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Optimization of the flowering stage by using stimulants of calcium carbide and paclobutrazol on pineapple at post tin mining area

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Abstract. Bangka Island is the potential to increase pineapple production because of the availability of marginal land caused by tropical tin mining. The success of pineapple cultivation is determined by the formation of flowers that will become fruit. The flowering process can be accelerated using carbide and paclobutrazol. This research aimed to study the effect of Calcium carbide and paclobutrazol application as a flowering stimulant for flowering initiation and yield of pineapple in the post tin mining area. This research was conducted from January 2018 – July 2019 located in post tin mining area owned by PT Timah Tbk, Dwi Makmur Village, Merawang Subdistrict, Bangka Island using an experimental method with randomized block design with a single factor which was a type of flowering stimulant consist of calcium carbide [Calcium carbide] [P0] and paclobutrazol [P1]. The result showed that both of flowering stimulant gave significant effect to flowering time, fruit diameter, fruit length, fruit weight with crown, and fruit weight without the crown of pineapple. The fastest flowering duration showed in the pineapple with Carbide application in the post tin mining area.

Keywords: Bangka Belitung, tin mining, *Ananas comosus*

1. Introduction

Pineapple [*Ananas comosus* [L.] Merr] is one of the plant types that can cultivate in marginal land such as the post tin mining area. Other plants that can cultivate on post tin mining land were sorghum [1] and pakcoy [2]. As the province which has a large post tin mining area, Bangka Belitung is the potential to increase pineapple production by cultivating pineapple. The physical characteristic of post tin mining land is porous, sandy texture with low water holding capacity and cation exchange capacity, soil pH is very acidic, C-organic, N, P, K content are low, and iron levels are quite high [3]. In the dry season, the temperature of surface sandy tailing in post tin mining land is high which is 35.5°C - 40°C [4].

The success of pineapple cultivation was determined by the formation of fruit set. Pineapple plants naturally bloom when they are mature. However, the flowering process needs a long time [5]. Pineapple plants need flowering stimulants to bloom quickly and simultaneously. The materials to stimulate the pineapple flowering stage are carbide [6] and paclobutrazol [7]. This research conducted to study the effect of Calcium carbide and paclobutrazol to stimulate the flowering initiation and yield of pineapple on post tin mining land.

2. Materials and methods

This research was conducted in post tin mining land of Dwi Makmur Village, Bangka and Agrotechnology's laboratory of Bangka Belitung University from January 2018 – July 2019. The research used an experimental method with a single factor block randomized design with four replication. The treatment factor is a type of flowering stimulant consist of calcium carbide [Calcium carbide] [P0] and paclobutrazol [P1]. Every replicate consisted of 4 samples, thus there were 16 experimental units and 64 plant samples in total. The size of each plot was 2 x 2 m² with 1 m space between plots.

The soil was prepared using hoe then formed into 32 plots measured 2 m x 2 m x 20 cm of each. Cow manure was applied a week before planting with a dosage of 1.5 kg/plot. Pineapple seedlings of Bikang accessions were inserted into the planting hole with a size of 15 cm x 15 cm x 10 cm and covered with soil. Plant maintenance includes fertilizing, watering, weed control, and pests and diseases control. Flowering stimulants were applied at 10 months old of pineapple. The carbide was applied by dissolved 100 g of carbide in 10 liters of water. Then sprayed to the pineapple plant with 80 ml of the solution. Paclobutrazol was applied by mixing 2 ml paclobutrazol with 1 liter of water then sprayed into all parts of the media around the plant. The harvesting was done at 18 months after planting when the pineapple was red/yellow-colored.

Data analyzed using the F test with a 95% significant level then it followed by the Least Significant Difference Test at a 95% significant level using Statistical Analysis System software.

3. Results and discussion

The results of data analysis [Table 1] showed that the application of flowering stimulants type has a significant influence on the parameters of flowering time, fruit length, fruit weight with crown, fruit weight without crown, and fruit diameter.

Table 1. Data analysis of flowering stimulants to flowering time, fruit length, fruit weight with crown, fruit weight without crown, and fruit diameter.

Parameters	Flowering stimulants		CV [%]
	F-Value	Pr>F	
Flowering time	732.34	0.0001**	6.16
Fruit length	92.64	0.0024**	22.53
Fruit weight with crown	62.98	0.0042**	26.46
Fruit weight without crown	48.29	0.0061**	29.43
Fruit diameter	119.71	0.0016**	19.7

Note: CV: coefficient of variance, **: The effect of very real at the level $\alpha=1\%$, Pr>F: Probability value

Least significant difference test [Table 2] showed that the flowering time, fruit length, fruit weight with crown, fruit weight without crow, and fruit diameter were significantly different on the type of flowering stimulants. The flowering time of pineapple plants using carbide treatment was faster than paclobutrazol treatment. Calcium carbide treatment gave the best value for fruit length, fruit weight with crown, fruit weight without crown, and fruit diameter of pineapple.

Table 2. Average of flowering time, fruit length, fruit weight with crown, fruit weight without crown, and fruit diameter on type of flowering stimulants.

Flowering stimulants	Parameters				
	Flowering time [DAA]	Fruit length [cm]	Fruit weight with the crown [g]	Fruit weight without crown [g]	Fruit diameter [mm]
Calcium carbide	31.81 ± 0.55 b	11.32 ± 0.55 a	921.19 ± 59.80 a	616.56 ± 42.57 a	94.96 ± 2.62 a
Paclobutrazol	123.19 ± 43.89 a	1.5 ± 6.93 b	136.13 ± 638.75 b	99.13 ± 468.38 b	12.82 ± 59.31 b

Note: the number followed by the same letter in the same column shows no significant difference at $\alpha=5\%$. Mean data were obtained from four replication.

The Calcium carbide treatment showed the shortest flowering period for pineapple plants at 31.81 days after application [DAA] compared to paclobutrazol treatment. This was presumably because carbide dissolved in water will quickly be transformed into ethylene so that the induction of pineapple flowering becomes faster. A water solution containing dissolved ethylene can induced flowering in pineapple when sprayed in the central cup [6]. The percentage of flowering induction of pineapple by giving 1.0% CaCl₂ [carbide] was 100% [8].

Calcium carbide treatment gave the best result for fruit length, fruit weight with crown, fruit weight without crown, and fruit diameter of pineapple than paclobutrazol treatment. This was presumably because of the high content of gibberellin that able to inhibit flowering. The high gibberellin content will inhibit flowering time where gibberellins stimulate growth and improve the shoot carbon supply [9]. According to [10], excessive accumulation of gibberellins can inhibit the generative growth, its effect only on vegetative growth. According to Prawitasari *et al.* [11], the application of paclobutrazol to induce flowering must be followed by the application of a dormancy-breaking agent after the application of paclobutrazol.

4. Conclusions

Calcium carbide stimulant showed the shortest flowering period and the best of all generative parameters of pineapple plants were cultivated in post tin mining land. Based on this research, we recommend Calcium carbide as the best flowering stimulant that reduces the flowering period and increases the yield in the post tin mining area.

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