International Journal of GEOMATE, Feb., 2017, Vol. 12, Issue 30, pp. 41 - 45
Special Issue on Science, Engineering & Environment, ISSN:2186-2990, Japan
DOI: http://dx.doi.org/10.21660/2017.30.96545

EFFECT OF PACLOBUTRAZOL CONCENTRATIONS AND TIME OF FOLIAR APPLICATION ON FLOWERING OF 'NAMDOKMAI-SITONG' MANGO

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ABSTRACT: Paclobutrazol (PBZ) is a growth regulator used to control vegetative growth, stimulating the reproductive capacity of plants. PBZ has been widely marketed throughout the tropics to stimulate mango flowering. In the recent years, many reports showed that application of PBZ by soil drenching can cause permanent stunting of flushes, the vegetative and root growth of mango was reduced. The aim of this work was to determine the effects of PBZ on flowering of mango by foliar application. The commercial mango cultivar 'Namdokmai-sitong' was used in this study. The experiment was analyzed as a completely randomized design. There were 4 replications with 10 treatments. Foliar application at 15 days after pruning with PBZ at 0, 500, 1,000, 1,500 and 2,000 mg./L and repeated at 30 days with 0 and 1,000 mg./L. There was significant difference on the time to flowering, percentage of flowering shoots and panicle length. The trees receiving the PBZ at 2,000 mg/L were exhibited stunting of flushes and panicle malformation. This study suggests that the multiple foliar application of PBZ was effective in promoting flowering in 'Namdokmai-sitong' mango, can help early flowering and higher percentage of flowering shoots.

Keywords: Paclobutrazol, Foliar application, Flowering, Namdokmai-sitong mango

1. INTRODUCTION

Mango is one of the most important fruit crop in Thailand. It has been defined as an economic crop in which the produce is used for domestic consumption and also for export. Thailand has been producing mango in great quantities and exports are tending to increase every year. In 2014, the export quantity was 79,622 tons and 3,241 millions baht of export value [1]. The well known commercial cultivar is Namdokmai-sitong.

Flowering is an important step in fruit production. The price of fruit depends on market demand, so therefore, induction of flowering at certain times is necessary. Mango flowering is an important physiological event that sets the start of fruit production. Mango trees flower in response to the age of the last vegetative flush in the tropical conditions [2]. Synchronization of the vegetative of tree canopies is a necessary first step in the flowering management program. Synchronization of growth is best accomplished by tip pruning all of the stems on the tree. The next step is to decide whether to use PBZ or not. PBZ has been used with considerable success to induce flowering in several fruit crops such as apple [3], pummelo[4], apricot [5] and mango [6]. PBZ inhibits gibberellin biosynthesis [7], reduces vegetative growth and induces water-stress tolerance as well as increases total non-structural carbohydrates (TNC) [8],[9]. PBZ has been widely marketed throughout the tropics to stimulate mango flowering. Soil application of PBZ has been found to be more responsive in regard to suppressing the vegetative growth and enhancing the reproductive growth in mango [10]. Studies have shown that PBZ is needed to be applied annually to increase mango fruit yields [11]. In the recent years, many reports showed that application of PBZ by soil drenching produced uneven distribution of the chemical throughout the plants as noticed by the uneven size of the panicles in the lower versus the upper part of tree. Overdose may cause undesirable effects such as stunting of flushes, panicle malformation, vegetative and root growth of mango was reduced [12]. In areas where PBZ is applied regularly, there may be risk of environmental contamination due to its residues persisting in soil for a very long time [13].

Then, the aim of this work was to determine the effects of PBZ on flowering of Namdokmai-sitong mango. Foliar application was used in this study to ensure uniform flowering and to reduce the detrimental side effects.

2. MATERIALS AND METHODS

2.1 Experimental details

This experiment was carried out at Tropical Fruit Research and Development Center, Kasetsart

University, Kamphaeng Saen Campus, Nakhon Pathom Province, Thailand. Mango trees (cv. Nam dokmai-sitong), at the age of 6 year-old, were selected. Tip pruning has been done to induce new flush from all the stems on the tree (Fig.1). Foliar application was performed at 15 days after pruning with PBZ at 0, 500, 1,000, 1,500 and 2,000 mg/L and it was repeated at 30 days with 0 and 1,000 mg/L.

(a)

(b)

Fig.1 New flush at 15 days (a) and 30 days (b) after pruning in Namdokmai-sitong mango.

2.2 Experimental design and data analysis

Completely randomized design (CRD) was used in this study. There were four replications with ten treatments: T1) control; T2) spray with 500 mg/L of PBZ at 15 days; T3) spray with 1,000 mg/L of PBZ at 15 days; T4) spray with 1,500 mg/L of PBZ at 15 days; T5) spray with 2,000 mg/L of PBZ at 15 days; T6) spray with 500 mg/L of PBZ at 30 days; T7) spray with 500 mg/L of PBZ at 15 days and repeated at 30 days with 1,000 mg/L of PBZ; T8) spray with 1,000 mg/L of PBZ at 15 days and repeated at 30 days; T9) spray with 1,500 mg/L of PBZ at 15 days and repeated at 30 days with 1,000 mg/L of PBZ; and T10) spray with 2,000 mg/L of PBZ at 15 days and repeated at 30 days with 1,000 mg/L of PBZ.

Shoots are randomly tagged around the canopy of each tree and monitored for flower in determination after foliar application of PBZ.

The parameters measured were percentage of flowering shoots, time taken from shoots pruning to flower emergence, panicle length and phenological changes of shoots. The data were subjected to analysis of variance and the means were separated by Duncan's new multiple range test at $P < 0.05$.

3. RESULTS

The results showed that the use of PBZ could stimulate higher percentage of flowering shoots than the control trees. Trees receiving 1,000 mg/L of PBZ and above had the highest percentage of flowering shoots of 100%, whereas those control trees showed the lowest flowering percentage of 20% (Fig.2, Table 1).

PBZ could stimulate earlier flowering. Time taken from application to flower mergence was highly significant among the PBZ treated trees (Fig.3, Fig.4).

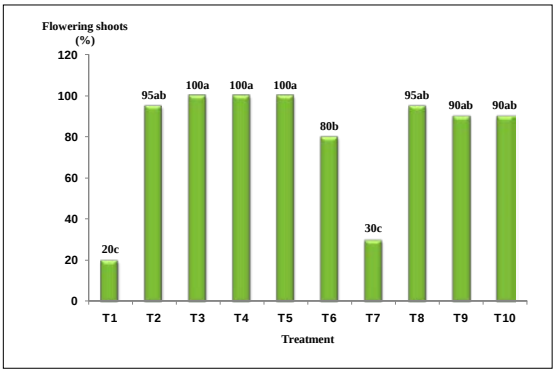

Fig.2 Percentage of flowering shoots of Namdokmai-sitong mango.

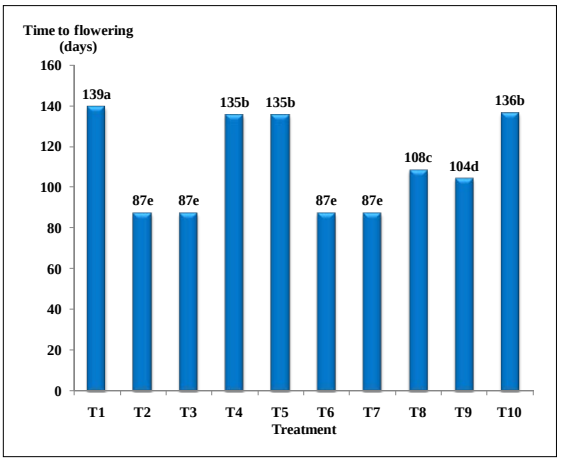

Fig.3 The time to flowering of Namdokmai-sitong mango.

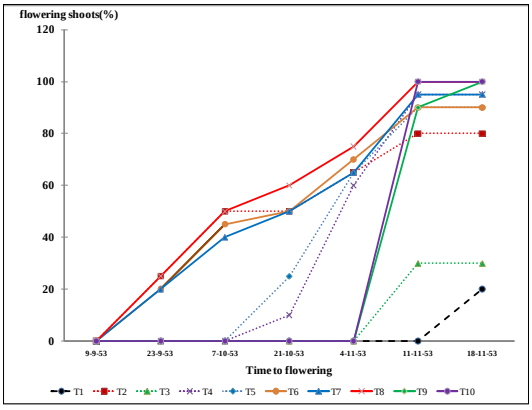

Fig.4 Percentage of flowering shoots of Namdokmai-sitong mango during the experimental period

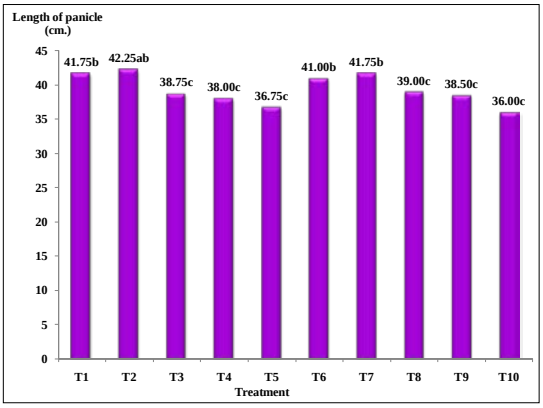

Fig.5 The length of panicle in Namdokmai-sitong mango.

There was a significant difference on the length of panicle. Trees treated with PBZ at the rate of 1,000 mg/L and above had significantly shorter panicles compared with the control However, the higher concentration of PBZ gave shorter panicles. Panicles from the trees receiving 2,000 mg/L of PBZ at 15 days and 1,000 mg/L at 30 days had the shortest panicle of 36.75 cm (Table 1, Fig.5).

The trees receiving the PBZ application showed its effect by decreasing shoot and panicle length significantly (Table 1).

In this study, the phyto toxic symptoms of shoots and panicles were observed on the PBZ treatments at 2,000 mg/L. The trees receiving the PBZ at 2,000 mg/L were exhibited stunting of flushes and panicle malformation (Fig.6).

Table 1 Effect of PBZ on percentage of flowering shoots, time to flowering and length of panicle of Namdokmai-sitong mango after foliar application of PBZ at different rate.

Treatment	Flowering shoots (%)	Time to flowering (days)	Length of panicle (cm)
T1	20 c	139 a	41.75b
T2	80 b	87 e	41.00b
T3	30 c	136 b	41.75b
T4	95 ab	108 c	44.00a
T5	90 ab	104 d	38.50c
T6	90 ab	87 e	42.50ab
T7	95 ab	87 e	42.25ab
T8	100 a	87 e	38.75c
T9	100 a	135 b	38.00c
T10	100 a	135 b	36.75c
F-test	*	*	*
cv.(%)	13.31	1.49	3.82

Means followed by the same letter at the same column were not significantly different at the 5% level by DMRT.
* = significantly different at $P < 0.05$

(a) (b)

(c) (d)

Fig. 6 The control tree (a) and phyto toxic symptoms of shoots (b) and panicles (c,d) in Namdokmai-sitong mango.

4. DISCUSSION

Application of PBZ affected vegetative growth and reproductive growth of Namdokmai-sitong mango. The vegetative growth of mango trees was observed 2 weeks after treated with PBZ. Shoot number was not different but shoot length showed significant differences among treatments. In the present study, PBZ application was effective in reducing shoot length since the PBZ inhibits GA biosynthesis by blocking the step in the oxidation of ent-kaurene to ent-kaurenoic acid [7] resulting in unelongated shoots, even though cell division still occurs. Similar results have been reported in apple [3]. In addition, PBZ could also induce flowering in mango trees because it reduced vegetative growth. The involvement of the GA in mango was also demonstrated by Yamashita *et al.*[14] who reported that GA acts as a flowering inhibitor. The use of PBZ could stimulate higher percentage of flowering shoots than the control trees. This result was supported by Yeshitela *et al.* [9] who found that PBZ produced the highest number of flowers per panicle in mango. The trees receiving the PBZ at 2,000 mg/L by foliar application exhibited stunting of flushes and panicle malformation.

5. CONCLUSION

Applying paclobutrazol to mango trees cv. Namdokmai-sitong as foliar spray could stimulate earlier flowering and higher percentage of flowering shoots than the control trees. Significant differences were observed on the time to flowering, percentage of flowering shoots and panicle length.

6. ACKNOWLEDGEMENTS

This research was supported by a grant from the program Strategic Scholarships for Frontier Research Network form the Higher Education Commission, Thailand.

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