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Effect of Preharvest Calcium Sprayed on Growth and Fruit Quality of Cherry Tomato cv. Red Lady

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Cherry tomato (*Lycopersicon esculentum* Mill.) are often planted in winter because of their high yield, less susceptible to diseases and insect infestation than summer and rainy seasons. Effect of preharvest calcium solution application on growth and fruit quality of cherry tomato cv. Red Lady were study. Tomato were seeded into the plastic tray then transplant into plastic bag (14″×22″) when the plantlet had 3-4 leaves and irrigated by drip method for 30 minutes twice per day. The experiment were separated for 2 treatment; sprayed with water (control) or sprayed with Magic® calcium-boron solution at the rate of 0.5% every weeks started at 21 days after transplant or when it was showed the second set of flowering for 6 times before harvest. The results showed that plant application with the calcium-boron had the percentage of fruit set, number of fruit per inflorescence, number of fruit per plant and fruit size higher than the control (non-sprayed) by about 12%, 4 and 30 fruits and 3.084 mm, respectively. Non significantly different between sprayed and non-sprayed with calcium-boron solution in number of flower per inflorescence and number of flower per plant. The results for fruit quality after harvest showed that plant sprayed with calcium-boron solution had higher in fruit firmness (10.90 N), vitamin c content (2.763 mg/100g) and titratable acidity (TA) content (1.04%) than the control treatment by about 2.22 N, 0.131 mg/100g FW and 0.033%, respectively. However, no statistically difference in total soluble solids (TSS) content and lycopene content between sprayed and non-sprayed with calcium-boron solution.

Keywords: lycopene, quality, firmness, inflorescence, vitamin C

Introduction

Cherry tomato (*Lycopersicon esculentum* Mill.) mean tomatoes with small fruit size and can be eaten in the form of fruits and vegetables. The characteristic of cherry tomatoes is sweet and sour taste. The average total soluble solid content of about 6-9 ºbrix, which is higher than other type of tomatoes, Also this type are high in nutritional value, especially lycopene, vitamin A and vitamin C, so it is suitable for healthy consumption. Cherry

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tomato are often planted in the winter because of their high yield, less susceptible to diseases and insect infestation than summer and rainy seasons. In Thailand, the rainy season starts in June, with heavy rains in September-October, some until mid-November, and with the lowest temperatures falling between December-January. Temperatures below 20 ℃ are relatively short and the summer is between February-May, with the highest temperature in April (35-38 ℃). It is seen that the tomatoes grown in the easiest and most productive, with only short breaks the winter (Sitadhani, 2012). As the temperature rises, the yield decreases (Watts, 1962). If temperature higher than 32.2 ℃, fruit set become low. The ideal temperature for fruit setting and development is 15-20 ℃, but below 13 ℃ resulting in low fruit yield (Iwahori, 1965). Spraying with calcium-boron can increase pollination and polarity. Extension of the flower bud stimulates growth and strengthens the plant structure (Pipithsangchan, 2012). Tomatoes, cucumber, mango and strawberry sprayed with calcium boron solution had increase in fruit yield when compared to untreated plants and reduced incidence of rot disease. In addition, it can increase the average fruit weight and yield, firmness, and soluble solids content (Ekinci *et al*., 2014; Abdur and Ihsan, 2012; Wo ǰcik and Lewandowski, 2003; Cardozo *et al*., 2001; Kamal, 2000; Fallahi *et al*., 1997).

The objective of this research was to study the effect of pretharvest calcium-boron sprayed on growth and quality of Red Lady cherry tomato.

Materials and methods

This research was conducted on field at Faculty of Agricultural Technology, King Momgkut's Institute of Technology Labkrabang, Bangkok, Thailand. Red Lady tomato were seeded into the plastic tray for producing plant plug with good quality. When plantlet developed 3-4 leaves, transplant into plastic bags (14×22 inch) and managed the distance between row and plant were 50×30 cm. Plants were irrigated by drip method, every day for 30 minutes twice per day. The 20 g per plant of chemical fertilizer with formula of 15-15-15 was applied 3 times at 7, 22 and 42 days after transplanted.

This experiment was carried out in Completely Randomized Design (CRD), with 7 replication about 5 plant each, comprised of 2 treatments included control (sprayed with water) and sprayed with Magic® calcium-born (33% CaO, 3% B) solution at the rate of 0.5%. These treatments were applied every weeks started 21 days after transplant or when it was showed the 2nd set of flowering until harvest (about 82 days after transplant).

Preharvest parameter included length and size of inflorescence, the number of flower per inflorescence and per plant, percentage of fruit setting, fruit weight per plant and fruit size were recorded. After harvest, fruit firmness, total soluble solids (TSS), titratable acidity (TA), vitamin C and lycopene contents were also recorded.

All data were subjected to analysis of variance (ANOVA). Differences between means were evaluated using Duncan's Multiple Range Test at $P \leq 0.05$.

Results and Discussion

The application with calcium-boron solution had non significantly difference in length (13.56 cm) and size (2.28 mm) of inflorescence, number of flower per inflorescence and per plant (12.8 and 64, respectively) when compared to non-sprayed (Table 1). This result had inconsistent with the research of Abdur and Ihsan (2012), they were reported that, tomato sprayed with 0.6% calcium chloride was able to increase flowering per inflorescence when compared to non-sprayed.

Table 1. Effect of preharvest calcium-boron sprayed on growth parameters in Red Lady tomato.

Treatments	Growth parameterts			
	Length of inflorescence/1 (cm)	Inflorescence size/2 (mm)	Number of flower per inflorescence	Number of flower per plant
Non-sprayed	12.88 ±2.47[a]	2.69 ±0.46[a]	13.02 ±1.52[a]	65.14 ±7.60[a]
Ca-B sprayed	13.56 ±2.96[a]	2.28 ±0.44[a]	12.8 ±3.14[a]	64 ±15.72[a]
F-Test	ns	ns	ns	ns
CV%	19.59	18.29	19.13	19.13

1/Length of inflorescence: measure length from base to tip of inflorescence.
2/Inflorescence size: use a vernier caliper, measure from the base of inflorescence, 1 cm.
*, **Significant ($0.01 < P < 0.05$) or highly significant ($P < 0.01$), respectively.
ns = not significant at $P > 0.05$

Tomatoes sprayed with calcium-boron solution had higher in number of fruit per inflorescence (9.15 fruits) and number of fruit per plant (72.35 fruits) than non-sprayed of about 4 fruit per inflorescence and 20 fruit per plant, respectively (Table 2). As calcium improves pollination, reduce the fall of receptacle and peduncle. (Pipithsangchan, 2012; Khansupa and Puttawarachai 2002, Cardozo *et al*., 2001). Rubio *et al*. (2009) reported that calcium

concentration in the plant increased the number of fruits per plant and total yield. Abdur and Ihsan (2012) reported that 0.6% of calcium chloride solution increased the number of fruit per inflorescence and number of fruit per plant in tomatoes cv. Roma.

Calcium-boron increased the percentage of fruit set for up to 50% while it was setting only 38% in non-sprayed plants. Also, fruit weight and fruit size were higher in sprayed calcium-boron than non-sprayed by about 97 g and 3.09 mm, respectively (Table 2, Figure 1). Confirming this results by the study in pepper plants after applied calcium fertilizer, this helps to increase leaf area and fruit fresh weight (Rubio *et al*., 2009; Haq *et al*. 2013). Additionally, Ekinci *et al*. (2014) also reported that calcium had an affected on yield as a resulted from the increased in fruit yield and fresh weight in tomato and cucumber. In addition, Alcaraz-Lopez *et al*. (2003) reported that foliar sprays containing calcium, magnesium and titanium help to increase fruit setting and fruit size in plum.

Table 2. Effect of preharvest calcium-boron sprayed on fruit growth, setting, size and yield in Red Lady tomato.

Treatments	**Number of fruit per inflorescence**	**Number of fruit per plant**	**fruit setting (%)**	**Fruit weight per plant (g)**	**Fruit size[/1] (mm)**
Non-sprayed	4.59 ±0.43[b]	42.18 ±1.31[b]	38 ±2.11[b]	92.95 ±6.95[b]	14.49 ±2.66[b]
Ca-B sprayed	9.15 ±5.56[a]	72.35 ±23.50[a]	50 ±20.80[a]	189.85 ±29.01[a]	17.58 ±3.24[a]
F-test	*	**	*	**	*
C.V. (%)	14.29	29.83	14	14.95	18.5

1/Diameter of lengthwise fruit.
*, **Significant ($0.01 < P < 0.05$) or highly significant ($P < 0.01$), respectively.
ns = not significant at $P > 0.05$

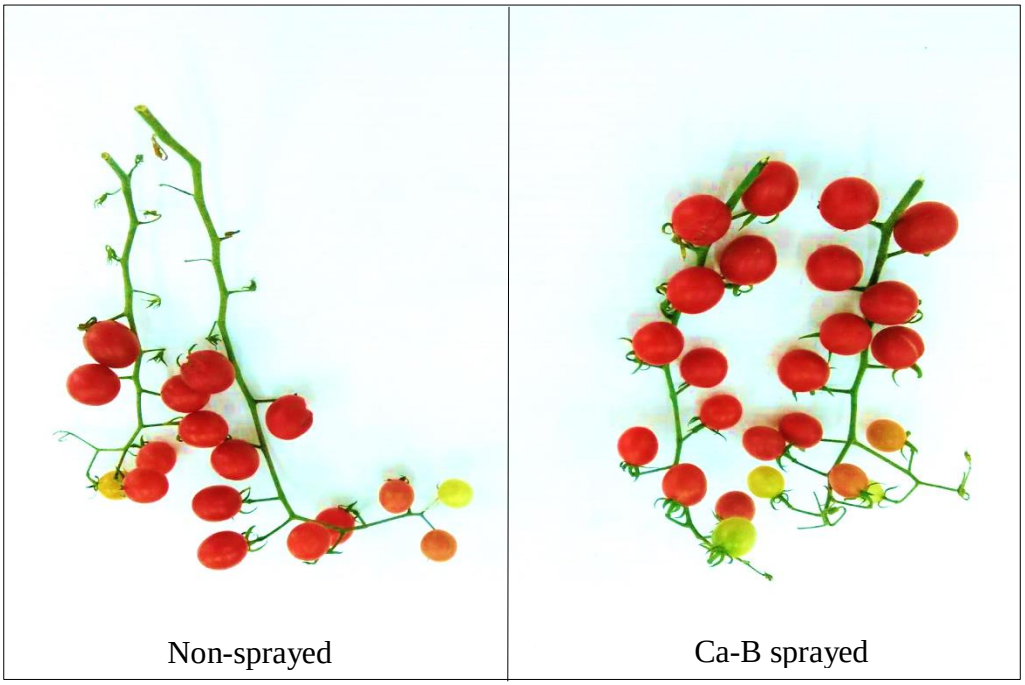

Figure 1. Fruit setting per inflorescence for Red Lady tomato after sprayed with water or with Ca-B sprayed.

Calcium contributes to improving the rigidity of cell walls; retards tissue softening also reduces pectinase enzyme activity, which is responsible for cell wall degradation (Vicente *et al*., 2009). Calcium is responsible for fruit firmness and its quality as well (Lurie, 2009; Machado *et al*., 2008; Khalaj *et al*., 2016). The results from this research for fruit quality after harvest showed that calcium-boron had significantly higher in fruit firmness (10.90 N) vitamin C content (2.76 mg/100g fresh weight) and titratable acidity (TA) content (1.04%) than non-sprayed (Table 3). Non significantly different were found in total soluble solids and lycopene contents between non-sprayed and sprayed with calcium-boron solution. The contents were about 8 ºbrix and 0.2 mg/ 100 g fresh weight, respectively. Additionally, our results were consistent with the findings of Gastol and Domagala (2006), they had reported the results of calcium foliar sprays could increased calcium in the fruit, resulting in high fruit firmness in pear. Wo ́jcik and Lewandowski (2003) applied the calcium by spraying at the rate of 1.5 kg Ca ha^{-1} and 160 g B ha^{-1} could increased fruit firmness in strawberry.

Table 3. Effect of preharvest calcium-boron on fruit quality and chemical compositions in Red Lady tomato.

Treatments	Fruit firmness (N)	TSS (°brix)	TA (%)	Vitamin C (mg/100 g FW)	Lycopene content (mg/100 g FW)
Non-sprayed	8.67 ±0.20[b]	7.30 ±1.16[a]	1.01 ±0.01[b]	2.11 ±0.01[b]	0.28 ±0.002[a]
Ca-B sprayed	10.90 ±0.56[a]	8.65 ±1.27[a]	1.04 ±0.01[a]	2.76 ±0.05[a]	0.28 ±0.003[a]
F-test	**	ns	*	**	ns
C.V. (%)	4.36	15.31	1.63	7.86	0.95

TSS mean total soluble solids.
TA mean titratable acidity.
*, **Significant ($0.01 < P < 0.05$) or highly significant ($P < 0.01$), respectively.
ns = not significant at $P > 0.05$

Conclusion

Cherry tomatoes cv. Red Lady were applied by preharvest spraying with 0.5% calcium-boron solution increased the number of fruit per inflorescence, number of fruit per plant and percentage of fruit setting. This condition could maintained fruit firmness, titratable acidity (TA) and gave higher in vitamin C content than non-sprayed plants.

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