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Effect of potassium chlorate combined with paclobutrazol, monopotassium phosphate and mepiquat chloride on fruit quality of Longan (*Dimocarpus longan*)

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Abstract The effect of potassium chlorate combined with paclobutrazol, monopotassium phosphate and mepiquat chloride on fruit quality of longan was investigated. Four treatments were potassium chlorate (control), potassium chlorate + paclobutrazol (PP), potassium chlorate + monopotassium phosphate (PM) and potassium chlorate + mepiquat chloride (PMC). The potassium chlorate was sprayed on 16 longan trees and the other chemicals were sprayed seven days after spraying with potassium chlorate. Results showed that there was no significant difference in fruit length, fruit diameter, fruit circumference, peel thickness, pulp thickness, total soluble solids, fresh weight of peel and pulp, and dry weight of peel, pulp and seed among treatments. Fruit set was increased by PP treatment as compared to the control. Fruit firmness resulting from PP, PM and PMC treatments were greater than fruit firmness resulting from the control. Results indicated that the sprayed chemicals did not reduce fruit quality of longan.

Keywords: longan, potassium chlorate, paclobutrazol, monopotassium phosphate, mepiquat chloride, fruit quality

Introduction

Longan (*Dimocarpus longan* Lour.) is an economic important fruit of Thailand. Longan can be sold as fresh fruit, dried fruit with peel, dried pulp, longan canned and frozen longan. The main export market is China where the highest price is during the Chinese New Year period. The income from longan in Thailand is more than 156 million dollars per year (Hanviriyapant, 2008). More than 80 percent of the growing area is in the north of Thailand. However, the highest amount of production in 2015 was at Chanthaburi province in east Thailand (Official of agricultural economics, 2016).

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Normally, the flowering of longan in the orchard requires a temperature of 15-20 ℃. Presently, farmers are able to induce longan flowering throughout the year by using chlorate. Farmers in Chanthaburi province also used this chemical to produce the longan off-season for selling during the Chinese New Year period (January-March). However, the decrease of flowering and fruit set in the rainy season as compared to the other seasons is still a problem of longan off-season production (Chanlueng, 2017).

Growth retardants are classified as plant growth regulators that have the capacity to reduce plant growth. They are organic compounds which were synthesized for agricultural utilization. Each of these compounds has different chemical properties. Such compounds effect many different physiological processes in plants, such as flowering, fruiting, drought-resistance, yield increase of vegetables, dark green leaves and thick leaves (Techapinyawat, 2001). Paclobutrazol and mepiquat chloride are also growth retardants that promote fruit set and fruit quality (Yeshitela *et al.*, 2004; Sridhar *et al*., 2009; Lim *et al*., 2004; Curry and Williams, 1986). Moreover, chemical fertilizers such as monopotassium phosphate can also promote fruit set and quality of fruit (Sarrwy *et al.*, 2010; Nerson *et al*., 1997; Chapagain and Wiesman, 2004). Therefore, the purpose of this experiment was to investigate fruit set and quality of longan during the rainy season as influenced by paclobutrazol, mepiquat chloride and monopotassium phosphate.

Materials and methods

The experiment was conducted from July 2017 to February 2018 in longan orchard at Soidao, Chanthaburi province, Thailand. The experimental design was a Completely Randomized Design (CRD). Four treatments were control (water), 2000 ppm of paclobutrazol (Srihara, 2014), 1% of monopotassium phosphate (Thongaon *et al.*, 2013) and 3000 ppm of mepiquat chloride (Nasee *et al*., 2017). Four longan trees were used for each treatment. Sixteen longan trees, approximately 10-12 years old and 6-8 m in canopy diameter were selected for the experiment. All longan trees were watered with potassium chlorate at 20 g/m^2 (Kativat, 2008) on 24 July 2017 during the rainy season in Thailand. Water, paclobutrazol, monopotassium phosphate and mepiquat chloride were spayed 15 days after spraying potassium chlorate.

Forty fruit bunches per longan tree were harvested on 3 February 2018 to measure fruit set, diameter, circumference and length of fruit. Peels were removed and data collected on peel thickness. Pulp firmness and total soluble solids were checked by using a fruit penetrometer and refractometer, respectively. Pulps were removed to measure pulp thickness. The length and

diameter of seed were also determined. Then fresh weight of peel, pulp and seed were determined. All parts of the fruit were dried in a hot air oven at 80 ℃ for 48 hours. Then all parts were weighted for data collection. All results were analyzed by analysis of variance and means separated by Duncan's multiple range test (DMRT).

Results

Results showed that there was a significant difference in percent fruit set and fruit number per bunch. The highest percent of fruit set resulted from the PP treatment, but did not differ significantly compared to fruit set resulting from the PMC treatment. However, percent fruit set in the control and PM treatment was significantly lower than fruit set resulting from the PP treatment (Fig. 1). Fruit number per bunch in the control was not significantly different as compare with PP and PMC treatments. The lowest number of fruits per bunch resulted from the PM treatment and was 8.26 fruits per bunch (Fig. 1).

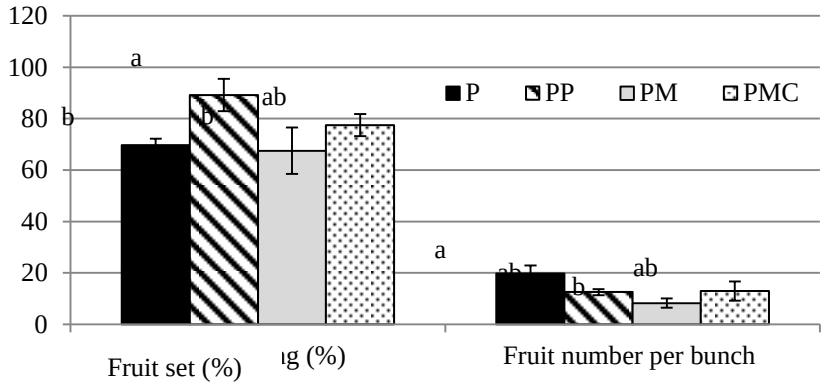

Figure 1. Fruit set and fruit number per bunch of longan at the end of the experiment. Bars with different letters in each plant part indicate significant differences in different treatments at the 0.05 probability level, according to DMRT.

There was no difference in fruit diameter, fruit height and fruit circumference among treatments. However, fruit diameter tended to be high in the PP treatment as compared to the control. Smaller fruit diameter resulted from the PMC treatment (Table 1). Fruit height tended to be high with the PP treatments compared to the control. The lowest fruit height resulted from the PM treatment (Table 1). The control treatment resulted in greater fruit circumference compared to the remaining treatments (Table 1).

Table 1. Fruit diameter, fruit height and fruit circumference of longan at the end of the experiment

Treatment	Fruit diameter (mm)	Fruit height (mm)	Fruit circumference (mm)
Potassium chlorate (P)	28.78 ±1.01	26.22 ±0.36	9.17 ±0.34
Potassium chlorate + Paclobutrazol (PP)	29.62 ±0.55	26.46 ±0.26	9.15 ±0.22
Potassium chlorate + Monopotassium phosphate (PM)	29.03 ±1.42	25.84 ±0.94	9.07 ±0.34
Potassium chlorate + Mepiquat chloride (PMC)	28.33 ±0.59	26.16 ±0.46	9.05 ±0.15
F-test	ns	ns	ns
CV (%)	3.31	2.17	3.05

ns = not significant at P≤0.05.

There was no significant difference in peel thickness and pulp thickness between the control and treatments. Peel thickness ranged from 0.57 to 0.83 mm and pulp thickness was 4.94 to 5.03 mm, respectively (Fig. 2). Pulp firmness was increased by the treatments as compared to the control. The highest pulp firmness resulted from the PM treatment. The control resulted in the least pulp firmness of 1.18 kg/cm^2 (Fig. 2).

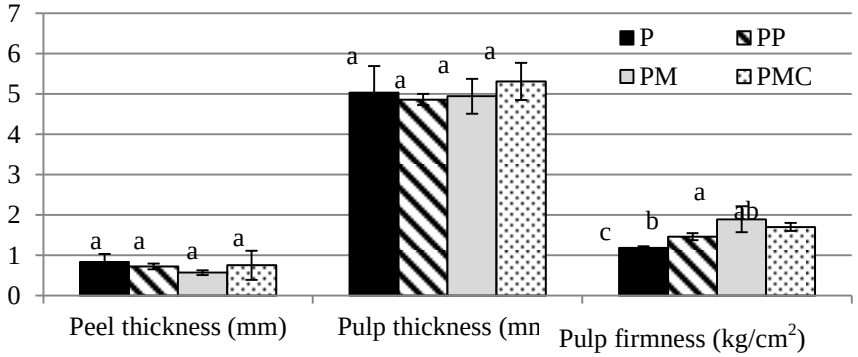

Figure 2. Peel thickness, pulp thickness and pulp firmness of longan at the end of the experiment. Bars with different letters in each plant part indicate significant differences in different treatments at the 0.05 probability level, according to DMRT

Total soluble solids in the control tended to be higher followed by PP, PM and PMC treatments which ranged from 18.51 to 18.87 ºBrix. However, there was no significant difference in total soluble solids among treatments

(Table 2). In case of fresh weight, there was no difference in fresh weight of peel and pulp between the control and treatments. Peel fresh weight ranged from 1.70 to 2.16 g while pulp fresh weight ranged from 7.75 to 7.92 g (Table 2). Fresh weight of seed was reduced by the PMC treatment as compared to the remaining treatments. Fresh weight of seed in the control did not differ as compared to the PP and PM treatments (Table 2).

Table 2. Total soluble solids, fresh weight of peel, pulp and seed of longan at the end of the experiment

Treatment	Total soluble solids (°Brix)	Fresh weight (g)		
		Peel	Pulp	Seed
Potassium chlorate (P)	18.93±0.49	2.16±0.40	7.75±1.15	1.64±0.06[a]
Potassium chlorate + Paclobutrazol (PP)	18.87±0.65	2.02±0.17	8.46±0.77	1.62±0.05[a]
Potassium chlorate + Monopotassium phosphate (PM)	18.64±0.66	1.89±0.20	8.08±1.28	1.63±0.04[a]
Potassium chlorate + Mepiquat chloride (PMC)	18.51±0.39	1.70±0.40	7.92±0.48	1.50±0.10[b]
F-test	ns	ns	ns	*
CV (%)	3.00	16.02	12.09	3.95

Means with different letters in each column are significantly different according to DMRT.
* = significant at P≤0.05. ns = not significant at P≤0.05.

Table 3. Dry weight of peel, pulp and seed of longan at the end of the experiment

Treatment	Dry weight (g)		
	Peel	Pulp	Seed
Potassium chlorate (P)	0.98±0.12	1.48±0.34	1.16±0.24
Potassium chlorate + Paclobutrazol (PP)	1.07±0.16	1.54±0.21	1.04±0.03
Potassium chlorate + Monopotassium phosphate (PM)	1.01±0.75	1.49±0.28	1.08±0.01
Potassium chlorate + Mepiquat chloride (PMC)	0.90±0.13	1.48±0.14	0.98±0.07
F-test	ns	ns	ns
CV (%)	12.32	17.15	11.87

ns = not significant at P≤0.05.

There was no significant difference in dry weight of peel, pulp and seed among treatments. However, peel dry weight resulting from the PP treatment tended to be higher from the PP treatment and lowest in PMC treatment (Table 3). Pulp dry weight was highest with the PP treatment as compared to the remaining treatments (Table 3). Results of seed dry weight were similar compared to the results of seed fresh weight. Namely, seed dry weight resulting from the PMC treatment was the lowest compared to the other treatments (Table 3).

Discussion

Yadava (2012) reported that paclobutrazol resulted in the highest percentage of fruit set in cape gooseberry. The highest fruit set maybe linked due to a balance between the C:N ratio and auxins. Results in this experiment showed that paclobutrazol increased percent fruit set in longan grown in the upland area in the east Thailand during the rainy season. These results were in agreement with Sripinta *et al.* (2009) who reported that fruit set of longan grown in upland area in north Thailand was increased by paclobutrazol.

In case of monopotassium phosphate, results showed that chemical fertilizer increased fruit firmness of longan. The result was in agreement with increased fruit firmness in mango (Taha *et al.,* 2014). This may be due to potassium in the fertilizer which is often described as the quality element for crop production (Usherwood, 1985). In addition, fruit firmness of longan was also increased by mepiquat chloride. This result is in accordance with that of Sherif and Asaad (2014) who reported that the firmness of pear was increased by mepiquat chloride.

Several researchers have shown that plant growth retardants improved some parameters of fruit quality and did not affect other parameters (Kim, *et al.,* 2008; Na Nakorn, *et al.,* 2017). In this experiment, there was no significant difference in fruit length, fruit diameter, fruit circumference, peel thickness, pulp thickness, total soluble solids, fresh weight of peel and pulp, and dry weight of peel, pulp and seed among treatments. Moreover, some experimental reports showed that plant growth retardants decreased fruit quality. Bhutia *et al.* (2017) who reported that high concentration of paclobutrazol reduced fruit set and yield. Results from this experiment indicated that 2000 ppm of paclobutrazol, 1% of monopotassium phosphate and 3000 ppm of mepiquat chloride did not ha a detrimental effect on fruit quality of longan. However, the effective method for increase fruit set and fruit quality of longan in rainy season should be further investigated.

References

Bhutia, S. O., Choudhury, A. G. and Hasan, M. A. (2017). Paclobutrazol in improving productivity and quality of litchi. International Journal of Current Microbiology and Applied Sciences. 6:1622-1629.

Chanlueng, S. (2017). Five steps for professional production of longan off-season. Official of Agricultural Economics. pp. 2.

Chapagain, B. P. and Wiesman, Z. (2004). Effect of Nutri-Vant-PeaK foliar spray on plant development, yield, and fruit quality in greenhouse tomatoes. Scientia Horticulture. 102:177-188.

Curry, E. A. and Williams, M. W. (1986). Effect of paclobutrazol on fruit quality: apple, pear and cherry. Acta Horticulturae. 179:743-753.

Hanviriyapant, S. (2008). The production of longan off-season. Official of agricultural research and development region 1, Department of Agricultural Extension. Retrieved from http://www.soidao.chanthaburi.doae.go.th/

Kativat, B. (2008). Effects of potassium chlorate on flowering and fruit setting of longan (*Dimocarpus longan* Lour.) cv. E-daw. (Master Thesis). Maejo University, Thailand.

Kim, H. G., Choi, D. G. and Kang, I. K. (2008). Effect of growth regulator treatments on quality and growth in 'Gailiangmeru' grape (*Vitis* spp.). Acta Horticulturae. 772:319-322.

Lim, S.C., Kim, S.K., Kim,Y.H., Youn, C.K. and Yoon, T. (2004). Vine growth and fruit quality of kyoho grapes as affected by mepiquat chloride and GA. Acta Horticulturae. 653:145-149.

Na Nakorn, S., Intramanee, V. and Nijkamp, R. T. (2017). Effects of paclobutrazol on flower induction and fruit production of off-season rambutan (*Nephelium lappaceum* Linn.'Rongrien'). Acta Horticulturae. 1178:57-60.

Nasee, M., Charoenkit, N., Sruamsiri, P. and Naphrom, D. (2017). Effect of mepiquat chloride, chlormequat chloride, and paclobutrazol on flowering of mango cv. Nam Dok Mai Si Thong. Journal of Agriculture, Chiang Mai University. 30:271-279.

Nerson, H., Edelstein, M., Berdugo, R. and Ankorion, Y. (1997). Monopotassium phosphate as a phosphorus and potassium source for greenhouse-winter-grown cucumber and muskmelon. Journal of Plant Nutrition. 20:335-344.

Official of Agricultural Economics (2016). Longan. Retrieved from http://www.oae.go.th/

Sarrwy, S. M. A., Mohamed, E.A. and Hassan, H. S. A. (2010). Effect of foliar sprays with potassium nitrate and mono-potassium phosphate on leaf mineral contents, fruit set, yield and fruit quality of picual olive trees grown under sandy soil conditions. American-Eurasian Journal of Agricultural and Environmental Science. 8:420-430.

Sherif, H. M. and Asaad, S. A. (2014). Effect of some plant growth retardants on vegetative growth, spurs and fruiting of 'Le - Conte' pear trees. British Journal of Applied Science and Technology. 4:3785-3804.

Srihara, N. (2014). Effect of paclobutrazol on canopy size, yield and quality of longan cv. E-DAW. (Master Thesis). Maejo University, Thailand.

Sridhar, G., Koti, R. V., Chetti, M. B. and Hiremath, S. M. (2009). Effect of naphthalene acetic acid and mepiquat chloride on physiological components of yield in bell pepper (*Capsicum annum* L.). Journal of Agricultural Research. 47:53-62.

Sripinta, P., Posawang, S., Panyapherm, A., Sanprom, C., Lilapiromkul, P., Upamalee, A. and Hassarangsee, S. (2009). Induction of flowering and fruit set of longan in summer

season. Vth Conference of Thailand Agricultural System, Ubonrachatani, Thailand, p. 490.
Taha, R. A., Hassan, H. S. A. and Shaaban, E. A. (2014). Effect of different potassium fertilizer forms on yield, fruit quality and leaf mineral content of zebda mango trees. Middle-East Journal of Scientific Research. 21:123-129.
Techapinyawat, S. (2001). Plant Physiology. Kasetsart University, Bangkok, pp. 179.
Thongaon, V., Charoenkit, N. and Sruamsiri, P. (2013). Use of ethephon and monopotassium phosphate combined with potassium chlorate to induce off-season flowering of longan cv. DAW in rainy season. Journal of Agriculture, Chiang Mai University. 29:13-18.
Usherwood, N. R. (1985). The role of potassium in crop quality. In: Potassium in Agriculture, Munson, R. D. (Ed.). ASA-CSSA-SSSA, Madison, W.I, pp. 489-513.
Yadava, L. P. (2012). Effect of growth retardants on floral biology, fruit set and fruit quality of cape gooseberry (*Physalis peruviana* L.). American Journal of Plant Physiology. 7: 143-148.
Yeshitela, T., Robbertse, P. J. and Stassen, P. J. C. (2004). Paclobutrazol suppressed vegetative growth and improved yield as well as fruit quality of 'Tommy Atkins' mango (*Mangifera indica*) in Ethiopia. New Zealand Journal of Crop and Horticultural Science 32:281-293.

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