

Methods of Producing Off-season Longan in Thailand

การผลิตลำไยนอกฤดูในประเทศไทย

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Abstract

Fresh longan fruits are now available in local markets in Thailand almost all year round. This is possible because a technique for producing off-season longan has been recently developed and is being adopted by growers in Thailand. The use of non-seasonal flowering cultivars and the application of chemicals to induce flowering in the seasonal flowering cultivars is practiced by growers in various provinces. The methodology for off-season production of longan in Thailand with the possible physiological responses of the trees is discussed.

Keywords *Dimorcarpus longan, chemical application, Euphoria longan, flower, longan, induction, off-season, Thailand*

บทคัดย่อ

ในปัจจุบันลำไยสดสามารถผลิตออกสู่ตลาดภายในประเทศได้เกือบตลอดทั้งปีทั้งนี้เนื่องจากการค้นพบเทคนิคใหม่ในการผลิตลำไยนอกฤดูภาคใต้เป็นผลสำเร็จแห่งแรกในประเทศไทยหรือในโลกโดยวิธีการเลือกใช้สายพันธุ์ที่ออกดอกได้ตลอดทั้งปีและวิธีการกระตุ้นการออกดอกด้วยสารเคมี ซึ่งมีเกษตรกรนำไปใช้ในหลายพื้นที่ที่มีการผลิตลำไยดังนั้นการผลิตลำไยนอกฤดูภาคใต้เป็นสิ่งที่เป็นไปได้เพียงแต่กลไกทางสรีรวิทยาที่เกี่ยวข้องกับการชักนำการออกดอกด้วยสารชนิดนี้ยังไม่สามารถอธิบายได้ขณะนี้

คำสำคัญ *Dimorcarpus longan* อัตราการใช้สาร *Euphoria longan* การออกดอก ลำไย การออกดอกนอกฤดูภาคใต้ ประเทศไทย

Introduction

Most tropical and subtropical fruit trees including longan are seasonal crops with short harvesting seasons. This problem together with short storage life of these fruits are a disadvantage to growers, since there is a surplus of tropical and subtropical fruits in the market at the peak harvest, lowering the price.

Attempts to lengthen the supply of longan fruits have been sought primarily by developing more cultivars with various flowering times, by selecting different growing areas with different microclimates to manipulate growth cycles as well as introducing various techniques in orchard management with the hope of forcing the flowering of longan. However, these efforts have not been very successful to date, as the results are not consistent.

1. The application of chemicals to induce flowering

Producing longan in the off-season months in Thailand came to a turning point around the end of 1998, when a group of local Thai and Taiwanese businessmen made a contract with longan growers in Pa-Sang District, Lamphun province, as well as some orchards in nearby Chiang Mai province. Renting these orchards, they applied a grayish-white chemical as soil drenching around the canopy, applied as a solution in water, and continued watering the trees after application. About 20-25 days after this application, emergence of floral inflorescence was evident in most treated trees. However, there were some trees that showed declining symptoms such as yellow leaves, and shoots sprouted in some trees with no flowering occurring (Jungyoosuk, 1999). This chemical substance was later analyzed and found to be potassium chlorate.

Hypothetical aspects on flowering of longan

Under natural conditions, the flowering of longan depends on the weather. A period of cool and dry weather is ideal for flowering. Longan is quite sensitive to environmental conditions with irregular yields from year to year. It is believed that inductive conditions trigger changes in endogenous hormones. Huang (1999) found high levels of cytokinin (isopentenyl adenosine) and low levels of gibberellin and abscisic acid during floral initiation. This finding is also supported by Chen et al., (1997) who found low levels of cytokinin during the sprouting of vegetative shoots and higher levels during floral initiation. Boonplod (1996) found that the levels of gibberellin started to decrease when the vegetative growth ceased and were not detectable at flowering. However, paclobutrazol failed to induce flowering in longan (Yupin, 1986). Thus, the role of hormones on flower induction of longan needs further investigation.

1.1. Potassium chlorate applied as soil drench

1) Concentration

As mentioned earlier, since the introduction of potassium chlorate to induce flowering in longan about 3 years ago, Thai growers have applied this chemical as soil drench with the

rate of application depending on tree size. Other factors that must be considered before the application include soil type, the availability of water supply, the management of the orchard, and the degree of healthiness of the trees. Studies from Mae Jo University in Chiang Mai (Manochai et al., 1999) reported the induction of 100% flowering in longan var. E-Daw with the rate of potassium chlorate at 8 g/m² as soil drench. This experiment was conducted in November, which is not the normal flowering time of longan. Lowering the rate to 4 g/m² induced the flowering to 86%. In See Chompoo variety, 100% flowering was seen at even lower rates of this chemical, i.e. all trees flowered when they were treated with 1-4 g/m² (Table 1).

Table 1 Effect of potassium chlorate applied as soil drench on flowering of longan cv. See Chompoo (Manochai et al., 1999)

Rate of chemical (g/m ²)	Flowering (%)
0	28
1	100
2	100
4	100

2) Stage of leaf development

An experiment was conducted using potassium chlorate as soil drench to longan trees at different stages of leaf development, i.e. when the trees had new young leaves of less than 10 days, at fully expanded leaf (20-25 days) and at mature leaf (40-45 days). The rate of chemical applied was 8 g/m² at all treatments. The results showed that trees with mature leaf proved the most responsive to potassium chlorate in flowering while trees with young and immature leaf stage were the least responsive (Table 2). Thus, it was concluded that in order to obtain good induction of flowering, potassium chlorate should be applied when the trees stopped growing vegetatively, i.e. when all leaves were fully matured and no new flushes occurred.

Table 2 Use of KClO₃ as soil drench to induce flowering in Longan cv. E-Daw at different stages of leaves (Manochai et al., 1999)

Application	Stage of leaves	% Flowering after application	
		45 days	60 days
KClO ₃	Control	0.00	0.00
8 g/m ²	Young leaves (less than 10 days)	5.00	6.70
	Fully expanded leaf (20-25 days)	30.00	61.70
	Mature leaves (40-45 days)	85.00	100.00

3) Suitable time of application

It was found that the most suitable time to obtain good induction in Thailand was from October to February when the average temperature was rather cool. The longan trees were in the dormant stage and were most responsive to the chemical. During the rainy months from May to September, the trees were less responsive; those receiving potassium chlorate at the rate of 8 g/m² gave about 60% flowering and sometimes a figure of less than 50%

flowering was found, especially in September where most frequent rainfall was evident (Manochai, 2000).

4) Cultivars

As expected, there were some differences in the degree of responsiveness to potassium chlorate among longan cultivars. See Chompoo was the most response cultivar to the chemical . Other cultivar that showed good responsiveness were E-Daw, Haew, E-Dam (or Bai Dam), as they can be induced to 100% flowering by using potassium chlorate at 2-4 g/m² (Manochai, 2000).

1.2. Potassium chlorate applied as foliar spray

An experiment using potassium chlorate solution sprayed to the tree canopy showed that flowering could be induced at the concentration of 1,000 ppm (Sritontip et al., 1999). Foliar spray has the advantage of using less chemical and leaving lower residual chemical in soil as compared to soil drenching. However, there are some limitations in using this chemical as foliar spray, the most evident one concerning leaf falling especially in some cultivars. It was found that using potassium chlorate at 1,000 ppm as foliar spray can induce flowering up to 97%, but still some leaf falling was evident. The degree of leaf falling was found to depend on concentration of the chemical and the temperature and sunshine at application time. More leaf falls were seen at high concentration and high temperature during the spraying time. It was recommended to spray in the early morning or evening when the temperature was not so high. The trees must not be under water stress and they must be in the dormant stage.

1.3. Potassium chlorate applied as trunk or stem injection

An experiment on the application of potassium chlorate as trunk injection (Viriya- alongkorn et al., 1999) showed that the rate of chemical at 0.25 g per 1 cm. diameter of stem gave effective result and could induce 80-90% flowering in See Chompoo cultivar (Table 3). The size of stem used for injection to be effective should not be less than 10-15 cm. in diameter. The method of injection is similar to trunk injection of potassium phosphonate fungicide to control phytophthora disease in avocado in Australia (Whiley, 1991). Watering the treated tree is required immediately after the treatment, as to increase the translocation in the tree.

Table 3 Use of KClO₃ injection to induce flowering in longan cv. See Chompoo (Viriya- alongkorn et al., 1999)

Treatment	Flowering (%) after applied		
	5 (weeks)	6 (weeks)	7 (weeks)
0 g. KClO ₃	0.0	3.3 b*	23.3 b
0.025 g. KClO ₃	13.3 c	56.7 a	60.0 ab
0.05 g. KClO ₃	53.3 b	63.3 a	83.3 a
0.25 g. KClO ₃	80.0 a	83.3 a	90.0 a

* Means within the same parameter followed by a common letter are not significantly different at 5% level of probability by DMRT.

1.4. Sodium chlorate as floral induction chemical

Sodium chlorate can be used to induce flowering in longan in the same way as potassium chlorate. Having a herbicidal property, this sodium chlorate should be applied as soil drenching, not as foliar spray. It has been reported in a comparative study on the effectiveness of potassium chlorate and sodium chlorate on flower induction of 4 year old longan cv. E-Daw that the average time taken from the application of both chemicals to the emergence of inflorescence was not significantly different (Khao-Sumeru, et al., 1999). It took an average of 18 and 21 days for sodium chlorate and potassium chlorate treatments respectively. The experiment on using sodium chlorate in longan cv. E-Daw by Changenraja et al. (1999) is depicted in Table 4, and shows that a high percent of flowering was seen within 21 days after the application of the chemical as soil drench.

Table 4 Use of NaOCl as soil drench to induce flowering in Longan cv. E-Daw (Changenraja et al., 1999)

Treatment	Time to flowering (days) After treatment	Flower (%)
Control	-	0
NaOCl 6% 5 ml	21	75
NaOCl 6% 10 ml	21	75

2. Regular flowering cultivar and “Tawai” clones

At present, growers can select and develop the easy-to-flower cultivars. The local name “Tawai” is used to indicate this practice in Thailand. These cultivars are naturally selected. The easy-to-flower longan cultivars in Thailand include ‘Petchsakon Tawai’, and some introduced longan from Vietnam. These longans flower and set fruits easily. The leaves of these cultivars are generally small. Under natural condition, the trees flower twice a year. The first flower flush appears in December-January and harvesting in May-June. The second flower flush is seen around July-August with harvesting in December. These longan cultivars are commonly grown in the central region of Thailand where the climate is a real warm tropic. It has the advantage of being easy to flower and does not need any chemical regulation. However, the quality of flesh and fruit size are inferior to those cultivars grown in the northern region.

This easy-to-flower cultivar can be induced to flower by girdling or cincturing of the branches or stems. The explanation of cincturing on flowering of the tree had been known (Menzel and Paxton, 1987). It has been reported that cincturing can induce earliness and uniform flowering in Petchsakon cultivar as compared to the control treatment (Chaiprasob, 1998; Saengpan, 1998).

3. Orchard management

3.1 Choosing a suitable location

Longan trees need a dry period for flower bud formation. A period of dryness is widely accepted as the effective criteria for flowering of longan grown under tropical conditions. Low temperature and/or water stress which restrict vegetative growth can enhance flower bud formation of longan. Thus, the normal flowering time of longan in Thailand is in January, during which the trees experience dryness and cool temperatures. Rainy areas with an insufficient dry period for floral bud formation must be avoided, as the flower forcing of longan in such area is quite difficult. Areas having low rainfall or receiving steady rain, and having sandy soil or good drainage soil, would be suitable for producing off season longan as enough dry period is commonly evident.

3.2 Proper management

Orchard management is very important in producing off-season longan. The practice of controlling the water level is commonly seen in longan and lychee growing under ridge cultivation in the central region of Thailand. Here the water level in a small ditch around the ridge bed can be controlled. However, the control of water level is difficult in the rainy season and flower forcing can not be easily practiced. Thus, the combination with other methods such as chemical treatment is necessary.

4. Future prospects

It is now evident that the chlorate salts of potassium and sodium can induce flowering in longan. The longan fruits produced have been analyzed and shown not to contain any chemical residues in the aril nor the skin, and it is permitted by The Food and Health authority to be sold to consumers. However, more research should be conducted on finding alternative chemicals, especially those that have less oxidizing power than potassium chlorate. Also the mode of action of the chemicals in inducing flowering as well as the physiological responses of longan trees should be understood in more detail.

The easy flowering cultivars such as 'Petchsakon' which do not require chemical treatment should be further studied, especially in identifying gene(s) that control flowering. Gene manipulation of the easy flowering character into the difficult to flower cultivars which have high quality fruits may be possible in obtaining better longan cultivars with easy to control flowering in the future.

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