrient elements that are easily absorbed by plants to increase growth and crop production (Wike, 2014)

REVIEW OF RELATED LITERATURE

AB Mix nutrient or Rockwool fertilizer was able to increase the growth and yield of pagoda mustard Green plants, but there was no interaction between the two treatment factors (Fauzi et al., 2024). AB Mix and liquid organic fertilizer tea pulp affected the growth of mustard plant height, number of leaves, and wet weight of mustard plants (Trisnawati, 2023). There is a significant interaction in the treatment of organic fertilizers on the variable number of leaves aged 14 DAS and plant wet weight (Sari et al, 2020)

RESEARCH METHODS

Tools and Materials

The tools used in this study are as follows: Covered buckets, measuring cups, water pumps, Total Dissolved Solid (TDS) meter, PVC pipes, electrical outlets, electrical cables, scales, and net pots. The materials used for this study are as follows: Cauliflower leaves bokashi fertilizer, cow dung bokashi fertilizer, AB mix (nutrient solution consisting of a nutrient solution containing stock A macro and stock B containing micronutrients fertilizer), mustard Green plant, hydrotone, water, Effective Microorganisms 4 (EM4), and brown sugar.

RESEARCH DESIGN

The research design using the DFT hydroponic system is as follows:

1. Cauliflower leaves bokashi fertilizer: As much as 6 kg of Cauliflower leaves are put into a bucket containing 10 liters of water, mixed with EM4 as much as 50 mL, and with 20 g

of brown sugar. The bucket was tightly closed for fermentation for 3 weeks and was checked weekly. Liquid as the result of the fermentation results was filtered to get the Cauliflower leaves bokashi fertilizer and to be applied to the Deep Flow Technique hydroponic system.

2. Cow dung bokashi fertilizer: Three (3) kg of cow dung are put into a bucket containing 10 liters of water, mixed with EM4 as much as 50 mL, and with 20 g of brown sugar. The bucket was tightly closed for 3 weeks for the fermentation process and was checked every week. Liquid as the result of the fermentation was filtered to get the cow dung bokashi liquid and to be applied to the Deep Flow Technique hydroponic system.
3. Cauliflower leaves and Cow Dung mixture. As much as 3 kg of each of the Cauliflower leaves and the cow dung were put into a bucket containing 10 liters of water, they were mixed with 50 mL of EM4 and 20 g of brown sugar. The bucket was tightly closed for 3 weeks for fermentation and was checked every week, and after 3 weeks the fermented mixture was filtered to get a liquid bokashi fertilizer and was to be applied to the Deep Flow Technique hydroponic system.

In making this DFT hydroponic system, the first step is to prepare a 4 m long and 7.10 cm in diameter PVC pipe. A bucket containing 10 liters of nutrients and a submersible pump (a device that has a hermetically sealed and enclosed motor for the pump body. The entire innermost linkage in the liquid for the pump), is used to circulate the nutrient solution to the Mustard Green plant planted. The hole distance per plant is 20 cm with a diameter of 4.5 cm, and the distance between pipes is 21 cm. The working principle of the DFT hydroponic system is to flow the nutrient solution continuously for 24 hours in a closed flow circuit. The nutrient solution from the reservoir bucket flows/is circulated using a water pump through the planting inlet PVC pipes, and then the nutrient solution in the planting PVC will flow back to the reservoir through the outlet PVC pipes this is the circulation process in the DFT hydroponic system of the study.

METHODOLOGY

Mustard Green Plant Transfer on Hydroponic Media

Mustard Green plant seeds were planted in the soil planting medium. Plants that already have roots of 1-2 cm, were transferred into the PVC pipe for the DFT system process. The plants transplanted into the plant net pot with hydrotone are healthy, not damaged, and have almost the same size and number of leaves.

Regulation of Nutrient Fluid Concentration

Before planting it is necessary to do several things so that the transplanted plants can grow well: Making sure the Deep Flow Technique (DFT) system is functioning properly and no leak, make sure the irrigation is not clogged, and making sure that they maintain healthy and good plants. Measuring the concentration variation of hydroponic solutions using Total Dissolved Solid (TDS) meter is needed before the Mustard Green plant are planted into the net

pot. Understanding and keeping the Total Dissolved Solid (TDS) meter is very important, the viscosity measurement of the solution should be adjusted to the type and age of the plant. The measurement method is to dip the tip of the tool into the fertilizer solutions and to maintain homogeneity of nutrients the solution was stirred 2 times per day regularly. The PPM of the liquid fertilizer is adjusted to the age of the plant, the Mustard Green plant requirement is 400-1,400 PPM.

For the maintenance and successful process, the water amount and flow were checked to avoid clogging, the nutrient was checked using the TDS meter. Dead plants are immediately taken/removed and replaced with new plants when it is still possible

Statistical Analysis

The data obtained was tested using two statistical analyses. To analyze the difference between plant growth yield data variables measured through the number and weight of leaves obtained as dependent variables and the level of concentration variations of the fertilizer as independent variables the Friedman Test was used in which to analyze the significance measure of the plant growth by calculating the number and weight of leaves obtained. Furthermore, a two-way Analysis of Variance (ANOVA) was used to see the different influences of the fertilizer on plant growth. The types of fertilizers as a variable in the level of concentration variations are the independent variable, and the number and weight of leaves obtained are the dependent variables.

FINDINGS

Research Results and Discussion

The data collected were first analyzed using the Shapiro-Wilk normality test, but since the results showed that the data obtained did not meet the level of normality, the Non-Parametric test the Friedman test was used in analyzing the results. The data obtained are tested descriptively and Friedman tests and presented in the form of tables.

Table 1
Friedman Test Analysis on the Number
of Mustard Green Plant Leaves Using AB Mix Fertilizer

N	15
Chi-Square	12.510
Degrees of Freedom	4
Asymptotic Significance	0.014

From the table above, it can be seen that the results of the Friedman test analysis show a meaningful level value where p-value = 0.014 < α = 0.05. This means that the level

concentration variations of AB Mix fertilizer give a significant difference in the growth Mustard Green plant according to the number of leaves.

Table 2
Friedman Test Analysis on the Number of Mustard Green Plant Leaves Using Cauliflower Leaves Bokashi Fertilizer

N	15
Chi-Square	7.077
Degrees of Freedom	4
Asymptotic Significance	0.132

From the table above, it can be seen that the results of the Friedman test analysis show meaningless level values where *p*-value = 0.132 > α = 0.05. This means that the concentration variations of Cauliflower leaves' bokashi fertilizer as fertilizer do not give a significant difference in the growth of the Mustard Green plant according to the number of leaves.

Table 3
Friedman Test Analysis on the Number of Mustard Green Plant Leaves Using Cow Dung Bokashi Fertilizer

N	15
Chi-Square	7.467
Degrees of Freedom	4
Asymptotic Significance	0.113

From the table above, it can be seen that the results of the Friedman test analysis show meaningless level values where *p*-value = 0.113 > α = 0.05. This means that the concentration variations of cow dung bokashi fertilizer do not give a significant difference in the growth of the Mustard Green plant according to the number of leaves.

Table 4
Friedman Test Analysis on the Number of Mustard Green Plant Leaves Using a Mixture of Cauliflower Leaves and Cow Dung Bokashi Fertilizer

N	15
Chi-Square	13.333
Degrees of Freedom	4
Asymptotic Significance	0.010

From the table above, it can be seen that the results of the Friedman test analysis show a meaningful level value where *p*-value = 0.010 < α = 0.05. This means that concentration variations of the mixture of Cauliflower leaves and cow dung bokashi fertilizer give a significant difference in the growth of the Mustard Green plant according to the number of leaves.

Table 5
Friedman Test Analysis on the Weight of Mustard Green Plant Leaves Using AB Mix Fertilizer

N	15
Chi-Square	21.067
Degrees of Freedom	4
Asymptotic Significance	0.001

From the table above, it can be seen that the results of the Friedman test analysis show a meaningful level value where *p*-value = 0.001 < α = 0.05. This means that the concentration variations of AB Mix fertilizer give a significant difference in the growth of the Mustard Green plant according to the leaves' weight.

Table 6
Friedman Test Analysis on the Weight of Mustard Green Plant Leaves Using Cauliflower Leaves Bokashi Fertilizer

N	15
Chi-Square	23.841
Degrees of Freedom	4
Asymptotic Significance	0.001

From the table above, it can be seen that the results of the Friedman test analysis show a meaningful level value where *p*-value = 0.001 < α = 0.05. This means that the concentration variations of the Cauliflower leaves bokashi fertilizer give a significant difference in the growth of the Mustard Green plant according to the leaves' weight.

Table 7
Friedman Test Analysis on the Weight of Mustard Green Plant Leaves Using Cow Dung Bokashi Fertilizer

N	15
Chi-Square	33.543
Degrees of Freedom	4
Asymptotic Significance	0.001

From the table above, it can be seen that the results of the Friedman test analysis show a meaningful level value where *p*-value = 0.001 < α = 0.05. This means that the concentration variations of the cow dung fertilizer give a significant difference in the growth of the Mustard Green plant according to the leaves' weight.

Table 8
Friedman Test Analysis on the Weight of Mustard Green Plant Leaves Using a Mixture of Cauliflower Leaves and Cow Dung Bokashi Fertilizer

N	15
Chi-Square	22.811
Degrees of Freedom	4
Asymptotic Significance	0.001

From the table above, it can be seen that the results of the Friedman test analysis show a meaningful level value where *p*-value = 0.001 < α = 0.05. This means that the concentration variations of the mixture of Cauliflower leaves and cow dung bokashi fertilizer give a significant difference in the growth of the Mustard Green plant according to the leaves' weight.

Table 9
Univariate Analysis of Variance on the Number of Mustard Green Plant Leaves

Source of Variation		Sum of Squares (Type III)	DF	Mean Squares	F Value	Sig.
Intercept	Hypothesis	290.083	1	290.083	285.328	0.000
	Error	4.067	4	1.017		
Types of Plant	Hypothesis	5.370	3	1.790	17.703	0.000
	Error	1.213	12	0.101		
Fertilizer Concentration	Hypothesis	4.067	4	1.017	10.055	0.001
	Error	1.213	12	0.101		
Types of Plant and Fertilizer Conc.	Hypothesis	1.213	12	0.101	0.740	0.712
	Error	38.267	280	0.137		

The table above shows that the concentration variations and types of fertilizer have a significant influence on the growth of the Mustard Green plant (*Brassica* juncea L. var.

Tosakan) according to the number of leaves with *p*-values = 0.000 < α = 0.05. Although it is not tested for the level of significance in this research hypothesis, because it is a random variable/factor related to the main variable/factor, namely the types of fertilizer, it was found that the variable level of concentrations of the fertilizer in this study have a significant influence on the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan) according to the number of leaves, it can be seen that this variable alone gives a meaningful effect with *p*-value = 0.001 < α = 0.05. The table above also shows that the interaction of the types of and the concentration variations level of the fertilizers do not have a significant influence on the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan) according to the number of leaves where *p*-values = 0.712 > α = 0.5

Table 10
Univariate Analysis of Variance on the Mustard Green Plant Leaves' Weight

Source of Variation		Sum of Squares (Type III)	DF	Mean Squares	F Value	Sig.
Intercept	Hypothesis	9.530	1	9.530	19.937	0.011
	Error	1.912	4	0.478		
Types of Plant	Hypothesis	5.061	3	1.687	11.555	0.001
	Error	1.752	12	0.146		
Fertilizer Concentration	Hypothesis	1.912	4	0.478	3.274	0,049
	Error	1.752	12	0.146		
Types of Plant and Fertilizer Conc.	Hypothesis	1.752	12	0.146	3.221	0.000
	Error	12.691	280	0.045		

The table above shows that the concentration variations and the types of fertilizers have a significant influence on the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan) according to leaves' weight with *p*-value = 0.001 < α = 0.05. Although the significance level of this research hypothesis was not tested, as it is a random variable/factor related to the main variable/factor, namely the type of planting substrate, it was found that the variable level of concentration of planting substrates in this study has a significant influence on the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan) according to the weight of the leaves, it can be seen that this variable alone gives a significant effect with *p*-value = 0.049 < α = 0.05. The above table also shows that the interaction between the types of fertilizers has a significant influence on the growth of Mustard Green plant (*Brassica* juncea var. Tosakan) plants based on the weight of the leaves with *p*-value = 0.000 < α = 0.05.

CONCLUSIONS AND SUGGESTIONS CONCLUSIONS

Based on data analysis obtained through the Friedman test, it was shown that each level of concentration of AB Mix fertilizer and a mixture of Cauliflower leaves and cow dung bokashi fertilizer, according to the number of leaves has a significant difference in the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan). Meanwhile, neither of the

Cauliflower leaves nor cow dung bokashi fertilizer provide a significant difference at all. Data analysis obtained through the Friedman test showed that all concentration levels of AB Mix fertilizer and the various bokashi fertilizers, according to the weight of the leaves made a significant difference in the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan). Based on data analysis obtained through univariate variant analysis tests, it was shown that the type of fertilizer used in this study, the AB Mix, Cauliflower leaves, a mixture of Cauliflower leaves and cow dung bokashi fertilizer had a significant influence.

SUGGESTION

Based on the results of the research that has been done, the researcher provides suggestions that can be a reference in conducting further research. Further testing can be done on the effect of bokashi and AB Mix for the growth of the Mustard Green plant (*Brassica* juncea L. var. Tosakan) with Deep Flow Technique (DFT) hydroponic systems, using various types of bokashi fertilizers, various types of hydroponic systems, test methods, and variations in the concentration level of other growing media.

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