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Induction of Flowering and Yield of Mango Hybrids Using Paclobutrazol

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ABSTRACT

Induction of flowering in mango plant growth regulator using paclobutrazol be able to set the time of flowering and fruiting on mature plants that have been in production, but in the type of mangoes hybrid that are still juvenile phase of 3 years aged and not reproduce has not been widely reported. This study aimed to determine the effect paclobutrazol on flowering and yield of mango hybrids. Plant material used is 20 accessions of mango hybrids 3 years aged of a hybrid Arumanis-143 cultivars which has a green skin color characters with 6 cultivars of mango which has a red skin color characters of the fruit. The plants grown in the field at a spacing of 4 x 4 meters, and then paclobutrazol splashed around the main stem of the plant under the canopy with a diameter of 0.5 meters, at a dose of 5 ml. per plant and 0 ml per plant as a control. The study was conducted using a randomized block design and observations variable for flowering consists of the number of flowering plants, the amount of flower, the emergence of flowers, the length and width of inflorescences and peduncle, while the observations variable for crop include the number and weight of fruits and fruit yield crop every plant . The results showed that paclobutrazol accelerate the induction of flowering as indicated by the number of flowering plant, the more flower, the emergence faster rate of flower, the more petals, but the length and width of inflorescences is shorter than the control. In variable of results, applying paclobutrazol indicate the higher quantity, weight and yield and type of accession significantly affect the number and weight of fruits and fruit crops of each plant with highest yield from accession F1-15 and F1-87, each with a weight of 41.27 kg and 22.59kg.

Keywords: Mangifera indica L., hybrids mango, flowering, yield, paclobutrazol

INTRODUCTION

Mango (*Mangifera indica* L.) is a fruit which contributes the third largest of the fruit production in Indonesia. East Java Province is the province's largest mango producer in Indonesia, namely 659,952 tons or 57.59% of the total national production of mangoes [1], whereas at the world level, the production of mango in Indonesia is sixth rank following India, China , Thailand, Pakistan and Mexico with world's total production of 1,478,204 metric tons [2]. Production of Indonesia's mango continues to decline and the export market share is still below 1% of international market. This condition is caused by incompatibility between Indonesia's mango quality and world's market demand.

Attempts to obtain the potential quality of mangoes for export has been carried out by hybridization between mango Arumanis-143 that tastes sweet, the color green rind with red mango clones Cukurgondang and have obtained some mango hybrids, then doubled through grafting and mangoes grown in the garden experiment Cukurgondang Pasuruan East Java [3-5]. Duration of juvenile phase being an obstacle to get hybrid mango superior candidate, despite having made an early selection and seedling stage, but have not been successful[6-8].

The successful selection will be perfect when the hybrid plants in the juvenile phase can be accelerated to be the generative phase and production and induction of flowering by growth regulators paclobutrazol expected to succeed in accelerating the early flowering of mango hybrids.

Although one of the problems in mango production is the nature of the "alternate bearing", a condition at the time or optimum fruit production in a given year or higher (on a year-on-season) and certain year bear little or no fruit (off year), but growth regulators such as paclobutrazol reported to be effective on inducing flowering mango off year. Paclobutrazol with the empirical formula [(2RS, 3Rs) -1 - (4-chlorophenyl) -4.4-dimethyl-2-(1H-1 ,2,4-triazole-1-yl) pentan-3-ol] being capable to inhibit the biosynthesis of gibberellins potentially [9-11].

Induction of flowering and setting out the season mango production that has been widely reported above is limited to plants that have been in production, but for the type of mango hybrid at juvenile phase and 3-year-old is not widely studied. The purpose of this research was to study the effect paclobutrazol on induction of flowering and yielding of 20 accessions of mango hybrids that have not been produced yet.

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MATERIALS AND METHODS

The study was conducted at the Cukurgondang Mango's Experimental Farm, East Java Pasuruan, belong to Tropical Fruit Research Institute (Balitbu) Solok, West Sumatra. Agro ecological conditions of the study sites as follows: latosol complex soil types, altitude 50 m above sea level, climate type D (according to Smith and Ferguson). The study began in March until December 2011.

The experiment was performed using a randomized block design with two factors and the treatment was repeated twice. The first factor is the dose of growth regulator paclobutrazol at two levels consisting of 0 ml / l / plant (control group) and 5 ml / l / plant (cultivar with the active ingredient 1.25 g). The second factor is 20 types of mango hybrids. Paclobutrazol given by splashing around the principal stem of plants with a diameter of 0.5 meters below the canopy in the morning.

Plants grown at a distance of 4 x 4 meters, using 20 accessions of mango hybrid 3-year-old, a hybrid cultivar Arumanis-143 which has a green rind color characters with 6 cultivars of mango which has a red color on the skin of the fruit respectively. Each hybrid were coded by Balitbu as follows: 1 (F1-15), 2 (F1-21), 3 (F1-46), 4 (F1-26), 5 (F1-27), 6 (F1-02) , 7 (F1-35), 8 (F1-22), 9 (F1-09), 10 (F1-31), 11 (F1-18), 12 (F1-53), 13 (F1-33), 14 (F1-87), 15 (F1-16), 16 F1-28), 17 (F1-47), 18 (F1-44), 19 (F1-50), 20 (F1-49).

Variable observations for flowering consists of the number of flowering plants, the amount of flowers, emergence of flower at periods I and II, inflorescence length and width as well as the number of peduncles, while variable observations include the number of fruit crops periods I and II and the weight of the fruit as well as fruit yield of each plant. The data were analyzed with statistical methods of Steel and Torrie [12] at 5% level. When F count showed noticeable differences will be followed by least significant difference test (least significant different), is not presented in the analysis of various forms of graphs and charts of the average value.

RESULTS AND DISCUSSION

1. Flowering Induction

Paclobutrazol affect flowering plants periodically, so that the observations were made during the period I and period II at various observation variables, paclobutrazol 5 ml / plant significantly accelerate flowering plants compared with the control (0 ml / plant). Amount of flowering plants in the treatment paclobutrazol period I and II were 85% and 82.5% while 27.5% in controls only (Figures 1.a and 1b). Paclobutrazol 5 ml per plant also speed up the time appearing flowers in the first period at 101 days after the application, and 153 days in the second period, while the control reached 159 days (Figures 2a and 2b).

Emergence of flowers from period I in June to period II in early August 2011, the period before flowering begins with the emergence of reproductive flush. In mango, the flush formed 3-4 times in a year. In Malang, East Java, the first flush produced at mid-December to early January, the second one occurs at mid-February, while the third one come about mid to the end of April. After the third flush, plants come into the reproductive phase around June, followed by the other flush in September. Flush time range is no different between mangoes of Gadung, Golek and Manalagi [13]. Flush phase in March to April affects the reproductive bud formation in June, while flush phase in September happen together with ripening fruit [13].

Further Tegopati et.al. [14] reported that applying paclobutrazol during flowering on 16 years- mango Arumanis-143 accelerates flowering 140 days earlier and plants capable of flowering twice a year but the first flower failed to produce fruit because of the rain. Yuniastuti and Suharjo [15] concluded that paclobutrazol can stimulate and accelerate the flowering of mango plants 2-4 months earlier, so that the plant can produce fruits two times a year, however, need to be conducted at the right time to avoid rainfall.

Efficiency and function paclobutrazol used to induce flowering of mango have been conducted, as reported by Martinez et al. [16] that application of paclobutrazol able to induce flower 50-100% at age 60-90 days after application, while the controls are not flowering, because paclobutrazol will increase the giberellin concentration of buds, levels of cytokines, and starch content in buds. Adil et al. [17] also describes a model of induction of flowering in mango plant in climate tropic Sudan as follows: substance of growth regulators retardants at temperatures below 20 ºC will control the growth of vegetative will further reduce the level giberellin and this depends on genetics, reduced levels of auxin, increased concentrations of cytokines, increased levels absicic acid, ethylene, increase nitrogen levels and consequently increase the level of sucrose, so that the leaves become mature and buds finally going to be receptive for flower induction. Paclobutrazol function is also explained by Tandel and Patel[18] that the application is very effective in controlling vegetative flush in October-November and pressing biosintesis of giberellin in three varieties of mango in India.

Inhibition of vegetative growth was also reported by Hoda et al. [19], Shide et al.[11] that the condition is consistent with the hypothesis of flowering proposed by many authors[20-23], about effect of paclobutrazol in inhibiting giberellin biosynthesis, so the results of this study appear that plants will earlier on flowering compared to controls if paclobutrazol applied.

Paclobutrazol also affect the amount of flower per plant more than control group (Fig.3). With the treatment, amount of peduncle increased to be 32.17 while only 9.57 in controls (Fig.4), however, applications of paclobutrazol effect the length and width of inflorescence become shorter than the control (Fig.5a and b). Sao Jose and Reboucas [24] has also reported that flowering plants will be 63% more than control when PBZ was given at a dose of 0.5 to 1.0 g active ingredient per meter of canopy diameter and flowers appeared 1 month earlier. Martinez et al. [16] reported the number of inflorescences increased when paclobutrazol applied and the number of flowering plants increased by 50% compared with control group. Length and width that are shorter in inflorescences in this study was also reported by Martinez et al.[16] who applied paclobutrazol on 14 years mango with doses of 0, 0.5, 1, 1.5 and 2 g in Mexico.

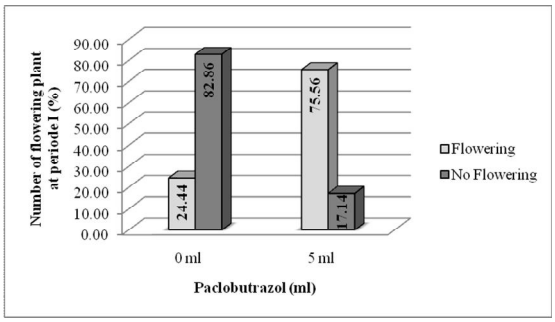

Figure 1a. Number of flowering plant at periode I

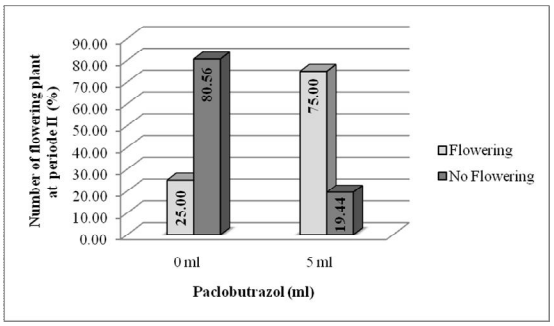

Figure 1b. Number of flowering plant at periode I

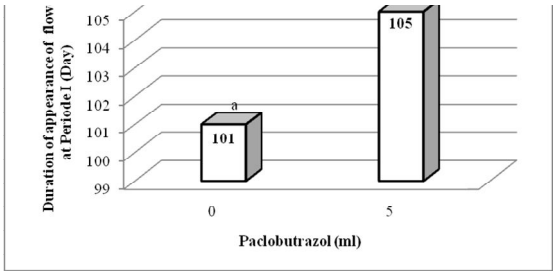

Figure 2a. Duration of appearance of flower at Periode I (day)

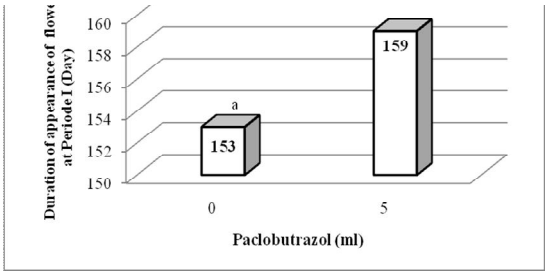

Figure 2b. Duration of appearance of flower at Periode II (day)

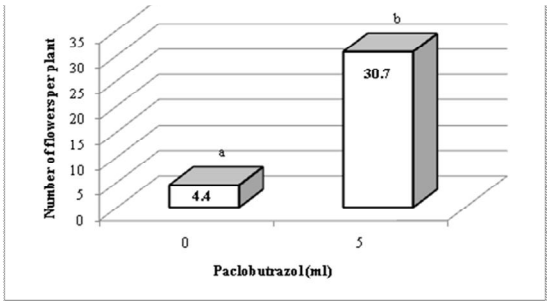

Figure 3. Number of flowers per plant

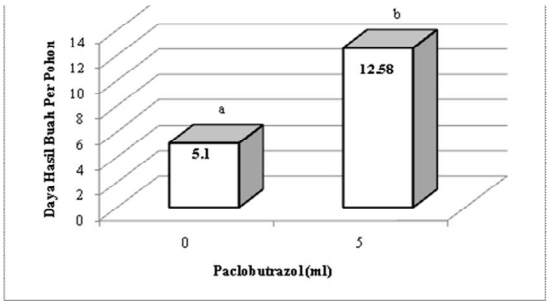

Figure 4. Number of peduncles

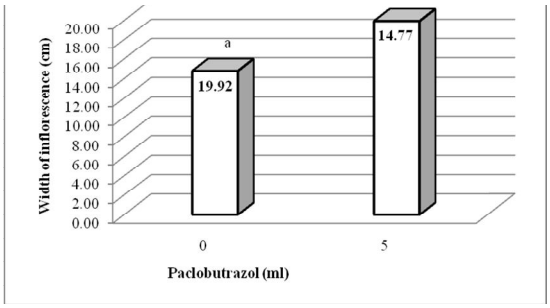

Figure 5a.Width of inflorescence (cm)

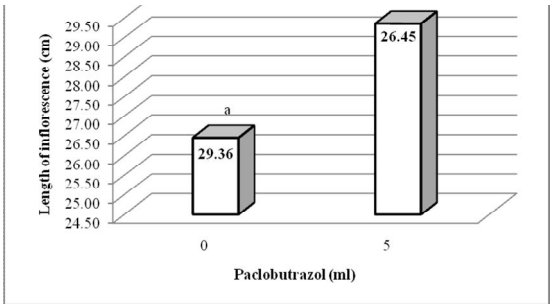

Figure 5b. Length of inflorescence (cm)

2. Yield

The number of fruit crops in the period I and II as well as the number of fruits harvested in the first period applied with paclobutrazol is higher than the control group. The number of fruit crops before the harvest period I and II of paclobutrazol treatment 5 ml / plant were 62 and 31.7 whilst in control group only 11.2 (Fig. 6a and b). The number of fruits harvested in the first period on the application of paclobutrazol 15.4 and 2.15 in the control plants (Fig.7), however, the number and weight of fruit period II was not significantly different, the type of hybrid insignificant, while the weight of fruit harvested in the period I showed higher than control group (Fig. 8), likewise the outcome of the fruit crop reached 12.58 kg/plant whilst in control group only 5.10 kg. (Fig. 9).

The high yield of crops with paclobutrazol application has also been reported by previous researchers, Tandel and Patel[18] reported PBZ application will increase the number of fruits and total production per tree for Alphonso, Kesar and Rajapuri cultivars. Besides improving results, Kulkarni et al. [25] and Martinez et al. [16] state that application paclobutrazol also increased yield and quality of mango.

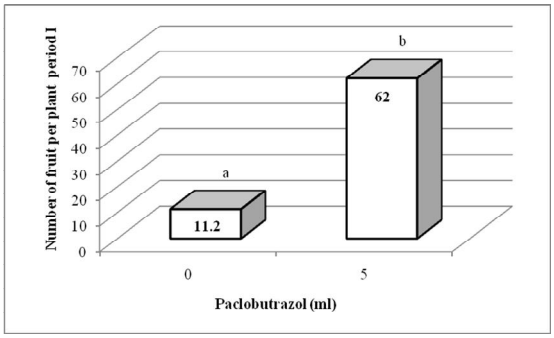

Figure 6a. Number of fruit per plant period I

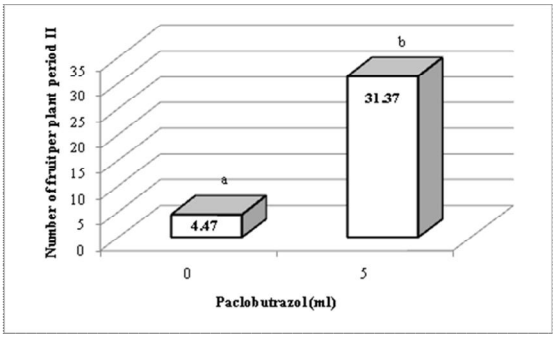

Figure 6b. Number of fruit per plant period II

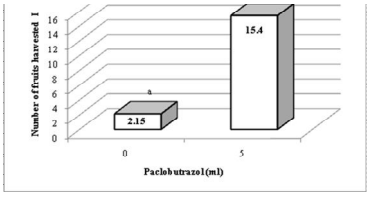

Figure7. Number of fruits harvested I

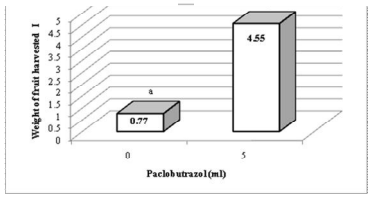

Figure8. Weight of fruit harvested (kg)

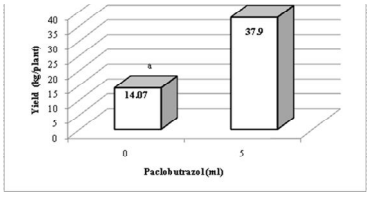

Figure.9. Yield (kg/plant)

The different types of mango hybrid on crop is presented in Table.1. The number of fruit harvested in the period I F1-09 showed the greatest number, while in the second period the highest is F1-87, followed by the F1-44, F1-15 and F1-09 respectively. The weight of the fruit harvest period II F1-09 continued to have a high yield of 12:02 kg. The highest yield of F1-87 and F1-15 respectively 41.27 kg and 22.29 kg. The difference in results is more influenced by the genetics of the plant, and in this study will be useful as the basis for selection of hybrid mangoes result in the next planting season to the stability of the results obtained, since the trial was the first time for this hybrid to flowering and fruiting

No.	Hybrids	Number of fruit harvest I	Number of fruit harvest II	Weight of the fruit harvest II (kg)	Number of fruit per plant	Yied (kg/plant)
1	F1-15	15 a	45.5 bc	16.995 b	60.5 b	22.595 c
2	F1-21	3.25 a	19.25 ab	7.8075 ab	22.5 ab	8.9925 abc
3	F1-46	2.25 a	12.5 a	4.165 a	17 ab	4.915 a
4	F1-26	4.75 a	0,00 a	0,00 a	0,00 a	0,00 a
5	F1-27	0.12 a	3.25 a	1.5125 a	5.75 a	3.1625 a
6	F1-02	2.25 a	0.25 a	0,00 a	4.5 a	2.55 a
7	F1-35	1.75 a	0,00 a	0,00 a	1,00 a	0.5 a
8	F1-22	2.5 a	0.75 a	0.3375 a	6.5 a	2.925 a
9	F1-09	62 b	39.25 a	7.785 ab	103.75 c	19.7125 bc
10	F1-31	7.5 a	6.75 a	1.63 a	12.25 ab	4.205 a
11	F1-18	14.25 a	4.75 a	2.0825 a	19 ab	8.3325 ab
12	F1-53	0.12 a	16.5 ab	7.075 a	20 ab	8.325 ab
13	F1-33	1.5 a	1.75 a	1.02 a	4.75 a	3.79 a
14	F1-87	18.75 a	86.75 d	27.9375 c	105.5 c	41.2725 d
15	F1-16	0.16 a	0.25 a	0.12 a	4.25 a	2.045 a
16	F1-28	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
17	F1-47	11.5 a	25.5 ab	8.5925 ab	40.25 ab	16.2175 bc
18	F1-44	5.75 a	56.25 c	17.0075 bc	62 b	18.3825 bc
19	F1-50	0,00 a	0,00 a	0,00 a	0,00 a	0,00 a
20	F1-49	12.5 a	11a	2.75 a	30.25 ab	8.975 ab
LSD = (p=0.05)		18.77	26.65	9.31	32.48	11.34
Means followed by the same letters in the same column are not significantly different (p=0.05) by LSD						

CONCLUSIONS

The results showed that paclobutrazol significantly affect in accelerating the induction of flowering compared with control group, indicated by the number of flowering plants and the amount of flowers, the more rapid emergence rate of flower, the more peduncles, however the length and width of inflorescence is shorter compared to control groups. In results variable, applying paclobutrazol indicate the quantity, weight and higher yield, type of accession affect significantly on the number and weight of fruits and fruit yield crops, which the highest yields on accession F1-15 and F1-87.

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