

Effects of paclobutrazol application on flowering time, fruit maturity and quality of durian clone D24

(Kesan aplikasi paklobutrazol terhadap masa pembungaan, tempoh buah matang dan mutu buah durian klon D24)

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Key words: durian (*Durio zibethinus* Murr.), D24 clone, paclobutrazol, application time, flower emergence, fruit maturity and quality

Abstrak

Kesan aplikasi paklobutrazol terhadap durian klon D24 telah dikaji di Stesen MARDI Jerangau, Malaysia. Pokok durian berukuran 50 cm lilitan-batang telah disiram dengan 4 g bahan aktif paklobutrazol di sekeliling pangkal pokok. Aplikasi paklobutrazol memberi kesan yang nyata dalam mempercepat pembungaan dan tarikh antesis (bunga kembang) pokok durian yang telah matang. Walau bagaimanapun paklobutrazol tidak memberi kesan terhadap tarikh buah gugur, purata saiz buah dan kejadian UFR (gejala buah mengkal). Paklobutrazol menyebabkan satu puncak pembungaan apabila disiram 2–3 bulan sebelum tarikh sebenar pembungaan. Aplikasi paklobutrazol pada tempoh tersebut menghasilkan bilangan jambak bunga yang rendah tetapi mencatatkan bilangan buah yang tinggi berbanding dengan perlakuan lain terutama pada perlakuan 2 iaitu 15 minggu sebelum tarikh sebenar pembungaan. Manakala aplikasi paklobutrazol kurang 2 bulan dari tarikh sebenar pembungaan telah menyebabkan dua puncak pembungaan berlaku, iaitu sama seperti pokok tanpa rawatan.

Abstract

The effect of paclobutrazol application on durian clone D24 was studied at MARDI Research Station in Jerangau, Malaysia. Matured trees, with girth size of 50 cm were soil drenched with 4 g a.i. paclobutrazol. Application of paclobutrazol had significant effect in enhancing the flowering time and flower anthesis of mature trees. However, fruit maturity time, mean fruit weight and incidence of UFR were not significantly affected by the time of paclobutrazol application. A single flowering peak was induced when the chemical was applied 2–3 months before the actual flowering date. Although flower (inflorescence) count was low when the chemical was applied within the period but fruit number was higher compared to other treatments, especially in treatment 2 i.e. 15 weeks before the actual flowering date. Application of paclobutrazol 2 months just before the actual flowering date, produced two flowering peaks, similar to the untreated trees.

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Introduction

In Malaysia, environmental factors, in particular dry period is believed to induce flowering in durian. Recent studies at different agro climatic zones in Peninsula Malaysia indicated that flower emergence coincided with the onset of dry season (Abd. Razak et al. 2000). Nevertheless, in Australia the low night temperature seemed to induce flowering (Lim and Luders 1998). In general durian trees come into flowering about one month after the onset of a dry spell. Continued dry weather is also required for subsequent good fruit-set and development. Excessive rainfall during these phases is detrimental to pollination and fruit-set. High soil moisture seems to encourage production of new leaves which in turn compete for assimilate within developing fruits.

The short and irregular dry season in Peninsula Malaysia (Nieuwolt et al. 1982) seems sub-optimal for good durian production. Except for most areas in the central and southern parts of Peninsula Malaysia, which experience equitable rainfall distribution between 1–2 months all year round and certain parts of the northern states, dry season occurred more consistently for 3–4 months.

One possible solution for better durian production is to induce earliness so that flowering can happen before the onset of dry season. Triazoles, in particular paclobutrazol [(2RS, 3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)pentan-3-ol] is a potent growth retardant in many plant species. Paclobutrazol has been shown to affect flowering in several fruit tree species (Davis et al. 1988; Okuda et al. 1996; Poerwanto et al. 1996; Salazar-Garcia-S and Vazquez-Valdivia-V 1997). Chandraparnik et al. (1992b) reported that paclobutrazol induced flowering in durian trees. This result confirmed the earlier observation (unreported) that this growth retardant had effectively induced flowering in 3-year-old immature durian trees. Previous record

indicated that flowering seasons in this region are between late February and mid March, which normally coincides with the annual dry spell. Therefore based on the information, a trial was designed with the main objectives to induce earliness in flowering by application of paclobutrazol and to evaluate the effects on fruit development and quality.

Materials and methods

The trial was conducted during 1996–97 flowering season in MARDI Research Station, Jerangau, Terengganu, Malaysia. Six-year-old durian trees clone D24 on seedling rootstocks planted in the late 1990 were selected for this trial. D24 is a commercial clone preferred by the growers and consumers. To ensure the uniformity of the experimental materials, only trees with trunk circumference ranged between 45–55 cm were selected. The selected trees are matured and had produced their first flowers in 1995.

The experiment was conducted in a completely randomized design with five single-tree replicates. Paclobutrazol was applied in eight treatments (*Table 1*). The treatment dates were approximately 4 months before the actual date (treatment 0) and was soil drenched once at the mid of canopy. The concentration of paclobutrazol used was at 4 g a.i./tree. This rate was earlier found appropriate for inducing flowering in durian tree of about similar age and size. Paclobutrazol (traded as *Cultar*, 22.9% w/w) was diluted in 10 litres of water before it was evenly applied to the soil surface under the tree canopy.

Flower emergence, time of anthesis, flower count and time of fruit maturity were determined for the three lowest branches of the treated trees. Time of inflorescence emergence was recorded when 10–15% of the floral bud attained green pea size stage. Anthesis dates were recorded when 10–15% of flowers bloomed and part of the stigma were exposed and ready to be fertilized by flying insects and moving air carrying the

Table 1. Effect of different time of paclobutrazol application on dates of flowering and fruit maturity in D24 (Phase I)

Treatment	Application date	Weeks from application to AFD	Flowering dates		Anthesis (Julian date*)	Fruit maturity (Julian date*)
			Julian date*	Difference with control (days)		
0	Control	0	56.5a	–	85.7ab	184.5a
1	28 Oct	17	33.4cd	–23.1	87.0ab	184.3a
2	11 Nov	15	23.0d	–32.5	82.5b	184.0a
3	25 Nov	13	40.0c	–16.5	85.2ab	184.0a
4	9 Dec	11	40.0c	–16.5	87.0ab	184.8a
5	23 Dec	9	41.0bc	–15.5	86.4ab	187.6a
6	6 Jan	7	46.0abc	–10.0	89.0a	186.0a
7	20 Jan	5	58.4a	+1.9	89.0a	186.0a
8	5 Feb	3	46.0abc	–10.5	89.0a	188.9a

Figures with the same letters are not significantly different at $p = 0.05$

*each Julian date represents one day from a total of 365 days in a year

AFD = actual flowering date (25 February 1997)

pollens. Flower count was expressed as inflorescence number per trunk girth [recorded as trunk cross-sectional area (TCA)]. For the purpose of expressing flower intensity i.e. inflorescence number per TCA, branch circumference was taken at the initiation of the treatments. Data on time of fruit maturity was based on 50% mature fruit drop. Fruit quality characteristics evaluated were fruit size and incidence of uneven fruit ripening (UFR). All data collected were subjected to normal analysis of variance (ANOVA).

Results and discussion

Flowering time

During the trial, natural flowering, as represented by the untreated trees, occurred in the late February (25 February 1997) or around 57 of the Julian date (each Julian date represents one day from a total of 365 days in a year; Table 1). Similar trend was also observed for trees in the surrounding orchards. Early application of paclobutrazol had significantly accelerated the flowering time of durian. Soil drenched with paclobutrazol 17 weeks and 15 weeks before natural flowering advanced flowering by 23 days and 32 days respectively. The effect was significantly reduced when

paclobutrazol was soil drenched at 13, 11 and 9 weeks before actual flowering where advancement of flowering was about 16 days earlier as compared to untreated trees. Earliness in flowering was further reduced when paclobutrazol was applied closer to the natural flowering dates. There was no significant difference between treated and non-treated trees when paclobutrazol was applied less than two months before natural flowering date.

Soil moisture content may play a role in the flower enhancement in durian when paclobutrazol is involved. In an experiment conducted by Masri (1999) elsewhere, moderate water supply alone 14 days to expected flowering date and continued thereafter for 60 days produced highest number of durian inflorescence. Soil moisture status is directly related to water supply or rainfall distribution. In *Figure 1*, abundant rainfall was detected between the 28 October and 11 November treatments and continued thereafter for 42 days. Paclobutrazol application together with moderate water supply seemed to be able to enhance flowering in durian and this deserves further investigation.

Effects of paclobutrazol on durian

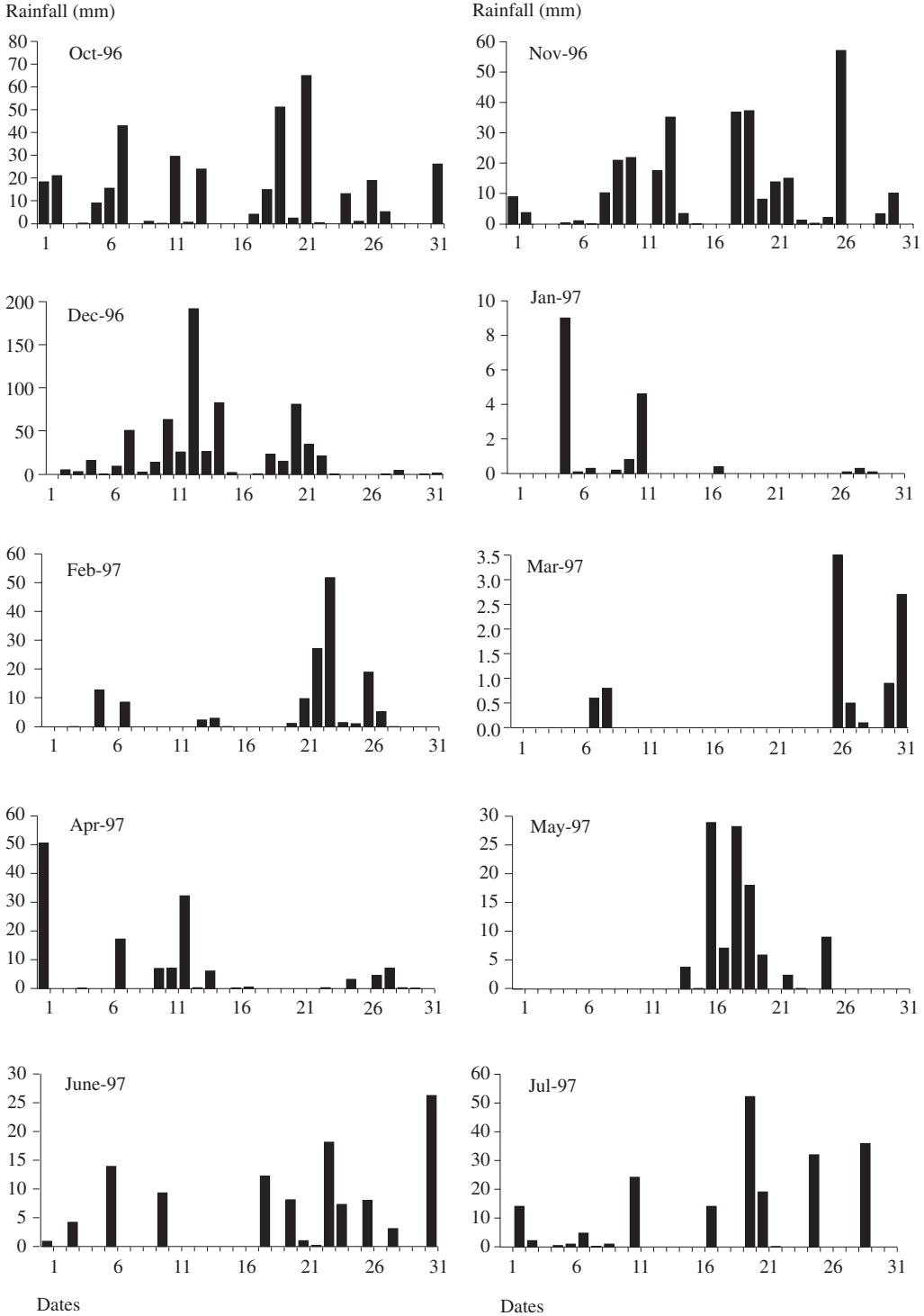


Figure 1. Rainfall distribution from October 1996 to July 1997. Rainfall collected at 8.00 a.m. from Jerangau Weather Station, Terengganu, Malaysia

Anthesis and fruit maturity

Anthesis of individual tree (for phase I only) shown in *Table 1* ranged between 82.5–89.0 Julian date whilst fruit maturity between 184–189 Julian date. There is no general trend in anthesis of the treated trees.

Anthesis in treatment 2 (approximately 15 weeks before actual flowering date) was significantly early to all other treatments and control while in treatment 6 to 7 anthesis was much later.

Fruit maturity was not significantly affected by paclobutrazol application when compared to control. Adversely, Chandraparnik et al. (1992b) observed that with the application of paclobutrazol, fruit maturity or fruit drop was delayed by 2 weeks compared to the untreated control. There was no specific trend observed except that, paclobutrazol was able to enhance early flowering in durians. Although early flower bearing and anthesis were observed in the treatment 2, early fruit maturity did not occur because the flowers may have dropped before fruit set took place. Flower drop may have occurred during the infructescence stages.

Flower intensity

Two flowering peaks were observed (*Table 2*) in some of the treated trees. First peak was the major flowering time and the second peak, which is much smaller, occurred about 6 weeks later. Only the control, treatments 6, 7, and 8 produced flower during the second peak. Treatment 8 where paclobutrazol was applied 3 weeks before natural flowering time significantly produced higher number of inflorescence that is comparable to that of the control. Treatments 1, 6 and 7 produced significantly lower number of flowers compared to treatments 2, 3, 4, 5 and control. It is interesting to note that application of paclobutrazol closer to natural flowering time produced flowers in the second peak. Application of paclobutrazol 11 weeks or before natural flowering time resulted in single flower peak. The second flower peak

that was recorded at 13 April developed into fruits but the maturity period was extended. In this particular incident, signs of fruit maturity i.e. fruit drop was observed but the fruits were unripe and inedible. Flowering trend was nonspecific in both phases.

Environmental factors especially rainfall and soil-nutrition status could have influenced the incident. Chandraparnik et al. (1992a) compared the effects of paclobutrazol + thiourea and paclobutrazol alone on durian flower intensity, cv Chane. Trees treated with both paclobutrazol and thiourea had 45% more total flower number per tree than trees treated with paclobutrazol alone. However, thiourea failed to intensify the flower production when the amount of rainfall exceeded 35 mm per day. Rainfall enhances leaf flushing and young leaves compete with flower and fruit development. According to Punnachit et al. (1989) flushing during the fruit development stage is detrimental to fruit quality, resulting in hard flesh and inedible fruit. In the study, rainfall occurred after 16 May to July was adequate to induce leaf flushing (*Figure 1*).

Fruit number and quality

Total fruit number harvested, mean fruit weight and percentage of uneven fruit ripening (UFR) are tabulated in *Table 2*. As application of paclobutrazol approaches the natural flowering dates, fruit number decreases accordingly. Trees applied with paclobutrazol in November (treatment 2) produced significantly highest fruit yield of 60 fruits per tree compared to the control (21 fruits per tree). Paclobutrazol applied in early January (treatment 6), i.e. nearer to the actual flowering date had significantly lower fruit yield. Chandraparnik et al. (1992a) sprayed durian trees with different rates of paclobutrazol and observed that harvestable fruit numbers per tree and mean fruit weight of treated trees were lower compared to those of the untreated trees.

Parameters, fruit weight and quality (%UFR) were not significantly affected by paclobutrazol application as indicated in

Table 2. Effect of different time of paclobutrazol application on inflorescence number and fruit quality

Treatments	Inflorescence number/ TCA			Fruit number/ tree	Fruit quality	
	Phase I	Phase II	Total		Mean fruit weight (kg)	% UFR
0	3.1	0.4	3.5	21ab	1.37a	38a
1	1.8	0.0	1.8	40ab	1.21a	43a
2	2.9	0.0	2.9	60a	1.42a	26a
3	4.5	0.0	4.5	34ab	1.31a	26a
4	3.2	0.0	3.2	27ab	1.32a	40a
5	5.0	0.2	5.2	25ab	1.21a	43a
6	1.5	0.2	1.7	26ab	1.24a	36a
7	1.5	0.9	2.4	6b	1.45a	24a
8	4.4	0.3	4.7	8b	1.41a	46a

Values with the same letter are not significantly different at $p = 0.05$

UFR = uneven fruit ripening (mean of 10 fruits)

TCA = trunk cross-sectional area (cm^2)

Table 2. Mean fruit weight from treated and non-treated trees were within the range of 1.2–1.4 kg. Incidence of UFR within the range of 24–47% was detected in all fruit samples collected.

Conclusion

Application of paclobutrazol was able to enhance early flowering in mature durian trees and significantly influenced flower anthesis. Fruit maturity dates or fruit drops, mean fruit weight and incidence of UFR were not significantly affected by the time of paclobutrazol application. The most ideal time of paclobutrazol application is approximately 2–3 months before actual flowering date. In mango, application of paclobutrazol also should be carried out at least 3 months before expected flowering season to get profuse flowering and fruiting (Omran 1997). It is advantageous if there is some rain at the time of paclobutrazol application. Although paclobutrazol was able to enhance flowering in durian but it cannot influence the number of fruit that set and the final yield collected. When flower intensity is high, fruit number need not necessarily be high as well. There must be some other factors that can influence flower bearing and fruit development using paclobutrazol, such

as climatic factors especially rainfall and fertilizer application. The effectiveness of the chemical compounds due to the climatic variations especially air temperature and moisture and the fertilizer requirements during the fruit development have to be investigated in future.

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