SEAS (Sustainable Environment Agricultural Science) E-ISSN 2614 – 0934
https://ejournal.warmadewa.ac.id/index.php/seas
Vol. 3, Number 1, April 2019, pages: 48 - 54 http://dx.doi.org/10.22225/seas.3.1.1333.48-54

Published: April 30rd, 2019

Concentration Response and Frequency of Biomi Liquid Organic Fertilizer Application for the Growth and Yield of Young Okra Plants (Abelmoschus esculentus L.)

Kadek Satriawan, Made Sri Yuliartini, Luh Kartini
Agrotechnology Department, Faculty of Agriculture, Universitas Warmadewa, Indonesia

Abstract

The study aims to determine the concentration and the appropriate frequency of biomi liquid organic fertilizer application for the growth and yield of okra plants. This experiment was a factorial experiment designed using a Randomized-group Design, which consisted of two treatments, comprising the concentration of liquid organic biomi fertilizer (C) and frequency of application (F). The results of the data analysis showed that the concentration of liquid organic fertilizer biomi (C) had a significant effect (P <0.05) on the maximum number of leaves per plant and had no significant effect (P≥0.05) on other variables. Meanwhile, the treatment of application frequency (F) and interaction (CxF) had no significant effect (P≥0.05) on all observed variables. The highest fresh weight of fruit per plant was found in the concentration of biomi liquid organic fertilizer 5 ml.l-1, which is 300.93 g, which increased by 4.55% compared with the lowest weight obtained at a concentration of 2.5 ml.l-1 is 287.83, although it is not significantly different from other concentrations. The frequency of application (3 times) is able to give the highest fresh weight of fruit per plant that is 299.14 g, which also experienced an increase of 1.99% and 3.69% when compared to the that of twice administration that is only 293.28 g and the lowest frequency of 4 times, was 288.48 g.

Keywords: biomi liquid organic fertilizer, frequency of application and okra plants.

Author Correspondence:
Made Sri Yuliartini
Agrotechnology Department, Faculty of Agriculture, Universitas Warmadewa, Indonesia
E-mail: sri.yuliartini@gmail.com

1. Introduction

Okra (*abelmoschus esculenthus L.*) especially those existing in Bali has not been well-known and is still rare, both in terms of its cultivation and the use of its fruit. The cultivating business of okra develops in several production centres in Indonesia as a profitable source of farmers' income. Okra fruit has a high nutritional content, rich in fiber, antioxidants and vitamin C. Young okra fruit contains 85.70% water content, 8.30% protein, 2.05% fat, 1.4% carbohydrate, and 38.9 % of calories per 100 grams (1). Therefore okra is widely consumed, both as a vegetable and as a medicine, given that the okra fruit provides positive benefits for the body in maintaining health. Okra fruit can be used as a consumable vegetable processed through boiling, sauteing, or sliced and eaten during raw. Okra (*abelmoschus esculentus L.*) plants grow in tropical and sub-tropical regions. This plant is grown commercially in India, Turkey, Iran, West Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia and Cyprus in South America. India ranks first in the world as a producer of 3.5 million tons of okra (70% of total flower production) yielded from an area of 350,000 ha (2).

One of the current efforts to develop vegetables that leads to organic farming is to reduce production costs but to increase yields. The alternative is the use of fertilizers that are appropriate and in accordance

with plant needs. For this reason organic fertilizer is an option. Organic fertilizers are fertilizers that play a role in increasing the biological, chemical, and physical activity of the soil so that the soil becomes fertile and good for plant growth (3). One form of organic fertilizer is POC, which is organic fertilizer in liquid preparations. Containing nutrients that are very finely shaped making this fertilizer very easily absorbed by plants, even by the leaves or stems. This fertilizer is applied by spraying the leaves or spraying it on the stems of plants. Sources of organic fertilizer raw materials are available anywhere with an abundant amount that is all in the form of waste, both household waste, restaurants, agricultural markets, livestock, and other types of organic waste (4).

The fertilizer used is biomi liquid organic fertilizer which is ready-made in a bottle which is the result of processed solid waste and cow's liquid waste with the addition of other starters. Biomi liquid organic fertilizer has complete nutrients which can play a role in supporting the growth and development of plants. In vegetable plants the recommended concentration for vegetables is 2-3 cc/liter of water (5).

This study aims to determine the application concentration and the appropriate frequency of application of biomi liquid organic fertilizer for the growth and yield of okra plants. The hypothesis proposed in this study is that the application of biomi liquid fertilizer concentration (5 ml.l-1 water) and the frequency of application (3 times) can give the highest yield and growth of okra plants.

2. Materials and methods

Time and Location of the Research

This study was conducted on a former paddy field in Sumerta Village, East Denpasar District, Denpasar City. This site is located at an altitude of 0 - 75 metres above sea level with an average temperature of 37 ° C - 32 ° C. The study was conducted from 28 March 2018 to 5 June 2018.

Materials and Instruments of the Research

The materials used in this study were okra seeds with brand name Know You Seed in 10 g packaging, biomi liquid organic fertilizer, and pearl NPK fertilizer (as a basic fertilizer), and 10 ml of Virtako insecticide.

The tools used in this study include: soil processing equipment (hoe, tractor), sickle, spraying equipment, rake, rake, seedbed tray, meter, scale, measuring cup, oven and stationery and documentation tools.

Research design

This experiment is a factorial experiment using a Randomized-group Design, which consists of two treatments, encompassing the concentration of liquid organic biomi fertilizer (C) and the frequency of application (F). The concentration factor of biomi liquid organic fertilizer consists of 4 levels: C0 = 0 ml.l-1, C1 = 2.5 ml.l-1, C2 = 5 ml.l-1, and C3 = 7.5 ml.l-1. The frequency factor consists of 3 levels: F1 = frequency with 2 times fertilizer application, F2 = frequency with 3 times fertilizer application, and F3 = frequency with 4 times fertilizer application. Thus there were 12 treatment combinations that were repeated 3 times so that there were 36 experimental plots.

The variables observed in this study were the maximum plant height, the maximum number of leaves per plant, the day of beginning to flower, the day of beginning to harvest, the number of fruit plants, fresh weight of fruit per plant, oven dry weight per fruit, fresh weight per plant, and dried weight

per plant.

Data Analysis

The data of the study were analysed by analysis of variance using analysis of variance according to the design used, in which if the results of the analysis showed a real to very real effect, followed by a BNT test of 5% level.

3. Results and Discussion

Findings

A summary of the average results for all observed variables is presented in Table 1. The significance of the concentration of liquid organic fertilizer (C) and the frequency of application (F) as well as their interactions (CxF) with the observed variables are presented in Table 1.

From Table 1 it can be seen that the treatment of the concentration of liquid organic fertilizer biomi has a significant effect (P <0.05) on the maximum number of leaves per plant and no significant effect (P≥0.05) on other variables. The treatment frequency of giving (F) and its interactions (CxF) had no significant effect (P≥0.05) on all observed variables.

Tabel 1

Significance of the concentration of biomi liquid organic fertilizer (C) and frequency of administration (F) and their interactions (CxF) on all observed variables

No	Variable	Treatment		Interaction
		Biomi Concentration (C)	Frequency (F)	
1	Maximum plant height (cm)	ns	ns	ns
2	Maximum number of leaves per plant (strands)	*	ns	ns
3	Flowering day (hst)	ns	ns	ns
4	Harvest day (hst)	ns	ns	ns
5	Number of fruits per plant (piece)	ns	ns	ns
6	Fresh weight of fruit per plant (g)	ns	ns	ns
7	oven dried weight of fruit per plant (g)	ns	ns	ns
8	Fresh weight of stover per plant (g)	ns	ns	ns
9	Stover oven dried weight per plant (g)	ns	ns	ns

Notes:

* = having a significant effect (P<0,05)

** = having a very significant effect (P<0,01)

ns = having no significant effect (P ≥0,05)

Discussion

The interaction between the concentration of biomi liquid organic fertilizer and the frequency of administration gave no significant effect on all observed variables. The average value of all variables observed in the treatment of biomi liquid organic fertilizer concentration (C) and frequency of administration (F) can be seen in Table 2.

Table 2

The average value of all variables observed in the treatment of biomi liquid organic fertilizer concentration (C) and frequency of application (F)

Concentration/ Frequency of Application	MP	ML	FD	HD	NF	FF	FW	FS	OW
0 ml.l^{-1} (K0)	104,66 a	32,58 b	26,11 a	33,22 a	23,11 a	292,64 a	9,13 a	1566,67 a	257,55 a
2,5 ml.l^{-1} (K1)	107,19 a	32,86 b	26,44 a	33,22 a	22,83 a	287,83 a	8,43 a	1657,37 a	269,95 a
5 ml.l^{-1} (K2)	108,01 a	37,17 a	26,11 a	33,33 a	24,08 a	300,93 a	10,17 a	1696,26 a	297,21 a
7,5 ml.l^{-1} (K3)	111,83 a	34,83 ab	25,89 a	32,89 a	23,28 a	293,14 a	9,77 a	1632,37 a	323,25 a
BNT 5%	-	2,64	-	-	-	-	-	-	-
2 times application (F1)	105,21 a	35.38 a	26.17 a	33.17 a	23,42 a	293,28 a	10,33 a	1640,53 a	281,56 a
3 times application (F2)	109,88 a	34.54 a	26.25 a	33.67 a	23,42 a	299,14 a	9,20 a	1694,58 a	293,97 a
4 times application (F3)	108,68 a	33.17 a	26.00 a	32.67 a	23,15 a	288,48 a	8,60 a	1579,38 a	285,43 a
BNT 5%	-	-	-	-	-	-	-	-	-

Notes:

The average value followed by the same letter in the same treatment and column, is not significantly different at the BNT test level of 5%

Observation Variables

MP = Maximum plant height (cm)

ML = Maximum number of leaves per plant (strands)

FD = Flowering day (hst)

HD = Harvesting day (hst)

NF = Number of fruits per plant (piece)

FF = Fresh weight of fruit per plant (g)

FW = Fruit oven dried weight per plant (g)

FS = Fresh stover weight (g)

OW= Oven dry weight stover (g)

The concentration of biomi liquid organic fertilizer gives a significant impact on the maximum number of leaves per plant, but on the other hand, gives no significant effect on other variables. The highest maximum number of leaves per plant was found in the concentration of biomi liquid organic fertilizer (5 ml.l-1 of (C2)) as much as 37.17 strands and not significantly different from the concentration of biomi liquid organic fertilizer at 7.5 ml.l-1 (C3) with a total of 34.83 strands. However, the variable is significantly different from the concentration of biomi liquid organic fertilizer (2.5 ml.l-^{1}) (C1), which is 32.86 strands and the concentration of biomi liquid organic fertilizer (0 ml.l-1) (C0) with the number of 32.58 strands, which increased respectively by 6.71%, 13.11% and 14.08%. Increasing the maximum number of leaves per plant in the treatment concentration (5 ml.l-1) of (C2) followed by

an increase in the number of fruits (r = 0.94 **), fresh fruit weight (r = 0.89 **), dried weight of the fruit oven (0.88 **), fresh stover weight (r = 0.75 **) and oven dried weight stover (0.66 *) (Table 3).

The highest amount of highest fresh weight of fruit per plant was obtained at a concentration of 5 ml.l-1 biomi liquid organic fertilizer (C2). The highest number of fruits is 24.08 which increased by 5.47% when compared with the lowest yielding the concentration of 2.5 ml.l-1 biomi liquid organic fertilizer (C1) which is 22.83 fruits, while the highest fresh weight of fruit per the plant is 300.93 g, an increase of 4.55% when compared to the lowest weight obtained with a concentration of 2.5 ml.l-1 (C1) which is 287.83 g, although it was not significantly different from other concentrations. The increase in the number of fruit and fresh weight of fruit per plant at a concentration of 5 ml. L-1 biomi liquid organic fertilizer (C2) is supported by the variable maximum number of leaves per plant (r = 0.94 **), and (r = 0.89 * *) and the number of fruits per plant (r = 0.99 **) (Table 3).

The high number of fruits per plant and the fresh weight of fruits per plant obtained at the treatment concentration of 5 ml.l-1 (C2) was also followed by the high oven dry weight of fruit per plant although it showed no significant difference. The highest oven dry weight of fruit per plant was obtained at a concentration of 5 ml.l-1 biomi liquid organic fertilizer (C2) which is 10.17 g, which was not significantly different from the concentration of 7.5 ml.l-1 biomi liquid organic fertilizer (C3), which is. 9.77 g and the concentration of 0 ml.l-1 biomi liquid organic fertilizer (C0) is 9.13 g. The lowest oven fruit dry weight per plant was obtained at a concentration of 2.5 ml.l-1 biomi liquid organic fertilizer (C1), which was 8.43 g, which experienced an increase of 4.09%, 11.38%, and 20, respectively. 64%. Increased oven dry weight of fruit per plant at a concentration of 5 ml. 1 -1 biomi liquid organic fertilizer (C2) is supported by the number of leaves (r = 0.88 **), day of flowering (r = -0.77 **) , number of fruits (r = 0.91 **), and fresh stover weight (r = 0.90 **) (Table 3).

Provision of biomi liquid organic fertilizer with a concentration of 5 ml.l-1 is able to provide nutrients suitable for the needs of okra plants for growth and development that is cultivated on experimental land that has a low content of organic C-material, so as to produce the maximum number of leaves per plant that is highest obtained at a biomi liquid organic fertilizer concentration of 5 ml.l-1. Biomi liquid organic fertilizer contains macro and micro nutrients as well as organic materials needed by plants for growth and development (6). Biomi liquid organic fertilizer has benefits that can encourage and increase the formation of leaf chlorophyll so that it can increase the ability of plant photosynthesis, increase the formation of flowers and ovaries, reduce the fall of leaves, flowers and ovaries (7). Therefore the increase in the maximum number of leaves per plant at a treatment concentration of 5 ml.l-1 is followed by an increase in the number of fruits (r = 0.94 **), fresh fruit weight (r = 0.89 **), dry weight of the fruit oven (0.88 **), fresh stover weight (r = 0.75 **) and oven dry weight stover (0.66 *) (Table 3).

The frequency of fertilizer application has no real effect on all observed variables. The frequency of application of fertilizer applied intends to divide the volume of application of each concentration of biomi liquid organic fertilizer that has been dissolved into 1 liter of solution given during the life of the okra plant, so that the availability of nutrients from biomi liquid organic fertilizer for the vegetative and generative phases of the okra plant become more efficient and also reduce the occurrence of evaporation of fertilizers by the environment (8). The frequency of 3 times application of fertilizer was able to provide the highest fresh fruit weight per plant that is 299.14 g, and an increase of 1.99% and 3.69% when compared to the frequency of 2 times application of 293.28 g, and the lowest frequency of 4 times

application is 288.48 g.

Table 3

Correlation coefficient (r) between variables due to the influence of biomi liquid organic fertilizer concentration

	1	2	3	4	5	6	7	8	9
1	1								
2	0,48^{ns}	1							
3	-0,55^{ns}	-0,41^{ns}	1						
4	-0,75**	0,13^{ns}	0,61*	1					
5	0,20^{ns}	0,94**	-0,42^{ns}	032^{ns}	1				
6	0,13^{ns}	0,89**	-0,49^{ns}	0,31^{ns}	0,99**	1			
7	0,46^{ns}	0,88**	-0,77**	-0,10^{ns}	0,90**	0,91**	1		
8	0,42^{ns}	0,75**	0,21^{ns}	0,27^{ns}	0,57*	0,44^{ns}	0,35^{ns}	1	
9	0,96**	0,66*	-0,68*	-0,65*	0,44^{ns}	0,39^{ns}	0,68*	0,45^{ns}	1

r (0,05; 10; 1) = 0,576 r (0,01; 10; 1) = 0,708

Table 4

Correlation coefficient (r) between variables due to the influence of frequency of fertilizer Application

	1	2	3	4	5	6	7	8	9
1	1								
2	-0,61^{ns}	1							
3	0,06^{ns}	0,75*	1						
4	0,25^{ns}	0,61^{ns}	0,98**	1					
5	-0,27^{ns}	0,93**	0,94**	0,87**	1				
6	0,30^{ns}	0,57^{ns}	0,97**	1,00**	0,84**	1			
7	-0,83**	0,95**	0,51^{ns}	0,34^{ns}	0,76*	0,28^{ns}	1		
8	0,21^{ns}	0,64^{ns}	0,99**	1,00**	0,88**	1,00**	0,37^{ns}	1	
9	0,88**	-0,17^{ns}	0,52^{ns}	0,67*	0,21^{ns}	0,71*	-0,47^{ns}	0,65*	1

r (0,05; 7; 1) = 0,666 r (0,01; 7; 1) = 0,798

Notes:

1. Maximum plant height (cm)
2. = Maximum number of leaves per plant (strands)
3. = The day starts flowering (hst)
4. = Day of harvest (hst)
5. = Number of fruits per plant (piece)
6. = Fresh weight of fruit per plant (g)
7. = Oven dry weight of fruit per plant (g)
8. = Fresh weight of stover per plant (g)
9. = Oven dry weight stover per plant (g)
10. * = Having a significant effect (P<0,05)
11. ** = Having a

4. Conclusion

Building upon the results of this study, conclusions are drawn on that, the interaction between the concentration of biomi liquid organic fertilizer and the frequency of fertilizer application has an insignificant effect on all observed variables. The concentration of biomi liquid organic fertilizer gives a real effect on the maximum number of leaves per plant, but has no significant effect on other variables. The highest fresh weight of fruit per plant is obtained at a concentration of 5 ml.l-1 biomi liquid organic fertilizer that is 300.93 g, which increased by 4.55% when compared to the lowest weight obtained at a concentration of 2.5 $ml.l^{-1}$, which is 287.83 g, although not significantly different from other concentrations. The frequency of fertilizer application has no significant effect on all plant variables. The 3 times frequency of fertilizer application was able to produce the highest fresh fruit weight per plant, which is 299.14 g, which increased by 1.99% and 3.69% when compared to the 2 times frequency of application which is 293.28 g, and the lowest frequency is 4 times the application (F3) is 288.48 g.

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