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The Effect of Fertilizer Concentration on the Growth of Land Kale (*Ipomoea reptans. Poir*)

Suparno[1], Mashelin Wulandari[2*]

[1] Department of Physics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.
[2] Postgraduates Students of Physics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.

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Corresponding Author:
Mashelin Wulandari
mashelinwulandari.2022@student.uny.ac.id

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Abstract: This study aims to examine the effect of fertilizer concentration on the growth of land kale. The research method chosen was a simple completely randomized design (CRD).The plant samples consisted of 6 groups, each consisting of 5 plants, with 1 group as the control group and the remaining 5 groups as the experimental group. The experimental group was treated with varying concentrations of liquid fertilizer from 2.44% by volume, 4.76% by volume, 6.98% by volume, 9.10% by volume up to 11.11% by volume and observations of plant growth were carried out once every 4 days for 5 period. Based on the plant height results, the experimental group produced the highest average plant in sample E with a concentration of 11.11% by volume. As for the number of leaves parameter, the highest number of leaves was also obtained in the experimental group sample E. Based on the results of analysis of variance using the Anova Test, it was found that the results of F_{count}>F_{table} were good in the analysis of the effect of fertilizer concentration on plant height and number of leaves. So that the use of liquid fertilizer has a significant effect on the growth of land kale (*Ipomea reptans. Poir*).

Keywords: Fertilizer; Growth; *Ipomea reptans. Poir;* Land Kale; Leaf

Introduction

Plant growth can be affected by various factors. These factors may include environmental conditions, growing media and fertilizers. What is meant by environmental conditions are temperature, humidity, altitude above sea level and solar heat. In addition, nutrients, acidity levels, and water content in the planting medium greatly affect growth. Likewise with fertilizer, the content of fertilizer, dosage, and frequency of fertilization are very influential on growth.

One type of liquid complementary fertilizer that can be used is Grow Quick LB fertilizer. The nutrients contained in this fertilizer consist of macro and micro nutrients. Macro nutrients in the form of Nitrogen (N), Phosphorus (P) and Potassium (K). While the micro nutrients are Boron (B), Copper (Cu), Manganese (Mn), Zinc (Zn), Iron (Fe), and Molybdenum (Mo). These nutrients are needed by plants to support plant physiological processes and growth so it is effective for providing nutrients to plants (Souri & Hatamian, 2018). The ratio of the ratio of the content and the amount of minerals in fertilizer can also affect plant productivity (Schulz & Glaser, 2012). However, the exact volume measurement for the use of Grow Quick LB fertilizer is not yet known. So it is necessary to do research by varying the concentration of the volume of this fertilizer in land kale plants.

Kangkung is one of the most popular and popular vegetables in Indonesia.Based on the Decree of the Minister of Agriculture No. 511/Kpts/PD.310/9/2006 it is stated that ground kale is one of the priority vegetable crops in Indonesia with large consumption of ground kale being the main cause.. Kale can be processed into various types of food, because kale has quite a lot of nutrients that are important for health (Raksun et al., 2020; Suroso & Antoni, 2017). Kale contains quite high nutrients, such as protein, fat, carbohydrates, calcium,

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phosphorus, iron, sodium, potassium, vitamin A, B vitamins, and vitamin C (Febriyono et al., 2017; Oka, 2007; Syafriani et al., 2022). Kale is also known by the Latin name Ipomea reptans and has two types of varieties, namely land kale which grows in land without standing water and water spinach which can grow in land with standing water.

Land kale (*Ipomea reptans Poir*) is a tropical plant that grows quickly. This leaf vegetable plant belongs to a group of annual or annual plants that are easy to cultivate, short-lived, and do not require a large area to cultivate them (Edi, 2014; Oka, 2007; Suroso & Antoni, 2017). The stem shape of ground kale is greenish white and has more seeds than water spinach, so it is propagated through seeds (Muntashilah et al., 2015). The nutritional content in 100 grams of kale includes energy of 29 cal; protein 3 grams; fat 0.3 gram; carbohydrates 5.4 grams; fiber 1 gram; calcium 73 mg; phosphorus 50 mg; iron 2.5 mg; vitamin A 6300 IU; vitamin B1 0.07 mg; Vitamin C 32 mg; Water 89.7 grams (Hidayati et al., 2017). The growth of kale can take place in the highlands and lowlands (Aminah et al., 2020). In addition, land kale plants can be planted in areas with hot and humid climates, and grow well in soils that are rich in organic matter and sufficient nutrients.

To increase yields, it is necessary to increase the growth of kale plants. With increased growth, kangkung production will also increase (Oka, 2007). Plant growth and crop production depend on the interaction between the plant and the environmental conditions in which the plant grows. Due to differences in environmental conditions can provide significantly different production results (Poorter et al., 2017; Rahman et al., 2019; Sampaio et al., 2016). Environmental conditions can be divided into several factors, namely climate, soil fertility and other organisms (Etesami & Maheshwari, 2018; Evizal & Prasmatiwi, 2021; Katili, 2013; Szakiel et al., 2011). These factors can limit and encourage plant growth and production, so that high production can be achieved by controlling environmental factors as best as possible.

One effort to regulate the environment of these plants and improve soil fertility is by adding fertilizer to plants. Fertilizers are all materials that are added to the soil with the aim of improving the physical, chemical and biological properties of the soil (Syofia et al., 2014). According to Kriswanto et al. (2016), the fertilizers used can be in the form of organic fertilizers (animal manure, compost, bokashi, etc.) and inorganic/chemical fertilizers in the form of single fertilizers (urea, SP-36, KCl) or compound fertilizers (NPK). In addition, fertilizers can also be divided into solid fertilizers and liquid fertilizers. Fertilization through leaves is a very efficient way, because nutrients easily penetrate the stomata and leaf cuticles and enter the cells (Lukman, 2018). One of the foliar fertilizers that can be used is Grow Quick LB for plant vegetative growth. This fertilizer contains macro nutrients N, P and K, micro nutrients Cu, Mn, Zn, B, Fe, and Mo besides containing vitamin B1 (Herlina et al., 2017; Sirliyana & Surtinah, 2019; Surtinah & Mutryarny, 2013).

The use of fertilizers that are rich in nutrients is expected to trigger plant growth. This is in line with research conducted by Fikri et al. (2015), that applying compost can increase growth, yield, and yield quality of kale plants. Pencemaran tanah merupakan masalah serius karena aplikasi limbah berbahaya dalam skala besar dan jangka panjang yang disebabkan oleh perkembangan industri dan pertanian (Zhang et al., 2020). Furthermore, research by Kriswanto et al. (2016) regarding the application of organic fertilizers and NPK fertilizers to corn plants showed that the two fertilizers had a significant effect on the parameters observed. The use of NPK fertilizer can also be in the form of liquid fertilizer which can be given through the leaves on plants. This is in line with the research of Sirliyana and Surtinah (2019) which states that applying various fertilizers through the leaves to orchid seedlings can affect seedling height, leaf length and number of leaves from orchid seedlings. This is in line with research conducted by Herlina et al (2017) that administering various doses of Grow Quick LB fertilizer given through the leaves can increase the growth of the Dendrobium Orchid plant. The same thing was also obtained in a study by Julhendri et al. (2013) who obtained the best treatment in the Grow Quick 7.5 ml/L treatment on Anthurium plants (Anthurium sp.). Based on some of the studies above, researchers have not found any use of this fertilizer in vegetable crops, especially water spinach. So that this research can complement previous research that has been done.

Fertilizer application is used to increase productivity and growth yields of land kale (*Ipomoea reptans. Poir*). So this study aims to see how the effect of the concentration of fertilizer given on the growth of land kale (*Ipomoea reptans. Poir*).

Method

The research that has been done is a type of experimental research with a simple complete randomized design (CRD). This study consisted of 6 treatments with 5 repetitions for each treatment. The tools and materials needed are land spinach seeds, polybags, measuring cups, planting media, hand sprayer liquid fertilizer, ruler, and other stationery.

The selected plant is land kale (Ipomoea reptans. Poir). The samples in this study were 30 pots of land kale

plants which were spaced 3 cm between the pots. The design of this study was used to examine the effect of variations in fertilizer concentration on the growth of ground kale in control and experimental plants. The fertilizer used is liquid fertilizer for leaves. The details of the control and experimental plants are as follows:

K = Without the use of liquid fertilizer (200 ml aquadest)
A = Giving liquid fertilizer 5 ml + 200 ml aquadest = 2.44% volume
B = Giving liquid fertilizer 10 ml + 200 ml aquadest = 4.76% volume
C = Giving liquid fertilizer 15 ml + 200 ml aquadest = 6.98% volume
D = Giving liquid fertilizer 20 ml + 200 ml aquadest = 9.10% volume
E = Giving liquid fertilizer 25 ml + 200 ml aquadest = 11.11% volume
1,2,3,4,5 = Repetitions performed for each treatment

The observations made were observations of the parameters of plant height, number of leaves, and measurement of the pH of each plant in each polybag. Observations of plant height and number of leaves were carried out every 4 days with a measurement range of 5 periods. The first observation period to the fifth observation period was carried out successively at the age of 4, 8, 12, 16 and 20 days after planting.

The data obtained were analyzed using the ANOVA test with a significance level of 5%. The Anova test is a method for analyzing data that is useful forexplain the differences by comparing the variances (Kim, 2017; Kirti et al., 2018; Guillén-Gámez et al., 2021). The ANOVA test in this study was usedto see the differences in plant growth by varying the concentration of fertilizer on the growth of kale kale plants.

Result and Discussion

Results Observations on the growth of plant height and number of leaves were carried out in the control and experimental plant groups. The control group is symbolized by K, and the experimental group is symbolized by A, B, C, D and E. This observation was carried out to obtain results regarding the effect of fertilizer on the growth of land kale through ANOVA test analysis.

Plant Height Parameters

Plant height measurements were carried out for 5 periods, starting on the 4th, 8th, 12th, 16th, and 20th day after planting. The results of observing the height growth of ground kale plants in the control group can be seen in the following table.

Table 1. Observation Profile of Plant Height Growth in the Control Class

Sample	Observation Period (cm)					Average
	1	2	3	4	5	
K1	1.3	3.5	5.5	8	12	6.06
K2	1.5	3.3	5.5	7.5	10	5.56
K3	1.5	3.5	5.5	8	12	6.1
K4	1.3	2.3	5	7.5	10	5.22
K5	1.5	2.5	5	7.5	11	5.5
Average	1.42	3.02	5.3	7.7	11	5.68

Based on table 1, it is known that the average plant height in the first observation period was 1.42 cm, the second period was 3.02 cm, the third period was 5.3 cm, the fourth period was 7.7 cm and the fifth period was 11 cm. Even though the control group was not given fertilizer, the kale plants could still grow. The average height produced in total is 5.68, with plants. The average growth of plant height in each period is presented in the following graph:

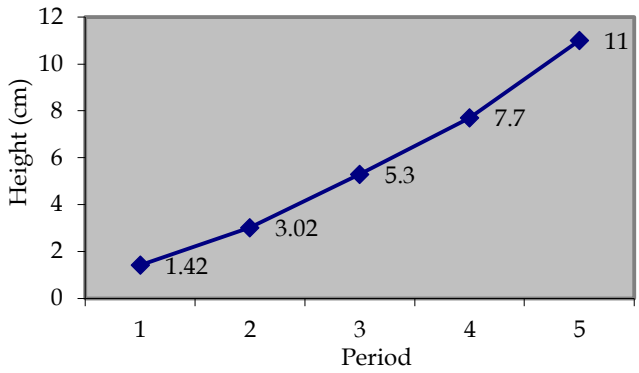

Figure 1. Graph of control group plant height (K)

Furthermore, observations were made in the experimental group with 5 variations of fertilizer concentrations used. The results of observations in the experimental group can be seen in table 2.

Table 2. Observation Profile of Plant Height Growth in Experimental Class

Sample	Observation Period (cm)					Average
	1	2	3	4	5	
A1	1.4	3.3	5	8	11	5.74
A2	1.5	3.5	5.5	8	12	6.1
A3	1.6	3.7	6	9	13	6.66
A4	1.5	3.5	5	8	12	6
A5	1.5	3.5	5.5	7.5	12	6
B1	1.5	3.5	5.5	8.5	12	6.2
B2	1.6	3.5	5.5	8	13	6.32
B3	1.5	3.5	5.5	9.5	12	6.2
B4	1.7	3.7	6	8.5	13	6.58
B5	1.7	3.5	5	9	14	6.44
C1	1.5	3.7	5.5	8.5	12	6.24

Sample	Observation Period (cm)					Average
	1	2	3	4	5	
C2	1.5	3.3	5	8	12	5.96
C3	1.7	4	6	9.5	14	7.04
C4	1.7	3.5	5.5	8.5	14	6.64
C5	1.7	3.5	5.5	9	14	6.74
D1	1.5	3.5	5.5	10	13	6.7
D2	1.6	3.5	5.5	10	13	6.72
D3	1.7	3.7	6	11	14	7.28
D4	1.7	4	6.5	11.5	15	7.74
D5	1.5	3.5	5	9	13	6.4
E1	1.5	4	6	10	14	7.1
E2	1.6	3.5	6	11	14	7.22
E3	1.5	3.7	6.5	11.5	15	7.64
E4	1.5	3.7	5.5	9	14	6.74

Based on table 2, information can be obtained that the different concentrations of the fertilizers given produce different heights for each plant treatment. The average growth height of ground kale in each treatment group in each period can be seen in the following Figure 2. Based on the Figure 2, the highest average value in plants A was 12 cm.

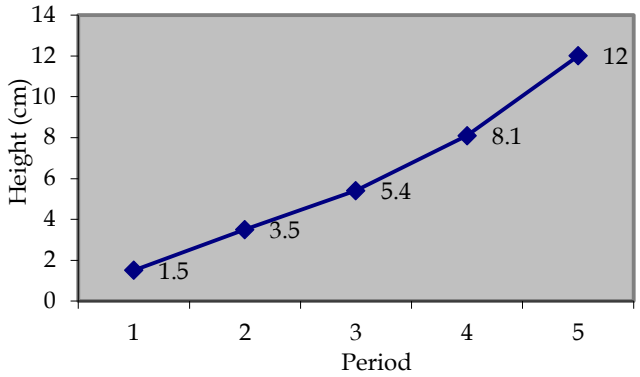

Figure 2. Graph of plant height of the experiment group (A)

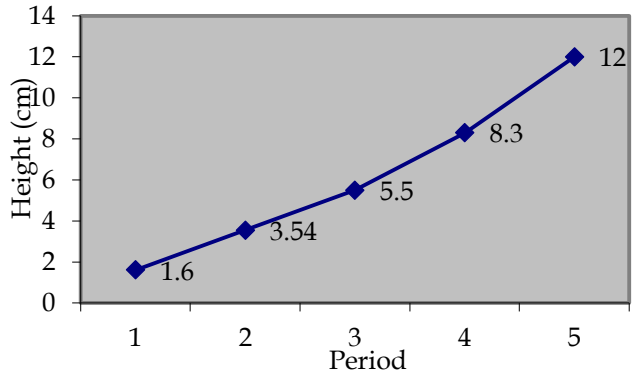

Figure 3. Graph of Plant Height of the Experiment Group (B)

Figure 3 shows the increase in plant height in the experiment group (B). Based on figure 3, the highest average value in plants B was 12 cm. Based on the Figure 4, the highest average value in plants C was 13.2 cm. Based on the figure 5, the highest average value in plants D was 13.6 cm

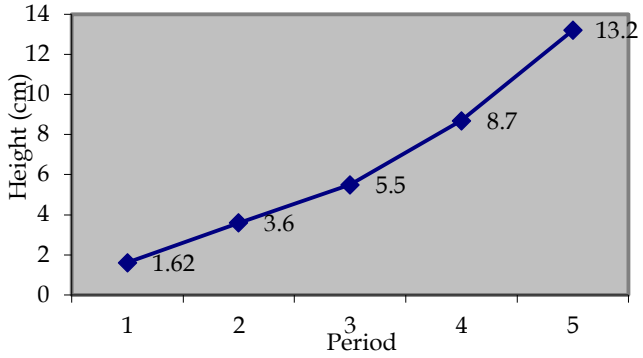

Figure 4. Graph of plant height of the experiment group (C)

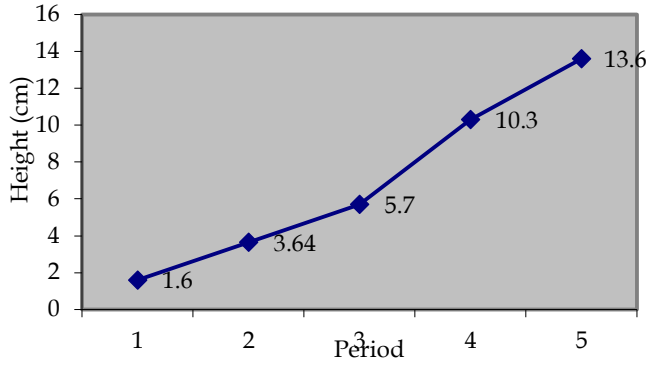

Figure 5. Graph of plant height of the experiment group (D)

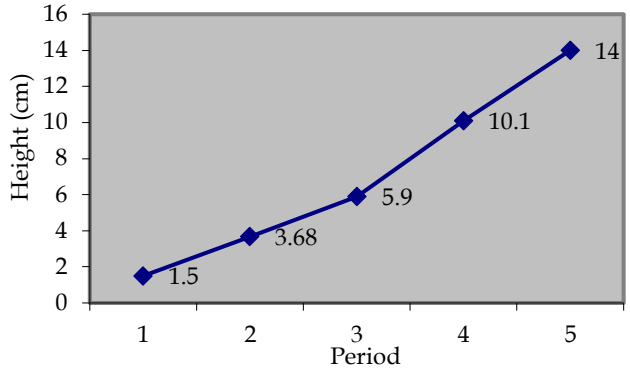

Figure 6. Graph of plant height of the experiment group (E)

Based on the figure 6, the highest average value in plants C was 14 cm. Based on the plant height profile graph in the experimental group, it can be seen that the maximum plant height was 14 cm obtained in the E plant sample, namely the use of a fertilizer concentration of 11.11% by volume (25 ml of fertilizer + 200 ml of Aquadest).

Parameter Number of Leaves

After calculating plant height, then observe the number of leaves produced on control and experimental

group. Based on the observations, the number of leaves observed on the 20th day after planting was.

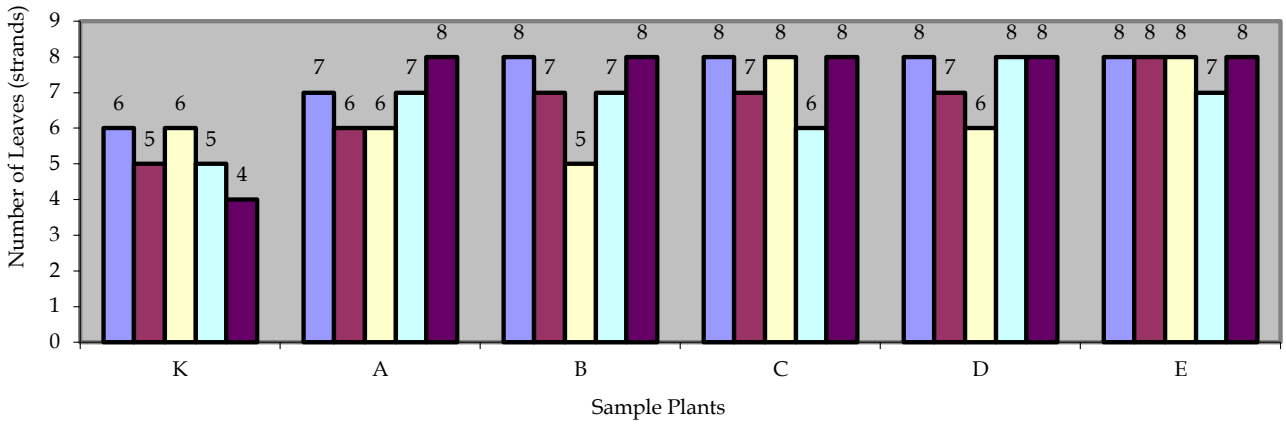

Figure 7. Graph of the number of leaves in each plant sample

Based on Figure 7, the highest number of leaves on the observed plants was 8 leaves, namely in experimental class plants in sample E with a fertilizer concentration of 11.11% by volume (25 ml of fertilizer + 200 ml of Aquadest. The leaves observed were leaves at 1 plant stems in each pot.

The Effect of Differences in Fertilizer Concentrations Given on Plant Growth

After observing the results of plant height and growth, an Anova test can then be carried out to determine whether there are differences in plant growth results by varying the concentration of Grow Quick LB fertilizer. The results of the ANOVA test for plant height and the results of the ANOVA test for leaf growth can be seen in Table 3 and Table 4.

Table 3. ANOVA Test Results on Plant Height Parameters

Source of Variation	SS	df	Ms	F	P-values	F crit	Information
Between Groups	30.56667	5	6.113333	7.804255	0.000176	2.620654	**
Within Groups	18,8	24	0.783333				
Total	49.36667	29					

Based on the results of the ANOVA test in table 3, it is known that the calculated F value obtained at a significance level of 5% is 7.804255. This means that Fcount > Ftable. The resulting sign is ** which means that The application of different fertilizer concentrations in the experimental class had a very significant effect on the height of the water spinach plants (Ipomea reptans. Poir) produced. Furthermore, the results of the ANOVA test on the parameter number of leaves are presented in the following table.

Table 4. ANOVA test results on the number of leaves parameter

Source of Variation	SS	df	Ms	F	P-values	F crit	Information
Between Groups	21.06667	5	4.213333	5.378723	0.001864	2.620654	**
Within Groups	18,8	24	0.783333				
Total	39.86667	29					

Based on the results of the ANOVA test in table 4, it is known that the calculated F value obtained at a significance level of 5% is5.378723. This means that Fcount > Ftable. The resulting sign is ** which means that pThe application of different fertilizer concentrations in the experimental class also had a very significant effect on the growth and number of leaves of the land kale (*Ipomea reptans. Poir*) produced.

The results obtained are in line with research conducted by Raksun et al. (2020) which states that the application of variations in fertilizer doses has a significant effect on plant stem height. Furthermore Sakdiah et al. (2017) also stated that differences in fertilizer doses affect leaf growth parameters. This is also due to the use of Grow Quick LB fertilizer which contains several macro nutrients such as N, P and K which are needed by plants in order to spur plant vegetative growth. As for the elemental content N as much as 45% and is the most abundant content in this fertilizer serves to stimulate growth and give green color

to the leaves. Element P serves to stimulate root growth and form a good root system. Likewise, the element K functions to regulate plant physiological processes such as photosynthesis, accumulation, translocation, carbohydrate transportation, opening and closing of stomata, and distribution of water in tissues and cells. This is what causes the growth of land kale to grow well.

Plant growth is of course not only influenced by fertilizer, but also influenced by other factors such as daily climatic factors and soil pH. The measurements were carried out using a digital soil meter equipped with measurements of temperature, humidity, light intensity and soil pH. The results obtained are averaged and presented in the following Table 5.

Table 5. Average Daily Climatic Factors

Period To	Air Temperature (°C)	Air Humidity (%)	Light Intensity (Lux)
1	26	Nor	Low+
2	28	dry	high-
3	26	Nor	Low+
4	27	dry	high
5	26	Nor	Low+

Table 6. Ph measurement for each treatment

Parameter	Sample					
	K	A	B	C	D	E
Ph	6	6.5	6.5	6.5	6.5	6.5

Based on table 5, it is known that the air temperature during growth ranges from 26 oC to 28 oC. Humidity and light intensity around the plant environment are still in the normal range. Meanwhile, based on table 6, the pH of the growing media obtained is 6 and 6.5. So that plants can grow in that environment. This is supported by the opinion of Gustia (2013) which implies that good weather and environmental conditions can support increased plant production.

Conclusion

The land kale or *Ipomea reptans. Poir* is one of the vegetable plants that can be cultivated easily. This cultivation can be done by providing fertilizer that is rich in nutrients. Fertilizer Grow Quick LB can stimulate plant vegetative activity, especially leaf growth. By providing variations in the concentration of this fertilizer, various results can be obtained on the parameters of height and number of leaves of ground kangkong. Based on the results of the study, it was found that the plants in the experimental group had better growth than the control plants. So it can be concluded that the application of variations in fertilizer concentrations has a significant effect on the growth of kale land.

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Author Contributions
The authors of this article consists of two people. The role of the author in this study is divided into executorsand advisor in this research.

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Conflicts of Interest
The authors declare no conflict of interest.

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