Effect of Harvesting Period on Growth Performance of Lemongrass (Cymbopogon Citratus)

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***Abstract*—** Cymbopogon citratus has been known for its use in a wide variety of products ranging from pharmaceuticals, cosmetics to food and drink flavoring. Statistics provided by the department of agriculture (DOA) suggest an increasing trend for C. citratus production from 2005 to 2008. However, the use of medicinal plants could be influenced by several factors and one of them was through the agronomic approach. Therefore, a study to evaluate the effectiveness of modified agronomic practices based on prolonged harvesting period has been carried out to evaluate its effects on C. citratus. The treatments consist of 6, 7 and 8 months. A total of 12 experimental units were planted and the experimental design was Randomized Complete Block Design (RCBD) with 4 replications. Each experimental unit consists of 32 planting points This study was carried out at Ladang 2, MARDI Kluang from September 2017 to November 2018. Agronomic practices include land preparation and planting distance followed guidelines from the Department of Agriculture (DOA). The data showed that leaves weight, slip weight, plant fresh weight, height, and stem diameter was significantly affected by harvesting periods. Most noticeable was the slip weight trend in which increment between 7 and 8 months was at par. All of the significantly affected parameters show a significant positive linear response towards the harvesting period. Furthermore, slip weight shares a significant positive association with leaves weight, height, and stem diameter which in return makes them a reliable herbage yield indicator.

***Keywords*—** Leaves weight, slip weight, height and stem diameter.

I. INTRODUCTION

Lemongrass is a perennial narrow-leaf grass plant locally known as 'serai makan'. It's normally being consumed by locals in cuisine. Apart from fresh consumption, lemongrass is also being explored in other industries such as essential oil, cosmetics, and pharmaceutical-related industries (Ramendra et al., 2016). According to Calixto (2000), the use of medicinal plants could be influenced by several factors which comprise cultivation, harvest period, climatic condition, humidity, brightness, plant parts, transportation approaches, storage, and drying process.

In accordance to Dasar Agromakanan Negara (DAN) 2011-2020 projection to increase national herbs & spice production from 17000 to 73000 metric tan with a yearly increment projection of 15.4% (MOA, 2011). To achieve this target, several strategies have been outlined and some of them include increasing production, providing quality and consistent planting materials, and enhancing R&D activities. Since medicinal plants production could be influenced by the harvesting period, a study to evaluate the effect of the harvesting period on C. citratus was carried out.

II. METHODOLOGY

A. Experimental Site

The experiment was carried out at Ladang 2 MARDI Kluang, Johor, Malaysia. The site was located at 1° 57' 3.744" latitude and 103° 21' 26.6214" longitude. The study site was rain forest agroecology.

B. Planting materials

To ensure uniformity planting materials was prepared 6 months before the study. Planting materials propagation was obtained from a single source.

C. Experimental design and statistical analysis

Randomized Complete Block Design (RCBD) was used in this study. Analysis of variance (ANOVA) was carried out to determine significance and Duncan Multiple Range Test (DMRT) was used for mean separation. The experiment consists of 3 treatments namely 6, 7, and 8 months planting duration with 4 replications. Each experimental unit comprises 32 planting points and each planting slip has a height of 12 cm (Zheljazkov et al., 2011). This whole study consists of 12 experimental units with 192 planting points. A planting distance of 1 m x 0.5 m was employed. The

distance between experimental units was 1.5 m and the distance between replications was 2 m.

D. Data Collections

The parameters evaluated in this study are leaves weight, slip weight, plant fresh weight (slip + leaves), height, SPAD and stem diameter were sampled at harvest. Border planting points were not taken to avoid the border effect (Premathilake et al., 2018). For stem diameter, height, and SPAD measurement, 4 random hills with the longest leaf blade were chosen per experimental unit (Ismail, A.A., 2020). For slip weight and plant fresh weight, 5 hills per plot were selected randomly (Bekele et al, 2019).

III. RESULTS AND DISCUSSION

A. Test of significance

Analysis suggests that parameters weight leaves weight, slip weight, total biomass, height, and stem diameter were significantly affected by the harvesting period (Table 1). SPAD meter reading was the only parameter that shows no significant response.

B. Leaves weight

Analysis suggests that leaves weight shows a significant positive response towards the harvesting period. The increment between the 6th and 7th months was approximately 57.89%. Further delay in the subsequent harvesting period leads to a higher leaves weight. However, the increment between 7th and 8th month was not significant. Lemongrass harvested at 7th month contributed to higher reading compared to 6th. Minimum impact on leaves weight increment between 7th and 8th month.

Gawali and Meshram (2019) stated that lemongrass could produce higher foliage yield in a short time. Nevertheless, the present study suggests prolong harvesting period may not beneficial since the increment specifically at 7th and 8th was not significant. According to Jimayu and Gebre (2017), the harvesting period significantly affected the number of leaves and tiller on lemongrass. Harvesting leaves at 90 days contributed to the highest no of leaves compared to 45, 60, and 75 days after planting.

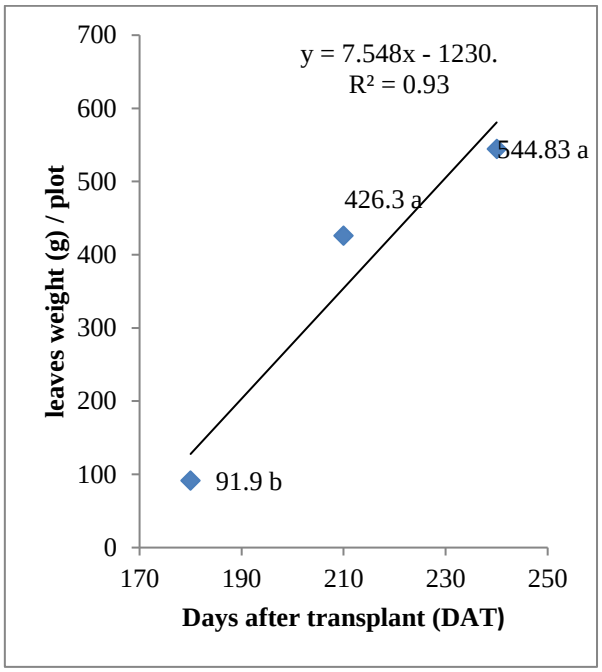

Figure 1: *Relationship between leaves weight and harvesting period,*

A. Plant height

Height also shows significant positive linear responses towards the harvesting period (Figure 2). Height increment between 6th and 7th was significant. Subsequent delay in harvesting period to 8th month increases height to a certain point but shows no significant compared to previous 7th month. Kassahun et al (2011) discovered that location can significantly affect lemongrass height consistently throughout several years. Apart from location and harvesting period, Yeshita (2019) found out that lemongrass height could also be affected by varieties and the number of slips per planting point. Variety WG-Lomisar-Java (182.40 cm) shows a higher plant height reading compared to Lomisa-I (63.24 cm). The increasing number of slips per planting point significantly reduced plant height as this is due to higher competition for a nutrient associated with plant growth.

Table 1: *Mean square ANOVA effect of harvesting period on herbage yield performance of C. citratus*

Sources of variance	Parameters					
	Leaves weight	Slip weight	Plant fresh weight	Height	SPAD	Stem diameter
Harvesting period	441422.13*	26073.69*-	107129.67*	935.37*	22.89	54.15*
Rep	7123.63	427.38	1001.21	60.4	0.71	0.41
Grand mean	354.38	121.12	248.73	91.92	34.08	8.64
C.V. (%)	35.66	34.53	35.63	9.94	7.84	16.23

Note: mean followed by * indicate significant difference at 0.05

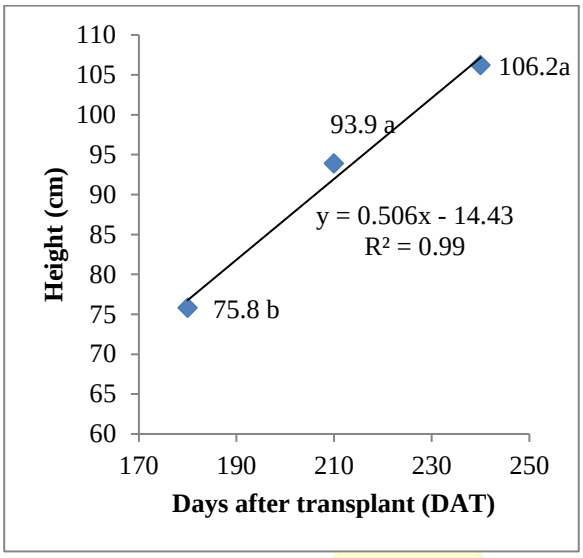

Figure 2: *Relationship between harvesting period and height.*

B. Stem diameter

The stem shows a similar significant positive response towards the harvesting period (Figure 3). The difference between the 6th and 7th months was 75.5% and it was significant. Further delay in harvesting age significantly increases stem diameter by 45.34%. This finding agrees with Lawal (2017) that concluded the lemongrass stem increases as the plant grows. Susilowati and Syukur (2022) discovered that the stem diameter of 20 lemongrass accessions shows no significant difference.

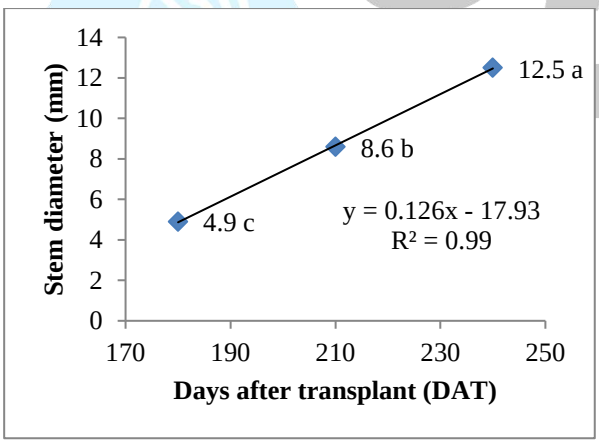

Figure 3: *Relationship between stem diameter and harvesting period.*

C. Slip weight and plant fresh weight

Slip weight also shows a significant positive linear response (Figure 4) towards the harvesting period. The difference between the 6th and 7th months was 356.13%. Subsequent delay in the harvesting period further increases slip weight by 30.97%. However, the increment between 7th and 8th exhibited statistical parity. This implies that the increment from between 7th and 8th was not significant. This trend is similar to that of leaves weight mentioned earlier.

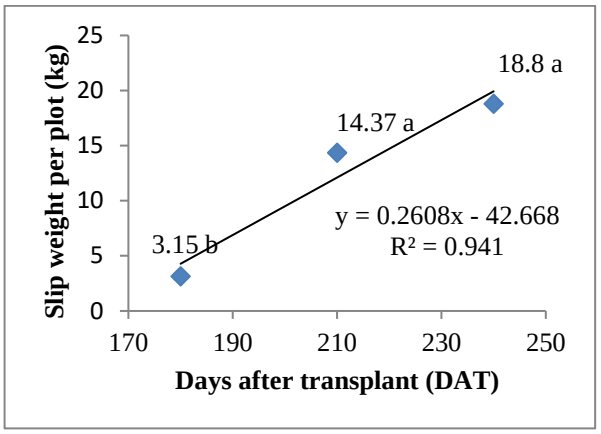

Figure 4: *Relationship between slip weight and harvesting period.*

Plant fresh weight also shows a similar trend with slip weight (Figure 5). The difference between the 6th and 7th month period was 439.34%. Subsequent delay in the harvesting period to 8 months' further increases plant fresh weight to 11.5%. There is a huge drop in increment percentage for both slip weight and plant fresh weight particularly at 8th month. According to Tajidin et al (2011), plant fresh weight shows no significant effect towards harvesting age while slip yield increases with harvesting age. Ismail et al (2021) stated that lemongrass herbage yield was significantly affected by both nitrogen and harvesting age but shares no significant interaction between them. Their study also suggests that herbage yield shows similar significant positive linear response towards the harvesting period. Bekele et al (2019) found out that lemongrass fresh herbage yield was significantly affected by variety and harvesting age. Overall, the variety WG-Lomisar-AU was significantly higher compared to Lomisar-I. Both varieties show higher herbage yield at 165 DAT compared to 105 DAT.

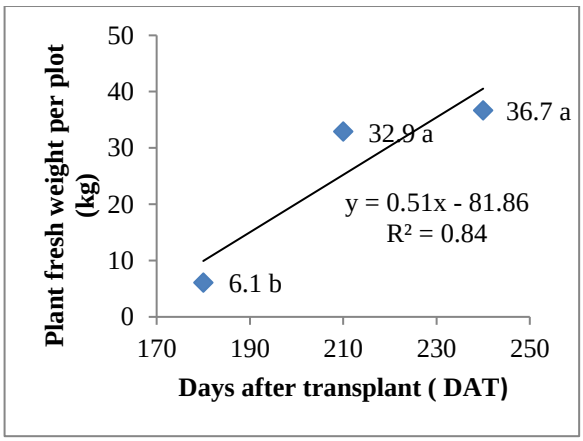

Figure 5: *Relationship between plant fresh weight and harvesting period.*

Table 2: *Correlation analysis among parameters*

	Leaves weight	Height	SPAD	Stem diameter	Slip weight	Plant fresh weight
Leaves weight	1	0.75	-0.68	0.76	0.97	0.97
		**	**	*	**	**
Height		1	-0.53	0.88	0.73	0.68
			ns	**	**	**
SPAD			1	-0.62	-0.75	-0.73
				*	*	**
Stem diameter				1	0.78	0.70
					**	**
Slip weight					1	0.97
						**
Plant fresh weight						1

Note: mean followed by * indicate significant difference at 0.05
mean followed by ** indicate significant difference at 0.01

D. Correlation analysis

Analysis suggests that slip weight and plant fresh weight shares a significant positive association with leaves weight, height, and stem diameter (Table 2). The only parameter that shows a significant negative association was SPAD reading. This may imply that good leaves weight; height and stem diameter reading has the potential to further increase slip weight and plant fresh weight. Any decrease in any of these parameters may negatively impair the herbage yield of lemongrass.

IV. CONCLUSION

The present study finds out that the harvesting period significantly affects lemongrass herbage yield and yield characteristics. Especially on plant fresh weight and slip weight. Prolong period spent towards increasing herbage yield of lemongrass may not be beneficial since minimum increment was observed between the 7th and 8th months.

Current lemongrass production SOP by the Malaysian Department of Agriculture (DOA) suggests a period of 6-8 months may need revision due to present findings. Small scale local farmers need to be educated about the impact of harvesting age on the herbage yield of lemongrass so that they can better organize their production schedule more efficiently.

V. ACKNOWLEDGMENT

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