



## RESPONSE OF GROWTH AND YIELD OF OKRA (*ALBEMOSCHUS ESCULENTUS* (L.) MOENCH) AGAINST VARIOUS COLORS OF PLASTIC MULCH AND GOAT MANURE

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Article Received on 07/02/2018

Article Revised on 28/02/2018

Article Accepted on 21/03/2018

### ABSTRACT

This study aimed to determine the growth response and okra plant results on various colors of plastic mulch and goat manure. The study was conducted in Namorambe, Deli Serdang District from February 2017 until June 2017. The study used Split Plot Design in a randomized complete block design with three replications and two factors. The main plot is a plastic mulch color (W) consisting of three levels, namely: silver (W<sub>1</sub>), black (W<sub>2</sub>), and transparent (W<sub>3</sub>). The subplot is a dosage of goat manure (K) consisting of four levels, namely: 0 t/Ha (K<sub>0</sub>), 10 t/Ha (K<sub>1</sub>), 15 t/Ha (K<sub>2</sub>), and 20 t/Ha (K<sub>3</sub>). The results showed the use of plastic mulch colors and goat manure dose did not affect the growth of okra, but affects okra yield. The pattern of the relationship between the growth of okra and the okra yields a quadratic line equation. The yield of okra is more influenced by the height of plant compared with the number of leaves based on the value of its determinant coefficient (R<sup>2</sup>).

**KEYWORDS:** Growth response, okra plant, coefficient.

### INTRODUCTION

Okra (*Albemoschus esculentus* (L.) Moench) better known as Arab bean still sounds familiar to some people of Indonesia. Unlike the people of countries in Central Asia and South Asia, okra is very popular. Okra is a fruit-shaped vegetable that can be processed into a variety of delicious and nutritious foods for health, including into the genus Hibiscus of the family Malvaceae. This plant has the nickname Lady's Finger because of its long fruit shape and tapered at the end like the fingers of a beautiful woman.<sup>[1]</sup>

Okra is a vegetable plant originating from tropical Africa brought to America by African slaves. Currently, okra plants are popular in many Asian, European and Australian countries. Even okra-based dishes are very popular in Sri Lanka, Japan, the Philippines, Saudi Arabia and Europe. In Indonesia okra not too well known, although it turns out this plant has been cultivated since hundreds of years ago.<sup>[1]</sup>

Okra production is estimated at 6 million t / year in the world. But not many know about the cultivation of okra plants, including Indonesia. In Indonesia, okra cultivation is planted in rice fields in the village of

Milangkori Patebon or Ngampel District, and in Kendal with an area of about 60 Ha.<sup>[1]</sup> This led to the production of okra in Indonesia is very low, so that efforts should be made to increase the production of okra by improving efficiency of production costs and increase value added. One of the alternatives for the cultivation of okra plants by pressing production costs is using mulch of various color plastic and goat manure with appropriate dose and in accordance with the optimal needs of plants.<sup>[2]</sup>

Mulch is a material to cover the soil surface so that the stability of moisture and soil temperature as a growing medium is maintained. Another mulch function is to suppress the growth of weeds so that the plants can grow optimally. Giving mulch on the soil surface during the rainy season can prevent soil erosion, while during the dry season will retain the sun's heat on the upper surface of the soil.<sup>[3]</sup>

The use of plastic mulch is one way of cultivation that has been proven to improve crop yields. According to,<sup>[4]</sup> the effectiveness of the use of plastic mulch in the tropics is derived from the physical ability of plastic mulch to protect the soil from direct exposure to raindrops, disintegrates soil underneath, prevents nutrient leaching, prevents splashes of soil into plants, prevents

groundwater evaporation, and slows the release of soil carbon dioxide from respiration activity of microorganisms. The surface color of the plastic mulch has an optical ability to change the quantity and quality of light that plants can harness in the growth process. Different mulch coloring in plants has different effects on temperature, moisture, groundwater content, weed suppression and pest organisms.

Commercially, commonly used plastic mulch colors are black, transparent, green and silver colors. Plastic black mulch can inhibit weed growth and can absorb more solar heat. Clear plastic mulch can create a greenhouse effect, while silver plastic mulch can reflect back some of the absorbed heat thereby reducing aphid attacks on plants.<sup>[5]</sup>

One of the intensification programs that can improve the productivity of land and plants is fertilization. Continuous loss of soil nutrients through crop yields without offsetting nutrient returns through fertilization will make the soil less productive. Organic fertilizer is often used is manure. Manure is a fertilizer derived from various kinds of livestock manure among them: goat manure.

Goat manure is one type of manure that contains many organic compounds, environmentally friendly, abundant availability and can reduce production costs and improve crop yields through the improvement of soil structure. The use of goat manure on a continuous basis gives a positive impact on soil fertility, because it facilitates the development of plant roots so that more easily absorb water and nutrients available in the soil. The results of the study<sup>[6]</sup> shown that the application of manure could increase the weight of fresh cob weighted, fresh weight cob without cornhusk and cob worth selling. Similarly, the results of the study<sup>[7]</sup> shown that the application of manure could increase the growth and production of sweet corn. This is due to manure is able to improve the physical, chemical and biological soil. Improvement of soil physical properties by making the soil becomes loose so that aeration be better. Improvement of soil chemical properties by providing the nutrients needed by plants. Biological properties of soil improvement through increased energy required for the life of the soil microorganisms.<sup>[8]</sup>

Based on this, the study aimed to determine the growth response and okra yields on various colors of plastic mulch and goat manure.

## MATERIALS AND METHODS

The research was conducted in Namorambe, Deli Serdang from March 2017 until June 2017. The study used Split Plot Design in a randomized complete block design with three replications and two factors. The main plot is a color plastic mulch (C) consisting of three levels, namely: silver (C<sub>1</sub>), black (C<sub>2</sub>), and transparent

(C<sub>3</sub>). The subplot is a dosage of goat manure (G) consisting of four levels, namely: 0 t/Ha (G<sub>0</sub>), 10 t /Ha (G<sub>1</sub>), 15 t/Ha (G<sub>2</sub>), and 20 t/Ha (G<sub>3</sub>).

Tillage performed with hoe three times and then flatten. Hereafter devised experimental plots with a size of 150 cm x 200 cm, and a height of 30 cm plot to plot the distances between 50 cm and 100 cm distance between replications.

Seeds sown in advance using polybags filled with soil. Maintenance in the nursery include watering and weeding. After 10 days in the nursery seedlings are transferred to the planting plots with spacing of 50 cm x 40 cm.

The manure goats were conducted before the mulch with doses 0 t/Ha, 10 t/Ha, 15 t/Ha and 20 t/Ha. The fertilizer by means of spreading to the whole swath plant. Provision of fertilizer by means of propagated throughout the plot of plants. Then do the installation of plastic mulch by pulling both ends of the mulch at the end of the plot and done perforation of mulch using used milk cans that given the embers of fire so much faster and neat.

Maintenance of covering: watering, replanting, weeding, and pest and disease control. Variables observed in height of plant per plant, number of leaves per plant, number of fruits per plant and per plot, as well as fruit weight per plant and per plot.

## RESULTS AND DISCUSSION

### The Growth of Okra

Based on the statistical analysis, the giving of mulch color of plastic and goat manure have no significant effect on height of plant per plant and the number of leaves per plant (Table 1).

**Table 1: Height of plant and number of leaves okra plant with provision of various colors of plastic mulch and dosage of goat manure.**

Treatment	Height of plant per plant (cm)	Number of leaves per plant (leaf)
Color plastic mulch (C)		
Silver (C <sub>1</sub> )	70.26a	17.36a
Black (C <sub>2</sub> )	70.24a	18.14a
Transparent (C <sub>3</sub> )	70.65a	18.97a
Goat manure (G)		
0 kg/Ha (G <sub>0</sub> )	64.76a	16.78a
10 t/Ha (G <sub>1</sub> )	69.73a	17.89a
15 t/Ha (G <sub>2</sub> )	72.29a	18.52a
20 t/Ha (G <sub>3</sub> )	74.74a	19.44a
Interaction treatment		
C <sub>1</sub> G <sub>0</sub>	64.98a	16.22a
C <sub>1</sub> G <sub>1</sub>	70.14a	16.33a
C <sub>1</sub> G <sub>2</sub>	72.58a	17.56a
C <sub>1</sub> G <sub>3</sub>	73.33a	19.33a
C <sub>2</sub> G <sub>0</sub>	65.07a	17.00a
C <sub>2</sub> G <sub>1</sub>	69.82a	18.22a
C <sub>2</sub> G <sub>2</sub>	71.10a	18.44a
C <sub>2</sub> G <sub>3</sub>	74.96a	18.89a
C <sub>3</sub> G <sub>0</sub>	64.24a	17.11a
C <sub>3</sub> G <sub>1</sub>	69.23a	19.11a
C <sub>3</sub> G <sub>2</sub>	73.19a	19.56a
C <sub>3</sub> G <sub>3</sub>	75.94a	20.11a

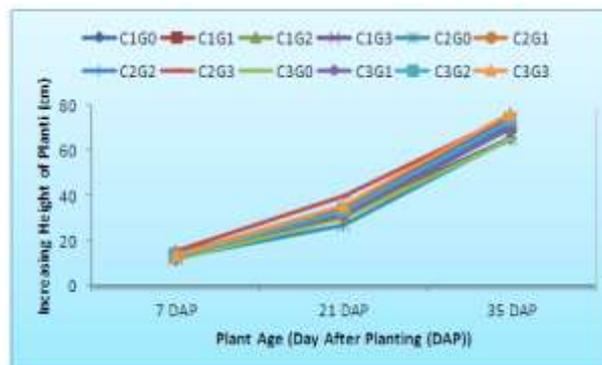
Notes: Values in the same column followed by the same letter are not significantly different at 5% Duncan.

The color of plastic mulch has no significant effect on plant height and the number of leaves per okra plant because mulching directly can create suitable conditions for the plant, especially the micro environment in the root area of the plant, able to maintain soil moisture and the availability of water in the soil, even if the soil is still able to provide water for the plants. In addition, plastic mulch can cover the soil surface tightly, so the possibility of losing water only slightly. With the use of mulch can keep the washing of fertilizer by rain water and prevent evaporation of nutrients by light.<sup>[9]</sup>

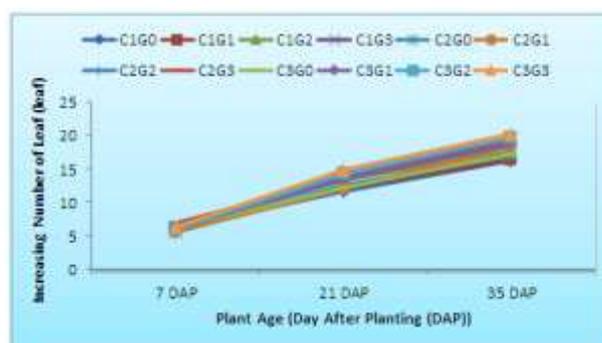
Provision of various doses of goat manure also has no significant effect on height of plant per plant and the number of leaves per plant due to height of plant and number of leaves is generally a genetic property of the plant. The position of the leaves of the okra plant lies on the stem, regularly intermittent and each book has one leaf.<sup>[10]</sup>

Treatment interaction between the various colors of plastic mulch and the dosage of goat manure also had no significant effect on height of plant per plant and the number of leaves per plant. This is because both factors support each other in improving the growth of okra.

Although based on statistic analysis giving mulch color and dosage of goat manure have no significant effect on plant height and number of leaves, but there is increase of height of plant and number of leaves with increasing age of okra (Figures 1 and 2).



**Fig. 1: Increasing height of plant by giving various color mulch plastic and goat manure at age 7 DAP, 21 DAP, and 35 DAP.**



**Fig. 2: Increasing number of leaves by giving various color mulch plastic and goat manure at age 7 DAP, 21 DAP, and 35 DAP.**

Figures 1 and 2 showed that there is an increase in height of plant and number of leaves with the age of okra increased. Provision of transparent plastic mulch and goat manure 20 t/ha gave the highest crop (Figure 1) and the largest number of leaves (Figure 2). In line with the results of the study<sup>[9]</sup> which showed that the growth rate of baby carrots is higher with transparent plastic mulching than silver and black plastic mulch. Similarly, the results of the study<sup>[11]</sup> suggest that the higher the dosage of goat manure, the higher the maize crop is also higher.

### The Yield of Okra

The result of statistic analysis giving various colors of plastic mulch has significant effect on the number of fruit per plant, the number of fruits per plot, and the weight of the fruit per plot, but no significant effect on the weight of fruit per plant. The dosage of goat manure has a significant effect on all variables of okra crops, while the

interaction of treatment between mulch color of plastic and goat manure has no significant effect on all okra plant variables (Table 2).

Table 2 menunjukkan bahwa Warna mulsa plastik berpengaruh nyata terhadap jumlah buah per tanaman, jumlah buah per plot, dan bobot buah per plot tanaman okra, tetapi berpengaruh tidak nyata terhadap bobot buah per tanaman okra. Jumlah buah per tanaman dan per plot terbanyak dijumpai pada penggunaan mulsa plastik transparan (C<sub>3</sub>), yaitu berturut-turut 11.94 buah, dan 73.75 buah. Sedangkan jumlah buah per tanaman dan per plot terendah dijumpai pada penggunaan mulsa plastik hitam (C<sub>2</sub>), yaitu berturut-turut 10.33 buah, dan 59.83 buah. Demikian pula dengan bobot buah per plot terberat dijumpai pada penggunaan mulsa plastik transparan (2087.50 g), dan terendah pada penggunaan mulsa plastik hitam (1732.08 g).

**Table 2: The number of fruit per plant, number of fruit per plot, weight of fruit per plant, and weight of fruit per plot by giving various colors of plastic mulch and the dosage of goat manure.**

Treatment	Number of fruit per plant (fruit)	Number of fruit per plot (buah)	Weight of fruit per plant (g)	Weight of fruit per plot (g)
Color plastic mulch (C)				
Silver (C <sub>1</sub> )	11.33ab	65.50ab	306.80a	1778.75b
Black (C <sub>2</sub> )	10.33b	59.83b	245.52a	1732.08b
Transparent (C <sub>3</sub> )	11.94a	73.75a	267.71a	2087.50a
Goat manure (G)				
0 kg/ha (G <sub>0</sub> )	8.15d	35.78d	169.06c	766.67d
10 t/ha (G <sub>1</sub> )	9.52c	59.44c	217.70b	1389.44c
15 t/ha (G <sub>2</sub> )	11.30b	75.22b	288.99a	2159.44b
20 t/ha (G <sub>3</sub> )	15.85a	95.00a	416.66a	3148.89a
Interaction treatment				
C <sub>1</sub> G <sub>0</sub>	8.33a	30.67a	191.21a	641.67a
C <sub>1</sub> G <sub>1</sub>	10.11a	65.33a	244.26a	1398.33a
C <sub>1</sub> G <sub>2</sub>	11.44a	75.33a	321.30a	2081.67a
C <sub>1</sub> G <sub>3</sub>	15.44a	90.67a	467.55a	2993.33a
C <sub>2</sub> G <sub>0</sub>	8.11a	41.00a	170.80a	865.00a
C <sub>2</sub> G <sub>1</sub>	8.67a	48.67a	196.11a	1270.00a
C <sub>2</sub> G <sub>2</sub>	11.00a	69.67a	279.45a	2056.67a
C <sub>2</sub> G <sub>3</sub>	13.56a	80.00a	335.74a	2736.67a
C <sub>3</sub> G <sub>0</sub>	8.00a	35.67a	145.17a	793.33a
C <sub>3</sub> G <sub>1</sub>	9.78a	64.33a	212.75a	1500.00a
C <sub>3</sub> G <sub>2</sub>	11.44a	80.67a	266.22a	2340.00a
C <sub>3</sub> G <sub>3</sub>	18.56a	114.33a	446.69a	3716.67a

Notes: Values in the same column followed by the same letter are not significantly different at 5% Duncan.

Plastic mulch affects the microclimate through forwarding and reflection of sunlight, temperature, and humidity below and above the mulch and soil moisture content so that the net assimilation rate and the rate of plant growth using plastic mulch is better.<sup>[12]</sup> Increasing the temperature around the plant due to transparent plastic mulching resulted in the rate of photosynthesis process and the growth rate of plants increased resulting in an increase in the number of fruit and fruit weight.<sup>[13]</sup> In line with the results of the study<sup>[9]</sup> which shows that the use of transparent plastic mulch gives the heaviest

weight of baby carrots weight compared to the use of black and silver plastic mulch. In contrast to the results of the study<sup>[13]</sup> which shows that the use of silver plastic mulch gives the largest amount of fruit compared with the use of transparent plastic mulch. Similarly with the results of the study<sup>[14]</sup> which showed that the use of silver plastic mulch gave the highest number of tomatoes compared to the use of transparent plastic mulch.

Table 2 also showed that the dose of goat manure has a significant effect on the number of fruits per plant, the

number of fruits per plot, the weight of fruit per plant, and the weight of fruit per plot. Provision of goat manure of 20 t/Ha ( $G_3$ ) able to produce the number of fruits per plant, the number of fruit per plot, the weight of fruit per plant, and the weight of fruit per plot of the highest okra plants, ie 15.85 fruit, 95.00 fruit, 416.66 g, and 3148.89 g. Without the application of goat manure ( $G_0$ ) yields the number of fruits per plant, the number of fruits per plot, the weight of fruit per plant, and the fruit weight per plot of the lowest okra, ie 8.15 fruit, 35.78 fruit, 169.06 g, and 766.67 g.

The higher the dose of goat manure is the amount of fruit per plant and per plot, and the weight of the fruit per plant and per okra plant plot produced higher. Similarly with the results of the study,<sup>[6]</sup> shown that the application of manure can improve the yield of corn crops. The results of the study<sup>[15]</sup> also showed that manure increases the weight of sweet corn cobs higher than without manure caused by the direct and indirect effects of manure given. Similarly, the results of research,<sup>[16]</sup>

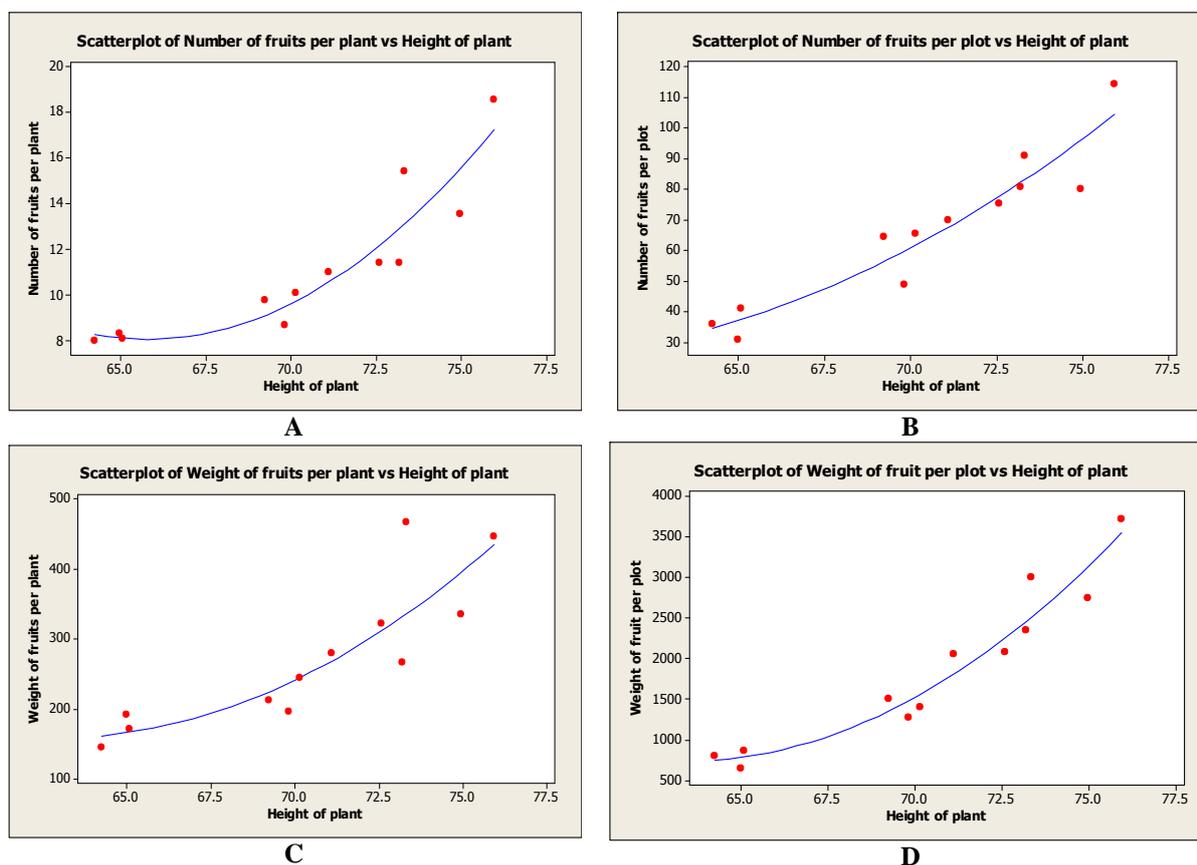
showed that the higher the dose of goat manure is given, then the yield of sweet corn also increased.

#### Relationships Plant Growth and Yield of Okra

To see the growth variables of okra plants consisting of height of plant and number of leaves affecting the component of yield of okra and the relation form used regression analysis presented in the form of Figure.

The relationship between the height of plant with the number of fruits per plant, the number of fruits per plot, the weight of fruit per plant, and the weight of fruit per plot is presented in Figure 2.

Figure 2 shown the relationship between height of plant and number of fruit per plant (Figure 2A), number of fruits per plot (Figure 2B), weight of fruit per plant (Fig. 2C), and weight of fruit per plot (Figure 2D) the quadratic line equation which is the minimum function with the coefficient of determination ( $R^2$ ) is 0.87; 0.89; 0.76; and 0.94.



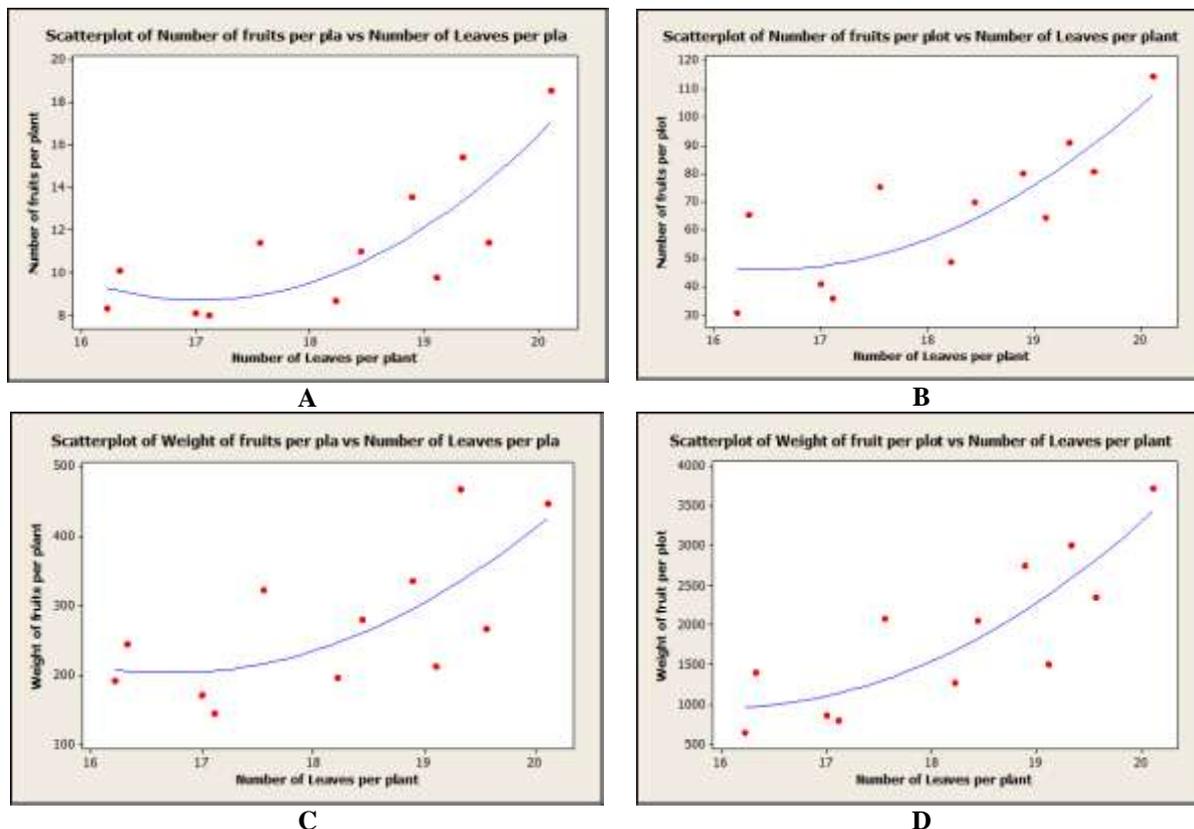
**Fig 2: Height of plant relationship with number of fruit per plant (A), number of fruit per plot (B), weight of fruit per plant (C), and weight of fruit per plot (D).**

The relationship between the height of plant and the number of fruits per plant, the number of fruits per plot, the weight of fruit per plant, and the weight of fruit per plot in the quadratic form means that the increase of the okra plant height up to the optimum limit will increase the yield of okra. The high value of okra plants that continue to increase, will not increase the yield of okra

significantly, even vice versa can decrease the yield of okra.

The relationship between the number of leaves with the number of fruits per plant, the number of fruits per plot, the weight of fruit per plant, and the weight of fruits per plot is presented in Figure 3.

Figure 3A shown the relationship between the number of leaves and the number of fruits per plant (Figure 3A), the number of fruits per plot (Figure 3B), the weight of fruits per plant (Fig. 3C), and the weight of fruits per plot (Fig. 3D) follows the quadratic line equation which is a minimum function with the coefficient of determination ( $R^2$ ) is 0.68; 0.70; 0.50; and 0.72.



**Fig 3:** The number of leaves per plant (A), number of fruit per plant (B), weight of fruit per plant (C), and weight of fruit per plot (D).

Based on the coefficient of determination ( $R^2$ ) on the relationship between height of and yield of okras, and the relationship between the number of leaves with yield of okra, relationship height of plant with yield of okra showed higher coefficient of determination than the coefficient of determination on the relationship of the number of leaves with yield of okra. This suggests that the yield of okra are more influenced by height of plant than the number of leaves. In line with the morphological description of the okra plant showing that the okra fruit emerges from each leaf's armpit,<sup>[17]</sup> so that the higher the plant will increase as well as the okra.

## CONCLUSION

The use of plastic mulch colors and goat manure dose did not affect the growth of okra, but affects okra yield.

The pattern of the relationship between the growth of okra and the okra yields a quadratic line equation.

The relationship between the number of leaves with the number of fruits per plant, the number of fruits per plot, the weight of fruit per plant, and the weight of fruit per plot in the quadratic form means that increasing the number of leaves up to the optimum limit will increase the okra yield. The number of leaves that continue to increase will not increase the okra yield significantly, contrary to lowering the yield of okra.

The yield of okra is more influenced by the height of plant compared with the number of leaves based on the value of its determinant coefficient ( $R^2$ ).

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