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The Effect of Giving Worm Manure on The Growth of Catfish and Kale in Buckets

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Abstract. This study was analyzes the effectiveness of worm droppings on the growth rate of catfish and kale in buckets. The dose of worm excrement given was 75, 125, and 175 grams in 40 liters water. The positive control used 5 ml of EM 4 and the negative control was given plain water. The growth of catfish was observed for 9 weeks and every two weeks the morphometric in catfish weight and length were observed. In the first 4 weeks, the weight of kale was measured and analyzed for SGR value (growth rate), Survival Rate, Food Convention Ratio, and catfish weight data. In stage 1, the growth rate (SGR) of treatment with vermicompost was 125 g (0.18%), vermicompost 75 g (0.18%), vermicompost 175 g (0.17%), EM4 (0.16%), and the last is plain water (0.13%). Survival rate at this stage is above 90%. In stage 2, the SGR was treatment with 175 g vermicompost, 125 g vermicompost, and 75 g vermicompost at 1.10%, followed by 1.06% plain water, and 1.05% EM4. The lowest survival rate in positive control. The result showed that the treatment with vermicompost was effective at the larval-juvenile stage (stage 1) of catfish with effective treatment at 75 grams.

Keywords: Worm droppings, Catfish, Larval-juvenile stage

1 Introduction

In the pandemic era, it is necessary to innovate food security in families and communities that have been affected by the economy. The researcher wants to help the local community by cultivating fish and vegetables, which will improve the family's economy and fulfill family nutrition. Simple cultivation, but can be appropriate for obtaining balanced nutrition, namely by cultivating fish and vegetables in one medium. Catfish or *Clarias gariepinus* is a favorite fish for many people and has high nutritional values. Kale or *Ipomoea* L. is a major plant that many people like to consume. In the cultivation of catfish and kale in buckets, people have done this by providing microorganism growers in aquaculture ponds (Buckets) and providing food as fish pellets or red worms. Juvenile catfish that are 1-week old need other feed besides the microorganisms present in the media, high protein feed that can grow catfish juveniles is very much needed in this culture. Red worms that are often given to juvenile catfish have a fairly expensive price. If excessive giving causes a decrease in profits so that it can cause losses. It is necessary to consider feeding juvenile catfish, with are cheap and favored by juvenile catfish.

Worm droppings are worm feces that are in the body and around the media containing high protein (N), phosphorus (P), potassium (K), magnesium (Mg), and

calcium (Ca) values so that the fish body needs it for growth. Juvenile catfish require sufficient protein (N) and carbohydrates (C) for energy for growth and Chromium should not be below in the medium [1]. Juvenile fish are less able to take food containing carbohydrates because juvenile catfish do not have good oral anatomy. The physical properties of worm droppings are dominated by the sand fraction with a range between 56.26-59.02%, then the clay fraction with a range of 22.92-24.16%, and finally the dust fraction with a range of 15.89 - 20.82% The ammonium value of earthworm droppings is quite high even though in some fields such as in organic vegetable fields it is around 6.44% while the nitrate value is around 2.1% and ammonium values in conventional vegetable fields are around 2.55-5.11% with an average value of 4.35% while the value of nitrate ranges from 1.12-3.08% with an average value of 1.92%. The P-value is also quite high at 393.40 mg kg⁻¹ compared to land conventional vegetables with a range of 107.03-158.65 mg kg⁻¹ with an average value is 130.22 mg kg⁻¹ [2]. The worm droppings used will indeed vary depending on the type of worm feed, such as worms with spinach will increase the high mineral content in the feces. In this study, the feed used for worms was cow dung, leftover kale, and tomatoes, so that the worm food became more complex. This would produce more complex worm manure minerals as well [3].

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There is no doubt that the potency of earthworm manure is that the use of worm manure fertilizer can increase the weight of cultivated plants in the soil, but there has been no research using worm manure in water media in aquaculture cultivation. There have been studies of giving worms to fish feed, but studies showing the provision of earthworm excrement in fish feed have not been found. This has prompted researchers to cultivate aquaculture of kale and catfish in buckets fed with worm manure. This study analyze the effect of worm droppings on the growth of catfish and kale in buckets of cultivation. The limitation of this research is that the age of the catfish used is 2 weeks old and the growth of kale is observed for 1 month while the growth of the catfish is observed for 3 months. The benefits of this research will provide knowledge to people who want to use buckets as simple cultivation.

2 Research Methodology

The experimental treatments used in this study were worm manure doses of 75 g, 125 g, and 175 g, as a negative control medium giving nothing, and as a positive control 65 ml of Em 4 was given. The repetition was carried out 3 times and the cultivation bucket were placed in the Department's Greenhouse of Biology, FMIPA Unesa which had been controlled by the same physical and chemical environmental factors. The research procedure has several stages, namely 1) the pre-cultivation stage, 2) the cultivation stage to calculate the weight and length of catfish, kale weight, and controlling pH of the media every week, 3) the data analysis stage is carried out by calculating the growth rate of the Specific Growth Rate (SGR) and FCR (Food Convention Ratio) and analyzed with Kruskal Walls to conclude the effect of the experiment. Analysis of the calculation of the growth of catfish were divided into two stages, namely the juvenile period 1-4 weeks and the pre-adult period over the age of 4 weeks.

2.1 Pre-cultivation stage

Kale seeds are sown using the aquaculture method by using a plastic cup that has been perforated and then adding cocopeat powder as much as 1/3 of the height of the glass, this seedling takes 7 days. The bucket as a catfish medium was given 40 liters of water and a fermentation process was carried out so that the water medium contained a lot of microbes by preparing 5 ml of EM4 fishery, mixed with 500 ml of sugar water, and left for 1 day and 1 night. Fill the bucket with 40 liters of water, then mix the prepared EM4 fishery. Do the Fermentation process for 5 - 7 days. If the color of the water changes towards gray or brownish then it is ready for fish spawning.

2.2 Cultivation Stage

Kale seeds that are 7 days old or 8-12 cm long are transferred to a bucket of catfish. Put the wire that has been attached to the plastic cup to the lip of the bucket.

Installation of plastic cups sequentially and circle the lip of the bucket (10-15 plastic cups) then place the installation in a location that is exposed to direct sunlight so that the growth process of plant development is optimal and the catfish is not exposed to white spot fungal infection on the skin. Give worm droppings by weighing worm droppings and place them on a cloth and hang the cloth tied to a bucket. The measurement of the weight of catfish and water spinach was carried out once a week and drain the bucket.

3 Result and Discussion

3.1 Recapitulation of SGR, FCR, and Survival Rate

Based on the results of the study, the average weight and length of African catfish larvae were got in each treatment, which was measured once a week for four weeks (Table 3). The values of SGR, Survival Rate and Food Convention Ratio in this study were divided into two, namely when the catfish was in the larval stage – juvenile and juvenile to adult. The larval/seedling to juvenile stage starts from 0 to 4 weeks of age, while the juvenile-adult stage starts from the fifth to the ninth week.

Table 1. Recapitulation of SGR, FCR, and Survival Rate for each repetition of Catfish larval age - Juvenile (%)

Treatment	CODE	SGR (%)	FCR (%)	Survival Rate		%
				Start	End	
PLAIN WATER	AB 1 / BAK 1	0,14	3,31	40	40	100
	AB 2 / BAK 2	0,14	3,42	40	40	100
	AB 3 / BAK 3	0,12	3,45	40	40	100
	Average	0,13	3,39	40	40	100
EM 4 65 ml	EM 1 / BAK 4	0,14	3,49	40	40	100
	EM 2 / BAK 5	0,13	4,14	40	35	87,5
	EM 3 / BAK 6	0,23	3,15	40	34	85
	Average	0,16	3,60	40	36	91
VERMIC-OMPOST 75 gr	KA 1 / BAK 7	0,20	3,06	40	39	97,5
	KA 2 / BAK 8	0,14	3,70	40	40	100
	KA 3 / BAK 9	0,19	3,10	40	38	95
	Average	0,18	3,29	40	39	98
VERMIC-OMPOST 125 gr	KB 1 / BAK 10	0,24	3,02	40	40	100
	KB 2 / BAK 11	0,16	3,18	40	40	100
	KB 3 / BAK 12	0,13	3,47	40	40	100
	Average	0,18	3,22	40	40	100
VERMIC-OMPOST 175 gr	KC 1 / BAK 13	0,12	3,5	40	39	97,5
	KC 2 / BAK 14	0,16	3,6	40	40	100
	KC 3 / BAK 15	0,24	3,1	40	37	92,5
	Average	0,17	3,41	40	39	97

Based on these data, the growth rate (SGR) if sorted from highest to lowest in the treatment of vermicompost 125 g (0.18%), vermicompost 75 g (0.18%), vermicompost 175 g (0.17%), EM4 (0,16%), and the last is plain water (0,13%).

Vermicompost 125 gr with an SGR value of 0.18% means that the weight gain of each catfish seed per week is 0.18%. This is supported by a smaller FCR compared to other treatments, which is 3.22%. Although the FCR is still too large (<1), this is not used as a basis for the success or failure of catfish cultivation, but how the feed needs to increase catfish weight to reach the requirements. Based on the FCR value, additional feed or feeding frequency is still needed so that the catfish's weight increases and the FCR gets smaller.

The survival rate in all treatments was still above 90%, which means the mortality rate was very low. This is because of various factors, such as fish survival, water treatment management, and microbial agents that can break down feed residues or manure [4][5].

Table 2. Recapitulation of SGR, FCR, and Survival Rate for each repetition of Juvenile - Adult Catfish (%)

Treatment	CODE	SGR (%)	FCR (%)	Survival Rate		%
				Start	End	
Plan water	AB 1 / BAK 1	1.06	2.55	40	40	100
	AB 2 / BAK 2	1.06	2.56	40	35	87,5
	AB 3 / BAK 3	1.05	2.63	40	40	100
	Average	1.06	2.58	40	40	93%
EM 4 65 ml	EM 1 / BAK 4	1.07	2.54	40	40	100
	EM 2 / BAK 5	1.07	2.54	35	35	87,5
	EM 3 / BAK 6	1.02	3.11	34	25	62,5
	Average	1.05	2.73	36	36	83,3
VERMIC-OMPOST 75 gr	KA 1 / BAK 7	1.09	2.51	39	39	97,5
	KA 2 / BAK 8	1.10	2.51	40	40	100
	KA 3 / BAK 9	1.10	2.51	38	38	95
	Average	1.10	2.51	39	39	98
VERMIC-OMPOST 125 gr	KB 1 / BAK 10	1.09	2.51	40	40	100

Table 3. Recap of average weight and length of larval - juvenile catfish in 4 weeks

Treatment	Week										\bar{x} weight	\bar{x} length
	0-th		1-st		2-nd		3-rd		4-th			
	gram	cm										
Plain water	0,00	0,00	0,96	0,86	1,33	1,07	1,49	0,84	0,91	1,21	0,94	0,80
EM 4 65 ml	0,00	0,00	1,08	1,08	1,18	1,27	1,26	0,86	0,37	0,43	0,78	0,73
Vermicompost 75 gr	0,00	0,00	1,33	1,09	1,86	1,48	2,00	0,91	1,32	1,12	1,30	0,92
Vermicompost 125 gr	0,00	0,00	0,86	1,00	1,69	1,35	1,66	1,09	1,16	0,96	1,07	0,88
Vermicompost 175 gr	0,00	0,00	1,07	1,24	1,43	1,42	1,03	0,57	0,88	1,02	0,88	0,85

Treatment	CODE	SGR (%)	FCR (%)	Survival Rate		%
				Start	End	
	KB 2 / BAK 11	1.10	2.51	40	40	100
	KB 3 / BAK 12	1.10	2.51	40	40	100
	Average	1.10	2.51	40	40	100
VERMIC-OMPOST 175 gr	KC 1 / BAK 13	1.09	2.51	39	39	97,5
	KC 2 / BAK 14	1.10	2.51	40	40	100
	KC 3 / BAK 15	1.10	2.51	37	37	92,5
	Average	1.10	2.51	39	39	97

The growth rate (SGR) from highest to lowest in the treatment of 175 g vermicompost, 125 g vermicompost, and 75 g vermicompost at 1.10%, followed by 1.06% plain water, and 1.05% EM4. In the treatment of vermicompost 175 g, 125 g, and 75 g have an FCR of 2.51 compared to the FCR in the treatment of plain water 2.58 and EM4 2.73. This means that the need for feed to increase catfish weight in the treatment of all vermicompost is more effective than in the control treatment of plain water and EM 4. The survival rate in the EM4 treatment has the lowest value compared to the others, this is influenced by various factors such as density, endurance, and temperature. Drastically changing environment [6, 7](Hastuti,S., Subandiyono. 2014, Kamalia et.al., 2017)

3.2 Catfish Weight Measurement

3.2.1 Larval Age Catfish Stage – Juvenil

Catfish weight data were obtained from measurements every seven days for four weeks and taken by sampling 10 tails per bucket of treatment repetition. Then the results were averaged and analyzed for weight gain each week.

Based on the table at week 0 all treatments did not have additional data, this was because they were still at the stage of transferring seedlings to the media after the specified treatment.

The increase in weight and length can be seen in Figure 1 and Figure 2, namely the graph of the average growth of catfish in each treatment.

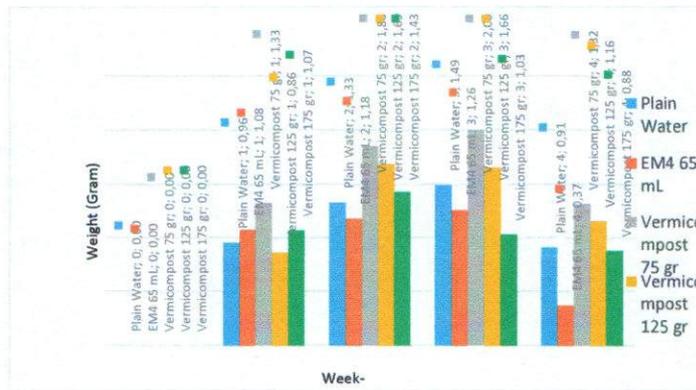


Fig. 1. Graph of the average weight gain of catfish for each treatment in weeks 0-4

Based on these data, the treatment of catfish with the highest to lowest average weight gain are 75 g vermicompost, 125 g vermicompost, 175 g vermicompost, plain water, and 65 mL EM 4. This is

because of the role of vermicompost as an initiator of natural bacterial growth that can improve the quality of water media and as a natural feed for catfish [6].

Table 4. Recap of average weight and length of juvenile-adult catfish in 5 weeks

Treatment	Week-										Weight (gr)	Length (cm)
	5-th		6-th		7-th		8-th		9-th			
	B (gram)	P(cm)										
PLAIN WATER	5.55	3.07	5.55	0.91	4.44	0.82	9.95	3.18	15.09	4.09	6.29	3.77
EM 4 65 ml	6.88	3.83	8.34	2.16	8.63	2.14	12.57	1.79	1.89	2.82	5.58	4.71
VERMICO MPOST 75 gr	14.86	1.81	5.25	0.49	9.20	1.95	4.35	1.58	2.77	2.41	6.81	2.20
VERMICO MPOST 125 gr	9.63	1.99	3.84	1.60	3.98	3.06	4.32	2.30	13.66	-0.87	6.83	2.02
VERMICO MPOST 175 gr	10.22	2.41	5.81	2.58	8.98	0.99	6.43	1.91	13.16	1.81	7.83	2.84

Based on these data, the catfish treatments with the highest to lowest average weight gain are vermicompost 175 g, 125 g, 75 g, plain water, and EM4. This is proportional to the FCR and SGR values. The vermicompost given to water media can stimulate the

growth of natural bacteria, algae, and some protozoa as natural food for catfish. This can add protein value, although not massively apart from the main feed pellet type LP-2 with a protein content of 33%.

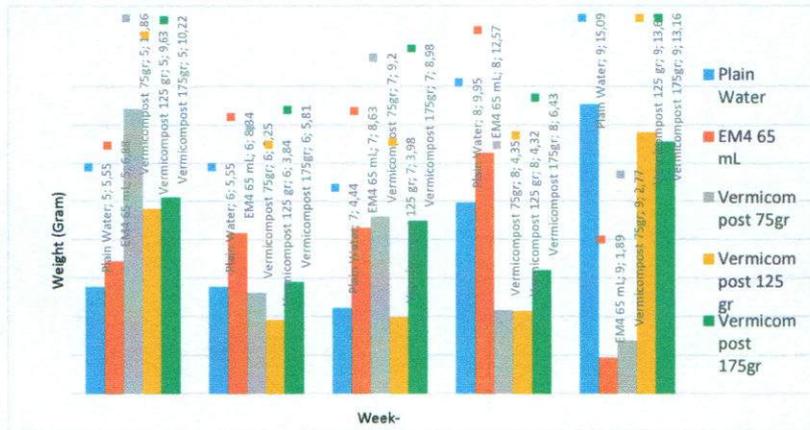


Fig. 2. Graph of the average weight gain of catfish for each treatment in weeks 5-9

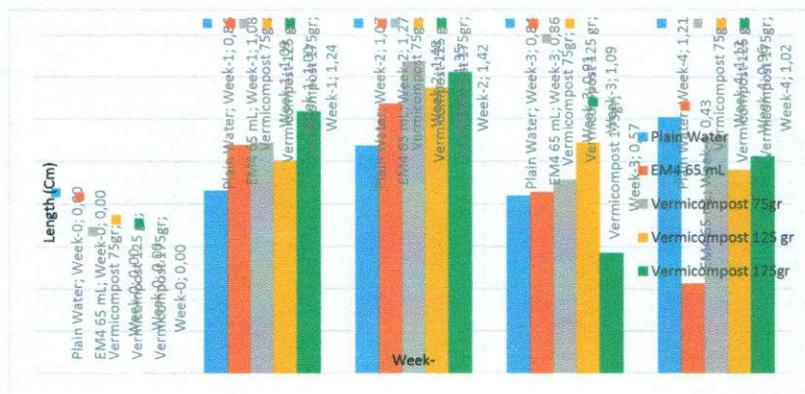


Fig.3. Graph of the average increase in the length of catfish in weeks 0 - 4

3.3 Catfish Length Chart

Based on the graph, the average length increase of catfish from 0 to 4 weeks in each treatment varied. Catfish seedlings, when stocked had an initial length of 5 cm and were measured every week using millimeter paper. In this study, feed is a control variable that is measured based on the total weight of the number of catfish in each bucket so that it is not expected to significantly affect the weight and length of the catfish.

In the treatment of plain water as control, the first week is 0 cm because it is the initial length and there is no increase. In the first week the average increase in body length of catfish is 0.86 cm; the second week 1.07 cm; the third week 0.84 cm; and the fourth week of 1.21 cm.

The treatment of catfish as a control on water media that was given EM4 65 L had an increase in the length of week 0 catfish of 0 cm because at the beginning of transferring seedlings. The length increase of the first week was 1.08 cm; the second week was 1.07 cm, the third week was 0.86 cm;

and the fourth week 0.43 cm. The increase in the length decreases from week to week because of the higher level of the gluttony of catfish so that the competition in getting feed is getting higher. This has been accompanied by feeding as needed, based on weighing every week.

The length increase in the catfish treatment with the addition of vermicompost media was 75 grams, namely the first week of 1.09 cm; the second week 1.48 cm, the third week 0.91 cm; and the fourth week 1.12 cm.

Water medium with addition of 125 grams of vermicompost has an increase in length in the first week of 1 cm; second week 1.35 cm; third week 1.09 cm; and the fourth week 0.96 cm. The length of catfish in water medium and vermicompost 175 grams increased by 1.24 cm in the first week; 1.42 in the second week, 0.57 in the third week; and 1.02 in the fourth week.

The length of catfish is influenced by internal factors: the level of greed and catfish seed health, while external factors are influenced by temperature, pH,

dissolved oxygen, feeding, and supporting factors of microorganisms in water media.

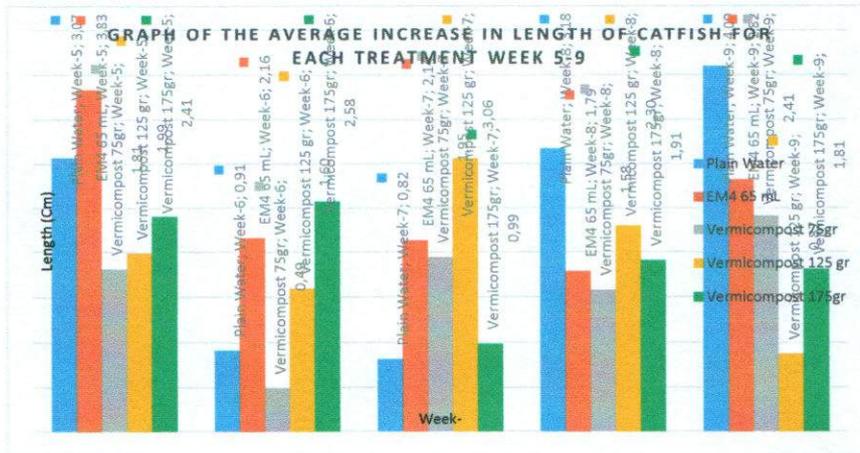


Fig. 4. Graph of the average increase in length of catfish in the 5th to 9th week

3.3.1 Statistical calculation results

The results of weekly statistical calculations using Kruskal Walls followed by the Mann Whitney test if the significance is as follows.

Table 5. Results of statistical calculations using Kruskal Walls

No.	Week-	Catfish Weight	Catfish Length
1	1	Significant	Not significant
2	2	Significant	Not significant
3	3	Significant	Not significant
4	4	Significant	Significant
5	5	Significant	Significant
6	6	Significant	Significant
7	7	Significant	Significant
8	8	Significant	Significant
9	9	Significant	Significant

Table 6. Mann Whitney test results on the weight of catfish at weeks 1,3,6 and 9

No	Treatment	Week-1	Week-3	Week-6	Week-9
1.	Plain Water	0,9563±0,46965 ^a	1,4933±1,08180 ^a	5,5477±1,61784 ^c	15,0913±24,06825 ^c
2.	EM4 (65 ml)	1,0753±0,44363 ^a	1,1733±1,23594 ^a	8,3380±1,78468 ^d	16,6723±11,89632 ^c
3.	Vermicompost 75	1,5467±0,64633 ^b	2,0033±1,45803 ^a	5,5240±1,67803 ^{bc}	2,7660±11,45092 ^a
4.	Vermicompost 125	0,8667±0,93452 ^a	2,8633±2,29083 ^b	3,8367±0,78249 ^b	13,6583±15,82499 ^b
5.	Vermicompost 175	1,0700±0,60637 ^{ab}	1,0300±1,20406 ^a	1,5263±1,74630 ^a	13,1610±20,33109 ^b

Table 7. Mann Whitney test results on the length of catfish at weeks 4,6 and 8

No	Treatment	Week-4	Week-6	Week-8
1.	Plain Water	1,2100±0,87389 ^b	0,9133±0,42496 ^b	3,1790±1,75404 ^c
2.	EM4 (65 ml)	0,4267±0,76876 ^a	2,1627±1,72401 ^c	1,7900±1,30363 ^a
3.	Vermicompost 75	1,1170±0,95685 ^{ab}	0,4940±0,57641 ^a	1,5807±1,27206 ^a
4.	Vermicompost 125	0,9600±1,75257 ^{ab}	1,5987±0,65235 ^{bc}	2,3003±0,53216 ^b
5.	Vermicompost 175	1,0233±0,74171 ^{ab}	2,5753±1,37798 ^c	1,9083±1,13218 ^{ab}

Statistical data showed that there was an effect of treatment on catfish weight and catfish length, however, the larval stage of weeks 1 to 4 showed that giving vermicompost 75 was the best result in feeding catfish, however, the immature stage after week 4 showed control and administration of EM. 4 is the best.

3.3.2 Kale Data

Kale weight data were obtained from measurements every seven days for four weeks and take 12 netpot per bucket of treatment repetition, then the results were averaged and analyzed the weight gain every week.

Table 8. Recap the average weight of kale in 4 weeks

Treatment	Week-								\bar{x} Weight	\bar{x} (n) leaf
	0-th		1-st		2-nd		3-rd			
	B (gram)	(n) leaf								
Plain Water	0,00	0,00	2,99	21,37	5,51	17,80	3,44	5,10	2,99	11,07
EM 4 65 ml	0,00	0,00	4,32	23,87	1,88	16,93	4,23	3,40	2,61	11,05
Vermicompost75 gr	0,00	0,00	3,04	24,10	6,17	15,40	7,63	15,87	4,21	13,84
Vermicompost125 gr	0,00	0,00	2,08	9,53	0,53	17,80	3,80	7,27	1,60	8,65
Vermicompost175 gr	0,00	0,00	1,44	13,67	0,65	14,17	5,95	10,87	2,01	9,68

KALE HARVEST 1

Based on the table 8 at week 0 all treatments did not have additional data, this was because they were still at the stage of transferring seedlings to the media after the specified treatment.

The increase in weight and length can be seen in Figure 5 and Figure 6, namely the graph of the average growth of Kangkung in each treatment.

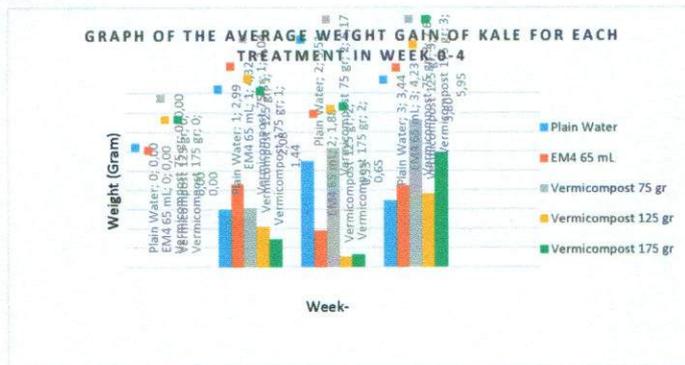


Fig.5. Graph of average weight gain of kale for each treatment in 4 weeks

Based on these data, the Kale treatment with the highest to lowest average weight gain was vermicompost 75 gr, plain water, EM 65 mL, vermicompost 175 gr, and vermicompost 135 gr.

The main factor that affects the weight gain of kale is the nutrients in the water medium in the bucket. Nutrients obtained from vermicompost and dirt catfish, which can be directly absorbed through the roots of kale [8, 9].

The difference in weight in each treatment is influenced by the amount of weight vermicompost and

the presence or absence of bacterial decomposition factor. In 75 g vermicompost, the weight gain was higher than other treatments, this was because the number of nutrients produced from catfish manure and vermicompost was higher than other treatments. Although in other treatments the number of vermicomposts can be higher in weight, this cannot directly affect the amount of weight gain in kale because the more vermicompost it takes a longer time to remove nutrients from the vermicompost clumps [9, 10].

3.3.3 Graphics of Addition of Kale Leaves

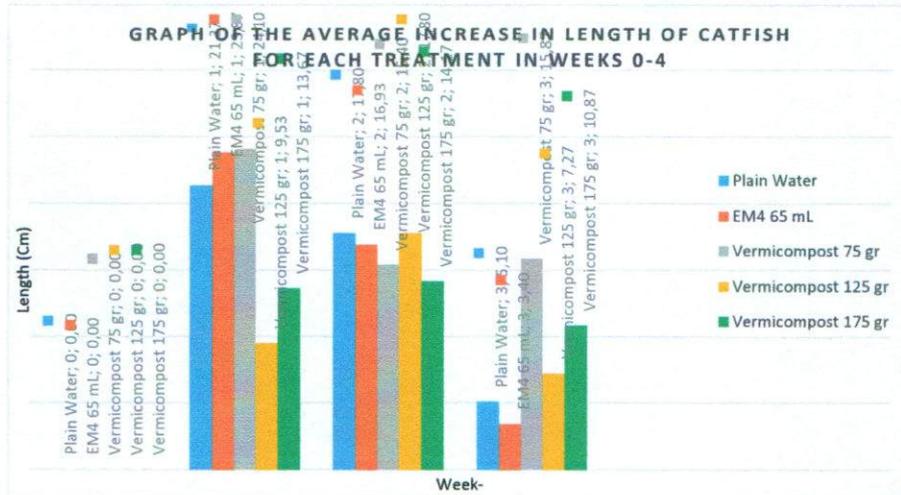


Fig.6. Graph of the average increase in length of kale in weeks 0 to 4

Based on figure 6, the highest number of leaf growth occurred in the 75-gram vermicompost treatment, followed by plain water, 65 mL EM4, 125-gram vermicompost, and 175-gram vermicompost. Leaves' growth is fast and much influenced by nutrients in the water medium where catfish live. Nutrients are obtained from vermicompost and the rest of the catfish manure used by water spinach for its growth and development process. External factors are not too influential because the sunlight, temperature, and pH are the same in each treatment.

The 75-gram vermicompost treatment had a higher number of leaves than others, this was because the nutrients contained were more and dispersed. These results are supported by table 1, the weight of catfish treated with vermicompost was 75 grams higher than the other can be concluded that the process of digesting food more evenly catfish and thus produces high levels of manure as the main nutrient.

4. Conclusion

When viewed from the growth and development of juvenile catfish morphometry, the treatment of worm manure was more effective at a dose of 75 g/liter than the maturation stage. The survival rate at the juvenile stage was higher in the treatment group (100%) than in the positive and negative controls. Observation results 0-4 weeks (juvenile catfish stage) The best water spinach mass gain at a dose of 75 g/liter.

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