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Phenotypic Performance of Kanesia-10 Cotton (*Gossypium hirsutum* L.) Variety Through the Use of Liquid Organic Fertilizers in Low Land

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Abstract

The program of cotton variety improvement is carried out by increasing the productivity and quality of fiber in order to rise the competitiveness of cotton farming through the production of fiber quality that is in accordance with the demand of export-oriented national textile industry. This study aimed to determine the performance of the Kanesia-10 cotton phenotype cultivated using liquid organic fertilizer in the lowlands and obtain the best concentration of liquid organic fertilizer in improving Kanesia 10 cotton performance. This research was conducted in Experimental Farm of the Faculty of Agriculture of the University of Cokroaminoto Palopo from August to November 2018. The genetic material used was Kanesia 10 cotton variety for its fiber content of 27.2%, production of 2.457,2 kg cotton seed per hectare and fiber uniformity of 83,3-84,6%. This study used a randomized block design consisting of five treatments and four times. The treatment used was control (P_0), 50 ml/L POC of gamal leaves (P_1), and 100 ml/L of gamal leaves (P_2) 150 ml/L POC of gamal leaves (P_3), and 200 ml/L POC of gamal leaves (P_4), so that there were 20 experimental units. The use of liquid organic fertilizer produces heterogeneous phenotypic performance for the parameters of the number of fruits per plot with a diversity coefficient value reaching 32.93%. The treatment of liquid organic fertilizer with a concentration of 50 ml / L resulted in the performance of plant height, number of leaves, number of fruits per plot, and the best fruit weight per plot with a mean of 64.13 cm, 57.75 strands, 43.00 fruits and 7.60 g, respectively

Keyword: coefficient of diversity, concentration, gamal leaves, POC

A. Introduction

Cotton (*Gossypium hirsutum* L.) is an annual shrub that becomes one of the major plantation commodities in Indonesia. This commodity produces fiber that is widely used as raw material in textile industry and several textile products (TPT) of Indonesia. However, this industrial advance is not yet completely produced fiber processed material due to the unavailability of raw material, especially cotton fiber.Cotton has been cultivated in India since 5000 years ago and subsequently becomes more popular and the development spread rapidly to China, the Near East, and area surrounding Mediterranean regions. This commodity is intensively developed, particularly in several continents such as America and Australia.

The development of this commodity in Indonesia has not yet met the need of textile industry, thus cotton is still imported every year despite the high potential of domestic cotton to be developed. Unavailability of raw materials is caused by low production of cotton, low farmer's interest to cultivate cotton, and increasing demand of domestic cotton (Sumartini *et al.*, 2013). Until today, over 500 ton of cotton fiber (more than 99%) is still imported to meet domestic demandsince cotton farming faces serious pest attack. Hence, cotton productivity and cotton farmer income is still low and continues to fluctuate (Harsanti *et al.*, 2017).

There was fluctuated cotton production in China, India and Indonesia from 2014 to 2017. In 2014,the production reached 4389.8 kg/ha, 1413.1 kg/ha, and 207.4 kg/ha, respectively. In 2015, cotton produced in each country was respectively 4467.9 kg, 1349.3 kg/ha, and 124.1 kg/ha. The production increased respectively in 2016 of 4747.8 kg/ha, 1602.5 kg/ha, and 202.6 kg/ha. In 2017, cotton seed production reached 4730.1 kg/ha, 1518.9 kg/ha, and 89.0 kg/ha, respectively. Cotton production in Indonesia fluctuated during 2014-2017, yet there was significant decrease of 113.6 kg/ha in 2016-2017, that was from 202.6 kg/ha to 89.0 kg/ha (FAO, 2018).Problemmainly occurs in cotton production is related to climate factor such as water unavailability that causes cotton production becomes not optimal. Moreover, there are other factors like low genetic and physical quality of seed used in the production and environmental condition during planting. Yield loss due to seed quality is expected to reach 30% of total loss, following by environmental factor such as pest attack and drought (Harsanti *et al.*, 2017).

Increase in cotton productivity can be achieved through the use of superior variety. Availability of superior variety that is able to adapt to environmental condition in Indonesia is necessary. Thus, the use of superior cotton variety that has resistance to abiotic and biotic stress and reaches high production both in dryland and paddy field is required (Sulistyowati dan Sumartini, 2009). One of superior cotton varieties that is able to achieve high production is Kanesia-10 cotton (97023/8). The ability of this variety to adapt to dry condition or water as limiting factor is better than that of Kanesia 14 and Kanesia 15 varieties(Dewi, 2014). This variety is better compared to other clones in term of fiber content, fiber fineness, fiber length, and yield productivity.

In addition, the factors that cause a decrease in cotton production are land degradation which results in decreased soil fertility, such as decreased nutrient content, organic matter content and soil pH (Aisyah et al., 2008). Giving liquid organic fertilizer is one of the ways and solutions to increase cotton crop production. Liquid organic fertilizer has the benefit of being able to improve the physical, chemical and biological properties of the soil, increasing the formation of leaf chlorophyll so that it increases the ability of plant photosynthesis and absorption of nitrogen from the air, can increase plant vigor. Thus, the plant becomes sturdy and strong, increases plant resistance to drought and weather stress, stimulates the growth of production branches and increases the formation of flowers and ovaries and can improve the quality of crop production, reduce inorganic fertilizers, and as an alternative manure replacement (Indrakusuma, 2000).

Sulistyowati and Sumartini (2009) mentioned the performance of Kanesia 10 cotton developed in several locations showed good productivity and were able to produce 1.002.5-2,287.3 kg cotton seed per ha without spraying and 1,969.6-3,025.5 kg cotton seed with spraying; the production potential of this variety was 2,97 and 19,32%, respectively, higher than that of Kanesia 7 and Kanesia 8. Peni *et al.*, (2018) said that Kanesia 10 seed variety development was observed to obtain the best agronomic performance for 2 MST (Weeks after Planting), 4 MST, and 8 MST. However, different agronomic performance was expected to be affected by environmental condition in Palopo City. This study aimed to determine the effect of fertilization on the performance of cotton phenotypes in the low land area.

B. Methodology

This study was conducted in Experimental Farm of Agricultural Faculty of the University of Cokroaminoto Palopo from August to November 2018. The geographical location of the research location is 3°04'08 '' LS and 120°14'34 '' BT with altitude ranging from 0 - 500 m above sea level. The air temperature ranges from 25.5°C - 29.7°C while the rainfall varies between 500 - 1000 mm/year. Genetic material used included cotton seed of Kanesia 10 variety. This study used a randomized block design consisting of five treatments and four times, so that there were 20 experimental units.

The treatment used was control (P_0), 50 ml/L POC of gamal leaves (P_1), and 100 ml/L of gamal leaves (P_2) 150 ml/L POC of gamal leaves (P_3), and 200 ml/L POC of gamal leaves (P_4). The application of liquid organic fertilizer is given to cotton plants after 2 weeks after planting and the application of liquid organic fertilizer is done in the afternoons every 1 week until male flowers appear on cotton plants.

Determination of spacing is adjusted to soil fertility. The recommended distance for infertile soils is around 80-30 cm with a planting depth of 5 cm. planting is done directly and each plant is planted 2-3 seeds / holes. Thinning is done when the cotton plant is 7 HST. The observed and measured parameters were plant height (cm), number of leaves (strands), flowering age (HST), number of fruits / plants (fruit), fruit weight (g), and root length after harvest (cm).

C. Results and Discussions

Performance of phenotype cotton varieties Kanesia 10 were developed in the lowlands using liquid organic fertilizer for the characters that plant height, leaf number, days to flowering, number of fruit per plant, fruit weight per plant, number of fruits per plot and fruit weight per plot is presented in Table 1. Based on the results of variance, there are four parameters are significant observations of plant height, leaf number, fruit weight per plant and fruit weight per plot. While the parameters that have a significant effect are the number of fruits per plant and number of fruits per plot. However, there is one parameter of observation that has no significant effect, namely the age parameter of flowering. It is assumed that the treatment of liquid organic fertilizer used was not able to show a significant influence on the performance of the cotton phenotype of kanesia 10 variats in the lowlands. It is suspected because of the environmental influences that cause differences in the performance parameters for days to flowering.

Table 1 Recapitulation of analysis of variance of Kanesia-10 cotton (*Gossypium hirsutum* L.) Variety Through the Use of Organic Fertilizers in Low Land

Parameter of observation		Organic fertilizer treatment	Coeffecient of variance (%)
Vegetative Phase	Plant height (cm)	8.16 **	10.90
	Number of leaves (strand)	64.63 **	11.23
Generative Phase	Flowering age (HST)	1.86 *tn*	8.51
Yield Component	Number of fruit per crop	3.48 *	30.75
	Fruit weight per crop (g)	10.01 **	21.20
	Number of Fruit per plot	4.25 *	32.93
	Fruit Weight per plot (g)	12.37 **	29.49

Description: tn = not significant; * = significant at α=5%; ** = significant at α= 1%.

Table 1 also presents the diversity coefficient values for each parameter is used. Parameters of plant height, number of leaves, and flowering age produced a relatively low diversity coefficient compared to other parameters. As for the parameters of the number of fruit per plot generate coefficient values are higher by 32.93% value. The coefficient of variance (KK) is a coefficient that indicates the level of accuracy of the conclusion of a trial.

The value of the coefficient of genetic diversity showed that the material used is not homogeneous and a low level of accuracy. Diwangkari et al., (2016) stated that the KK value of 10.74% can be categorized as small value, because high KK shows that the research material is not homogeneous and the greater the physical error in carrying out the experiment and parameter measurement, it can be concluded that the experiments were good. Hanafiah (2010), the value of KK is getting smaller, showing a higher degree of accuracy and the validity of the conclusions obtained from these experiments is also getting higher.

1. *Vegetative Phase*

Vegetative phase is a growing phase where carbohydrate resulted from photosynthesis is mostly used for root, stem, and leaf development. Vegetative phase measured and observed in this study is presented in Table 2. Table 2 shows the parameters of plant height and the number of significant leaves for the administration of liquid organic fertilizer so that further testing using BNT level 5%.

Plant height increase is one part of the growth phase. The best plant height was shown in the treatment of 50 ml/L POC with an average of 64.13 cm but not significantly different from the administration of 200 ml/L POC with an average of 63.15 cm. While, the treatment of 0 ml/L POC (control) produced the lowest plant height with an average of 52.28 cm. This is caused by the use of gamal-based liquid organic fertilizer (POC) which is capable of triggering the growth of plant height because it contains nutrients N, P and K. Nutrient content, especially nitrogen can stimulate and accelerate plant growth. Oviyanti et al., (2016) stated that the more concentration of liquid organic fertilizer made from gamal leaves, the better the condition of the plant without disrupting its growth and metabolic processes. Dhani et al., (2013), nitrogen nutrients are needed by plants for the synthesis of amino acids and proteins, especially in plant growth points so as to accelerate plant growth processes such as cell division and elongation and have an impact on increasing plant growth.

However, the growth of Kanesia 10 varieties of cotton plants cultivated in the lowlands using liquid organic fertilizer has not been able to show a significant difference when compared with the description of Kanesia 10 varieties is 110.17 cm in according with Kepts/SR.120/2/2007. It is suspected that cotton plants cultivated in the lowlands experience environmental stresses that affect the mechanism of photosynthesis and have an impact on plant growth. Sibley et al., 1999; Wollenweber et al., 2003; Wahid, 2007 states that environmental stress in the form of high temperatures and drought can influence the mechanism of photosynthesis resulting in the amount and content of assimilate.

Table 2 Performance of Kanesia 10 cotton phenotype using Liquid Organic fertilizer in the low land area for the vegetative phase

Treatment	Vegetative Phase	
	Plant Height (cm)	Number of Leaves (Strand)
Kontrol	52.28^{bc}	18.00^{c}
50 ml/L POC	64.13^{a}	57.75^{a}
100 ml/L POC	58.63^{ab}	32.75^{b}
150 ml/L POC	43.00^{c}	23.75^{c}
200 ml/L POC	63.15^{a}	37.25^{b}

Description: Values within the same column following by different subscript letters show significantly different result in BNT at level of 0.05.

The optimal number of leaves formed was shown by giving 50 ml/L POC with an average of 57.75 strands and significantly different from other treatments. However, it is different from the administration of 200 ml / L POC resulting in an average number of leaves of 37.25 strands. This is due to the concentration of a given POC different. The content-based POC Gliricidia leaves for the formation of the leaf that is the element N. Bungard et al., (1999), the number of leaves can be attributed to increasing vegetative growth of onion plants through the synthesis of different components of the protein needed for leaf development.

The number of leaves is also closely related to the capture of light and CO_2 more effectively so that it has an impact on increasing the rate of photosynthesis and is associated with production. Elizabeth et al., (2013), the more number of leaves produced, the better the chance to produce fresh and dry weights. Unlike the case with Nasreen et al., (2008), in several reference studies said that the discharge of excess liquid organic fertilizer tends to reduce the number of leaf plants.

2. *Generative Phase*

Generative phase the growth phase that accumulates most carbohydrate produced from photosynthesis process. This carbohydrate is further utilized to form flower, cotton fiber and seed, or enlargement of food storage structure in plants. Parameter of observation for generative phase consisted of flowering age as presented in Figure 1.

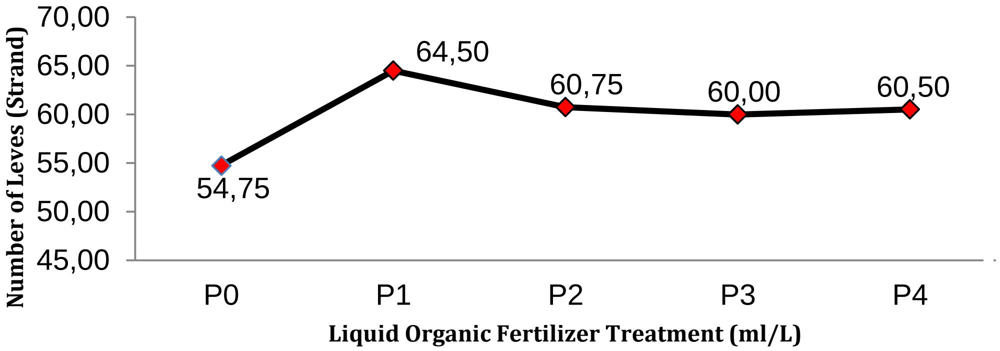

Figure 1 Performance of Kanesia 10 cotton variety for flowering age characters using liquid organic fertilizer in the low land area

In accordance with the description of the Kanesia-10 Kpts/SR.120/2/2007 variety, Kanesia-10 flowering age reaches 55 - 60 HST. Based on these descriptions, giving 150 ml/L POC results in a better flowering life compared to other treatments. Meanwhile, giving 0 ml/L POC (control) results in a faster flowering age and the administration of 50 ml/L POC results in a slower flowering age. This is due to the unavailability of effective P nutrients for flower formation. While for the administration of 150 ml/L POC, it can provide effective P nutrients for the formation of cotton flowers.

P nutrients are important components of compounds for energy transfer (ATP and other nucleoproteins), for genetic information systems (DNA and RNA), for cell membranes (phospholipids), and phosphoprotein Gardber et al., 1991; Lambers et al., 2008), sugar phosphate and specifically on energy transport and storage whose role is largely from complementary materials (Havlin et al, 2005; Gardner et al, 1991; Barker and Pilbeam, 2007).

3. *Yield Component*

The yield component observed included number of fruit per crop, fruit weight per crop, number of fruit per plot, and fruit weight per plot as presented in Table 3. The four components of production have a significant effect on the provision of liquid organic fertilizer. The treatment of 100 ml/L POC showed the parameters of the number of fruits per plant and fruit weight per best plant with a mean of 12.00 fruits and 1.65 g respectively, not significantly different from the 200 ml/L POC treatment. While for the parameters of the number of fruits per plot and the best fruit weight per plot produced by the treatment of 50 ml/L POC with an average of 43.00 fruits and 7.60 g.

Table 3 Performance of Kanesia 10 cotton phenotype using Liquid Organic fertilizer in the low land area for the yield component

Treatment	Yield Componenet			
	Number of Fruit per Crop	Fruit Weight per Crop	Number of Fruit per Plot	Fruit Weight per Plot
Kontrol	5.00 ^{b}	0.58 ^{b}	23.50 ^{b}	3.13 ^{b}
50 ml/L POC	8.75 ^{ab}	1.40 ^{a}	43.00 ^{a}	7.60 ^{a}
100 ml/L POC	12.00 ^{a}	1.65 ^{a}	26.50 ^{b}	3.80 ^{b}
150 ml/L POC	8.50 ^{ab}	1.08 ^{ab}	20.00 ^{b}	2.33 ^{b}
200 ml/L POC	9.25 ^{a}	1.40 ^{a}	23.00 ^{b}	3.18 ^{b}

Description: Values within the same column following by different subscript letters show significantly different result in BNT at level of 0.05.

Addition of nutrients through fertilization can replace nutrients lost due to washing and erosion. Liquid organic fertilizer contains many macro, micro, hormone and amino acids needed for the yield component (Pangaribuan et al., 2017). Jayadi (2009), the content of gamal-based liquid organic fertilizer contained 3.15% N, 0.22% P, 2.65% K, 1.35% Ca, and 0.41% Mg.

D. Conclusion

The causes of the low production and productivity of cotton in Indonesia are one of them is conventional cultivation techniques and lack of availability of nutrients in the soil. Soil can provide sufficient nutrients for cultivated plants by adding organic fertilizer. The advantages of liquid organic fertilizer is that it is easily absorbed by plant roots. One of the plants originating from the family of leguminosae and potentially as a liquid organic fertilizer is gamal leaves. The use of liquid organic fertilizer produces heterogeneous phenotypic performance for the parameters of the number of fruits per plot with a diversity coefficient value reaching 32.93%. The treatment of gamal leaf liquid organic fertilizer significantly affected the parameters of plant height, number of leaves, number of fruits per plant, fruit weight per plant, number of fruits per plot and fruit weight per plot. The treatment of liquid organic fertilizer with a concentration of 50 ml/L resulted in the performance of plant height, number of leaves, number of fruits per plot, and the best fruit weight per plot with a mean of 64.13 cm, 57.75 strands, 43.00 fruits and 7.60 g, respectively. Giving 100 ml/L POC showed the number of fruits per plant and fruit weight per best plant with an average of 12.00 fruits and 1.65 g, respectively. Meanwhile, giving 150 ml/L POC produced the best flowering age with an average of 60.00 HST according to the description of Kanesia-10 variety (55 - 60 HST).

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