

Combination of Organic Fertilizer from Catfish Wastewater (*Clarias gariepinus*) with Inorganic Fertilizer for Best Growth of Chili (*Capsicum frutescens*)

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Received 6 August 2023, Revised 26 August 2023, Accepted 4 September 2023

ABSTRACT

This study was designed to observe the effects of catfish wastewater as a fertilizer on the growth and yield of chilli pepper (Capsicum frutescens). The aim of our research is to find out the alternative to reduce the usage of inorganic fertilizers for chilli cultivation. In addition, it is also to investigate the potential of catfish wastewater as an organic fertilizer for chili pepper cultivation. Three treatments were used to evaluate the effect of fertilizers on chili pepper growth performance, and they were as follows: organic fertilizers (catfish wastewater) (T1), co-application of organic and inorganic fertilizers (T2), and inorganic fertilizer (T3). The data collected for growth and yield included the average (\pm) height (cm), Number of leaves, Leaf width (cm), Number of buds, Weight of fruits, Length of fruits and Number of fruits. Based on the results obtained from this experiment, T2 fertilizer, which applies a combination of organic (catfish wastewater) with inorganic fertilizer, shows higher growth, quality, and yield performance than control treatment using inorganic fertilizer only. However, the lowest growth, quality and yield showed the fertilizers from organic (catfish wastewater) only. Thus, organic (catfish wastewater) has good potential as an alternative fertilizer same as chicken dung and cow dung that can be used for crops.

Keywords: Organic (Catfish wastewater), Chilli, Inorganic Fertilizer, Fertigation system.

1. INTRODUCTION

Inorganic fertilizers nowadays have caused the prices of food to increase. Chili pepper (*Capsicum frutescens*) is a genus of *Capsicum* and is widely recognized as one of the most important vegetables or spices that has been used all over the world [1]. Hot chili (*Capsicum frutescens*) is the most valuable crop in Malaysia [2]. There are two kinds of chili, which is red chili and small chili, which are commercially cultivated. However, the cultivation of chilli needs much effort, especially the type of cultivation technique used. Nowadays, the fertigation system has become popular for the cultivation of crops like chili [3]. This technique is easy to manage because the fertilizers can be distributed consistently to the crops. There are two ways of cultivation system, which are under rain shelters and open fertigation [4]. Fertilizers were an important element in the cultivation of crops. About 40% of the fertilizers are needed by the world population to produce food. Fertilizers were used to ensure the crop gained enough nutrients and could grow in time. There are two types of fertilizers, which are organic and inorganic fertilizers. Mostly, the inorganic fertilizers were chosen because of the high contents of the three essential nutrients: nitrogen, phosphorus, and potassium (NPK). Inorganic fertilizers nowadays have caused the prices to increase and are costly because of dependency on these agricultural commodities [5]. While organic fertilizers provide several benefits which reduce production costs and are environmentally friendly, like improved soil structure and enhanced activities of the tiny organisms in the soil naturally [2]. According to this problem, this research was conducted to see

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the potential of wastewater from catfish (*Clarias gariepinus*) on the growth performance of the chili plant. According to [6], organic waste has been found to have a content of nutrients that are capable of promoting plant growth. Fish wastewater contains the essential nutrients through fish feed supplied (N, P), fish excretion, and the Ca content in the water used for fish production. Thus, this study intends to provide an alternative method by using inorganic fertilizers with a combination of organic fertilizers from fish wastewater to grow the chili plant.

2. MATERIAL AND METHODS

2.1 Treatments and Experimental Design

An experiment was conducted in the Politeknik Sandakan Sabah, Malaysia nursery. The chili seeds were sown on the seedling tray and transplanted into the polybag after 4 weeks. An experiment was prepared using cocopeat as a medium. The planting media is placed in a polybag measuring 16 cm long and 16 cm wide, and each medium in the polybag is 12 cm high. About 30 polybags were used in this experiment. Every 10 polybags with the different types of fertilizers: T1 for organic fertilizers (catfish wastewater), T2 combinations of inorganic fertilizers (AB) with organic fertilizers (catfish wastewater) and T3 for inorganic fertilizers (AB) only. The experiment was designed by using the fertigation system concept. The timer was set to the pump in the system to control the fertilizer times. The fertilizers were pumped into the polybag 5 times a day. The parameters were observed: average (\pm) Height (cm), Number of leaves, Leaf width (cm), Number of buds, Weight of fruits, Length of fruits and Number of fruits.

2.2 Measurement of parameters

Data was collected every week for every treatment. Plant height was measured starting from the base stem to the tip of the highest leaf using measuring tape and a ruler. The number of leaves, buds and fruits per plant was accomplished by manual observation and counting. The length and width of the leaves were selected based on the biggest size and measured using a ruler. The size of fruits was measured randomly for every chilli plant for each treatment using a ruler. The weight of fruits was measured using an electronic weighing balance and a gram unit.

2.3 Statistical Analysis

The data obtained was analyzed using Statistical Package for Social Science Software with ANOVA test to detect the treatment effects on the plant growth. P value less than 0.05 was statistically significant.

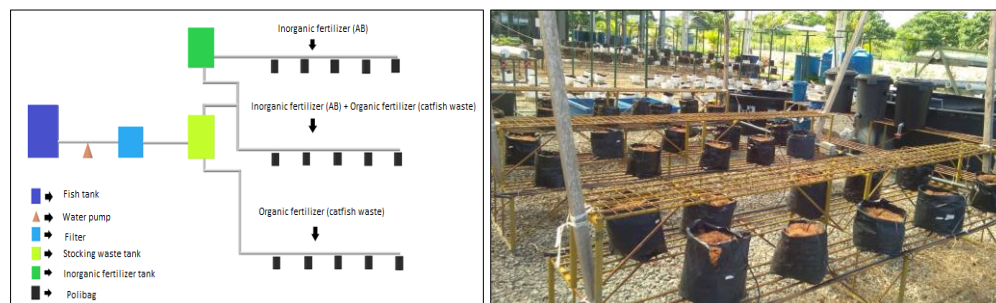


Figure 1: Experimental design of combinations of organic and inorganic fertilizers for chili plant in fertigation system.

3. RESULTS AND DISCUSSION

The results showed that the T2 fertilizers (Inorganic and organic (catfish wastewater) had a not very significant effect on plant height (cm), number of leaves and weight of chili (Table 1). However, the results show that the highest height plant was found in the T2 fertilizers, which was 82 cm, and the lowest was in T1, which was 43 cm, found in the organic fertilizers. According to [7], plant growth is manifested by an increase in size due to an increase in protoplasm caused by an increase in the size of plant cells, such as plant height. Plant height is the main criterion used to determine growth because the taller plant indicates that plant growth is better. The growth of plants is influenced by several factors, namely internal and external factors. The external factors included water's physical, chemical, and biological characteristics, which means fertilizers are used [7].

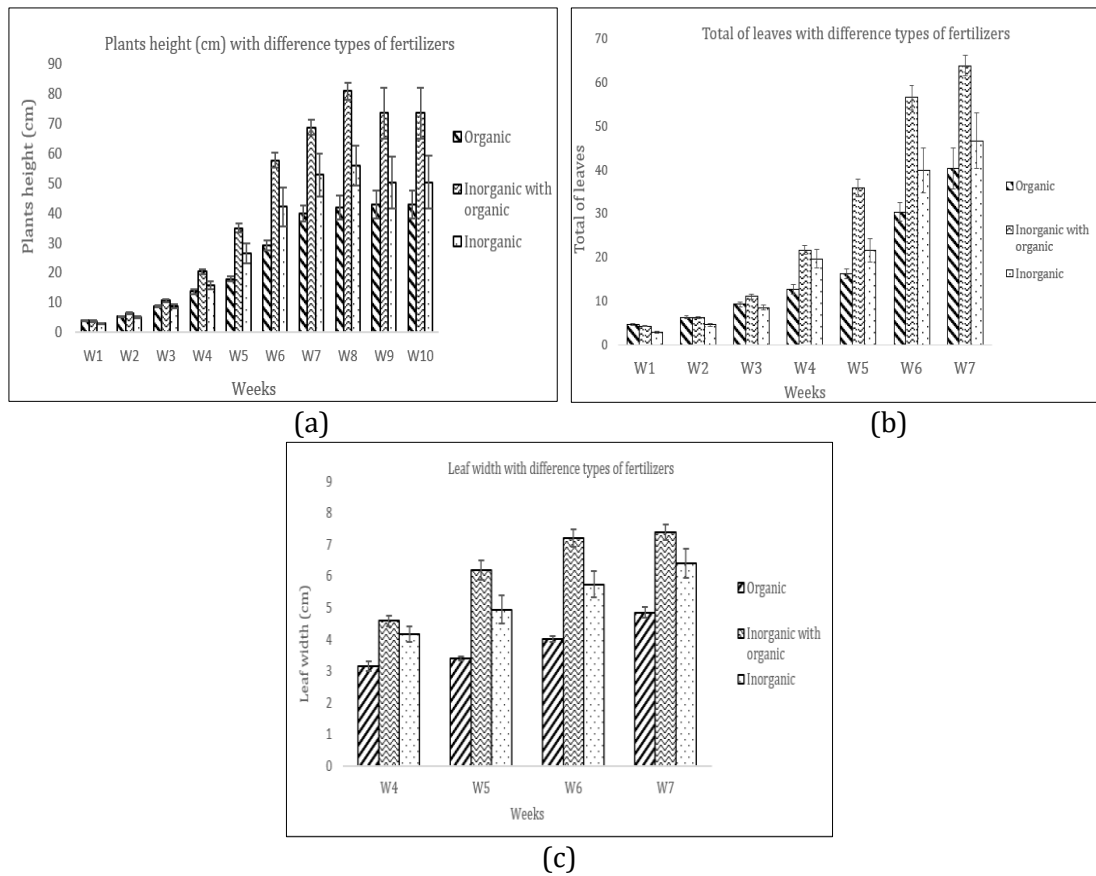


Figure 2: (a) Effects of combining organic fertilizers (Catfish wastewater) with inorganic fertilizers on plants height (cm), (b) total of leaves and (c) leaf width (cm) on (*Capsicum frutescens*). Data are means of 10 samples with standard errors shown by vertical bars. Data are not statistically significant different, as determined by one-way ANOVA.

The number of leaves and leaf width showed T2 fertilizer highest with the total of strands was 64 with a width 15 cm, and the lowest was T1 fertilizers was 40 strands with a width 5 cm. The highest of leaves and width depends on the nutrient supply. The combination of organic fertilizers (catfish wastewater) with inorganic fertilizers in T2 is very helpful to increase and shorten the growth times of chili plants. Due to enough nitrogen from both fertilizers (catfish wastewater and inorganic fertilizers) provided an ideal nutrition balance for chili, which increased the number and width of leaves [2].

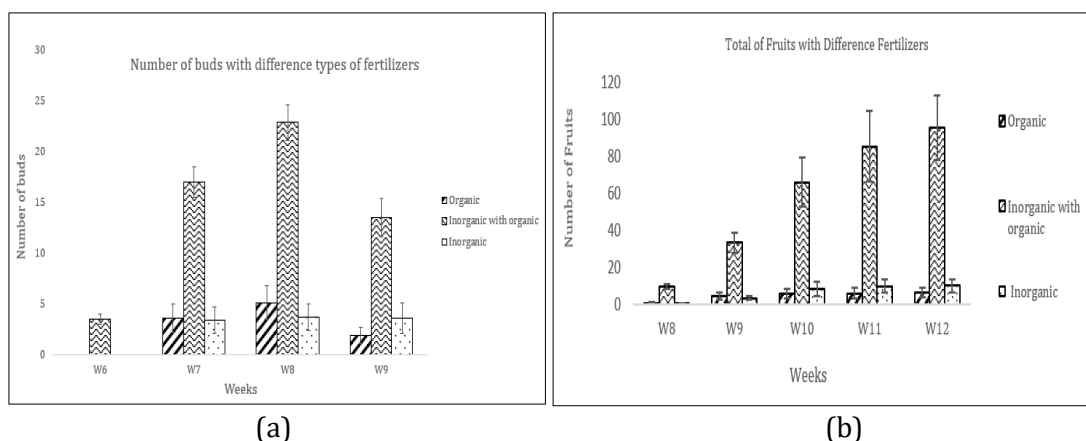


Figure 3: Effects of combining organic fertilizers (Catfish wastewater) with inorganic fertilizers on (a) buds and (b) number of fruits (*Capsicum frutescens*). Data are means of 10 samples with standard errors shown by vertical bars. Data are statistically significant different as determined by one-way ANOVA.

The number of buds and fruits was significantly higher in combination fertilizers T2, with the average buds 127.4 and the number of fruits was 955. The lowest was fertilizers from organic fertilizers, only T1 with the average buds 27 and number of fruits 63. The buds of plants were started to produce in week 6 and started to produce fruits in week 8 for T2 than other fertilizers T1 and T3. According to [8], the highest number of fruits might be due to the vigor of plants and a greater number of leaves per plant. However, [9] reported the highest number of fruits per plant increased with the increasing nitrogen application. We are totally agree, because nitrogen content in catfish wastewater combined with inorganic fertilizers can produce more nitrogen that can be used by chili plant; that why we can see the results showed more chili fruits was produced in treatment using T2.

The results of fruitful weight showed the highest was T2 fertilizers, with 771.56 g, and the lowest was organic fertilizer T1, with 73.17 g. The positive response of the fruit yield to the T2 fertilizers treatment played a significant role in producing chili fruits. According to [3=2], applying organic fertilizers will increase the values of fresh weights of fruit plants. Similar to this research, combining organic fertilizers from catfish wastewater is very helpful in reducing 100% inorganic fertilizers in chilli cultivation. Because this combination proves that only 50% of inorganic fertilizers used with a combination of 50% of organic fertilizers for catfish wastewater can yield the best chili production.

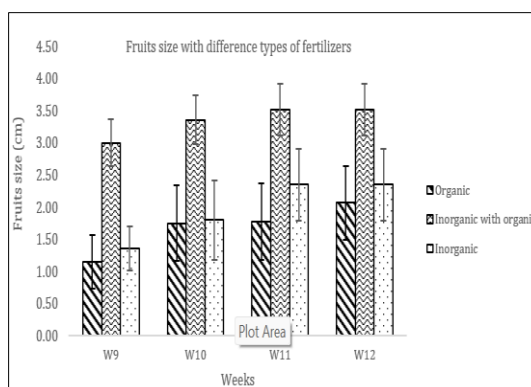


Figure 4: Effects of combining organic fertilizers (Catfish wastewater) with inorganic fertilizers on fruit size (*Capsicum frutescens*). Data are means of 10 samples with standard errors shown by vertical bars. Data are not statistically significant different as determined by one-way ANOVA.

The T2 fertilizers showed the highest fruit length with 3.75 cm, which is slightly different from T3 fertilizers and T1 fertilizers only with 3.2 cm of fruit length (Table 1). The results also agreed with [7=9], who observed an improvement in fruit size with increasing nitrogen contents in organic fertilizer. We are agreed because the nitrogen content in catfish wastewater combined with inorganic fertilizers can produce more nitrogen than chili plants can use; that is why we can see the results showed the size of chilli fruits biggest by using combination fertilizers.

Table 1: Average (\pm) Height (cm), Number of leaves, Leaf width (cm), Number of buds, Weight of fruits, Length of fruits and Number of fruits of chilli plant in three differences of fertilizers.

Criteria	Treatment 1	Treatment 2	Treatment 3
	Organic Fertilizer (Catfish wastewater) (T1)	Combinations Inorganic Fertilizer (AB) + Organic Fertilizer (Catfish wastewater) (T2)	Inorganic Fertilizer (AB) (T3)
Height (cm)	43	82	56
Number of leaves	40	64	52
Leaf width (cm)	5	15	6
Number of buds	27	127.4	27
Weight of Fruit (g)	73.17	771.56	108.6
Length of Fruit (cm)	3.2	3.75	3.2
Number of fruits	63	955	101

The results of the data analysis show that the combination fertilizer T2 is better and can be used as an alternative fertilizer to reduce the use of inorganic fertilizers only in chili cultivation. However, using 100% T1 catfish wastewater as fertilizer also proves that this catfish wastewater can show good results. Nutrients contained in catfish wastewater can be used as fertilizer for chilies. Although the results obtained are less. Referring to the study [7], fish waste has N, P and Ca that plants need. Fish wastewater contains the essential nutrients through fish feed supplied (N, P), fish excretion, and the Ca content in the water used for fish production. Nutrient from fish wastewater is not balanced, and it must be continued with the inorganic fertilizer for good results on the crop. The combination can reduce the application rate of some inorganic fertilizers, reducing the cost of inorganic fertilizers and being safe for the environment.

4. CONCLUSION

Combination of organic fertilizer from catfish wastewater and inorganic fertilizers is the best fertilizers for chili pepper. The results obtained confirm that catfish wastewater can be utilized in fertigation systems. This combination helps to increase the growth, quality and yield of chili pepper, including the average (\pm) height (cm), number of leaves, leaf width (cm), number of buds, number of fruits, weight of fruits and length of fruits than control treatment from inorganic fertilizer only. However, the lowest growth, quality and yield showed only the fertilizers from catfish wastewater. Thus, it can be concluded that catfish wastewater has excellent potential as an organic fertilizer for chili pepper and can be used as an alternative organic fertilizer like chicken dung, cow dung and other organic fertilizers. But, for the best results, the combination fertilizers are a good implementation and bring more advantages, such as the usage of inorganic fertilizers can be reduced, saving cost and environmentally friendly.

ACKNOWLEDGEMENTS

We give special thanks to Politeknik Sandakan Sabah for facilities support during the research conducted. Thanks to team members for technical support during the experimental design, building the fertigation system and collecting the research data. We would like to thank the organizer, the Department of Agrotechnology, Universiti Malaysia Perlis (UniMAP), for the 1st International Agriculture Revolution Symposium for allowing us to join.

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