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Effect of foliar spray of calcium chloride and boric acid on shelf-life of guava

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ABSTRACT

The present investigation was conducted during 2015-16 on guava cv. Pant Prabhat having 9 treatments of different combinations of calcium and boron sprays made in 3 replications. The results obtained showed that minimum physiological loss in weight (PLW) was found under T_2 (calcium chloride @ 0.4%) treatment. Whereas, TSS (11.99ºB), ascorbic acid (252.4 mg/100 g) and total sugars (7.51%) were found to be maximum in T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%) treatment and overall acceptability of fruits in storage up to six days was also found maximum under the same treatment. The findings of the present investigation revealed that the pre-harvest foliar application of calcium chloride and boric acid twice was an effective way for improvement of fruit quality and shelf-life of guava. Calcium chloride (0.4%) and boric acid (0.2%) were found to be effective in increasing quality, whereas, calcium chloride (0.4 %) alone was effective for maintaining fruits under ambient storage conditions for six days.

Key words: Boric acid, calcium chloride, guava, storage condition, shelf-life.

INTRODUCTION

Guava (*Psidium guajava* L.) is a popular fruit tree of the subtropical climate and is considered as one of the exquisite, nutritionally valuable and remunerative crops. Guava fruits are used for both fresh consumption and processing (Singh, 9). Foliar nutrient feeding has been universally used and established as an essential part of crop production, mainly on horticulture crops. It has been well established that calcium (Ca) is involved in the regulation of maturation and ripening processes of fruits. Fruit with low Ca content are prone to many biotic and abiotic disorders, and such fruit have usually short shelf-life and hence, foliar applications of Ca may extend the aging process significantly. Another nutrient supposed to have an important role in fruit quality is boron (B). It is an essential nutrient element and it is essential for cell division, reproduction, formation of pollen germination and pollen tube growth, also aids in the translocation of calcium, sugars and is required for protein synthesis. Therefore, the present study was conducted with the objectives to find out the most effective treatment for improving shelf-life and fruit quality of guava cv. Pant Prabhat.

MATERIALS AND METHODS

The present investigation was carried out at Horticultural Research Centre, Patharchatta, Department of Horticulture, GBPUA&T, Pantnagar during 2015-16. The soil of the experimental plot has been classified as series VI (sandy loam under the order Mollisol) of Patharchatta (Deshpande *et al.*, 2). The experiment was conducted on six-year-old guava trees of cv. Pant Prabhat where all the selected trees were uniform in growth and vigour. The trees were given uniform cultural operations during the course of investigation. The experiment was laid out in completely randomized design. The number of treatments were 9, T_1 {Calcium chloride(0.2%)}, T_2 {Calcium chloride (0.4%)}, T_3 {Boric acid (0.1%)}, T_4 {Boric acid (0.2%)}, T_5 {Calcium chloride (0.2%) + Boric acid (0.1%)}, T_6 {Calcium chloride (0.2%) + Boric acid (0.2%)}, T_7 {Calcium chloride (0.4%) + Boric acid (0.1%)}, T_8 {Calcium chloride (0.4%) + Boric acid (0.2%)} and T_9 {control (water spray)} and each treatment was replicated three times. All the treatments were given on 15th August, on fruit set and repeated again on 30th August after 15 days of first application. The chemicals, *viz.*, calcium chloride, boric acid and their combination, respectively were sprayed at different concentrations. The total soluble solids were measured by hand refractometer. Titratable acidity of fruits was calculated by titration method. The ascorbic acid was estimated by 2, 6-dichlorphenol-indophenol visual titration method and expressed in terms of mg per 100 g pulp. The sugars were estimated as described by Ranganna (6). Physiological loss in weight was expressed into percentage. Organoleptic evaluation was done by a panel of four judges taking into consideration of fruit colour, appearance, flavour and taste.

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RESULTS AND DISCUSSION

Calcium and boron treatments and storage periods had significant effect on physiological loss in weight (PLW) of guava fruits under ambient condition (Table 1). Minimum PLW (18.02%) was recorded in calcium chloride (0.4%) (T_2) treatment followed by 18.51% PLW in calcium chloride 0.2% (T_1) treatment, whereas, maximum PLW (24.58%) was recorded in control (T_9). From the above finding it's clearly indicated that storage day's affected PLW significantly which increased gradually irrespective of the treatment as the storage period progressed. Application of calcium chloride 0.4% (T_2) retarded the weight loss of guava fruits during storage period compared to the control. Loss of weight in fresh fruit is mainly due to the loss of water caused by transpiration and respiration processes. Fruits treated with higher concentrations of calcium chloride recorded less loss of weight, which may be due to the role of calcium in maintaining fruit firmness, limiting respiratory rate and transpiration during pre-climacteric and climacteric phases, which was attributed to the altered membrane permeability as reported by Tingwa and Young (10). The calcium could also have reduced the endogenous substrate catabolism during respiration by limiting the diffusion of substrate from the vacuole to the cytoplasm and favoured the uptake of sorbitol, thus, disallowing its involvement in reactions related to internal breakdown. Results of present findings are in support with those of Jayachandran *et al.* (4) and Raychaudhary *et al.* (7) on guava.

The data pertaining to TSS varied significantly due to different treatments (Table 1). The maximum TSS (11.99°B) was observed in T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%) treatment, followed by 11.27°B in T_6 (calcium chloride @ 0.2% + Boric acid @ 0.2%) and 10.90°Brix in T_7 (calcium chloride @ 0.4% + boric acid @ 0.2%) treatments compared to 8.57°B TSS in T_9 (control). The results on increased TSS under these treatment was supported by findings of Bhat *et al.* (1) on pear. The maximum acidity (3.71%) was recorded under T_9 (control) followed by 3.44% in T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%). Whereas, minimum acidity (2.57%) was observed in T_4 (boric acid @ 0.2%). Lower acidity in fruits may be ascribed to the higher accumulation of sugars, better translocation of sugars into fruit tissues and conversion of organic acid into sugars. Similarly, maximum ascorbic acid content (252.4 mg/100 g) was recorded in T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%) followed by (237 mg/100 g) in T_7 (calcium chloride @ 0.4% + boric acid @ 0.1%). Whereas, minimum ascorbic acid (157.6 mg/100 g) was in T_9 (control) (Table 2). The increased ascorbic acid content in guava fruit might be due to higher synthesis of organic acids, on account of maximum availability of plant metabolism. The data presented on reducing sugars clearly indicates that the maximum reducing sugar (11.33%) was recorded in T_2 (calcium chloride @ 0.4%) treatment followed by 10.95% in T_1 (calcium chloride @ 0.2%), (10.54%). Whereas, minimum reducing sugar (10.01%) was obtained in the control (T_9). However, non-reducing sugar was recorded maximum (12.21%) under treatment T_9 (control). The total sugar content of guava fruit was found maximum (15.89%) in T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%) followed by 15.80% total sugars in T_1 (calcium chloride @ 0.2%) (Table 2). The possible reason for increase in sugar content of fruits with the application of these nutrients might be due to hydrolysis of polysaccharides to simpler from, *i.e.*, mono-and dis-accharides and better transportation of assimilates from leaves to their place of utilization, which helps in increase the sugar content of fruits and consequently reduces the acidity. These results corroborate the earlier records of Kaur and Dhillon (5) and Dutta and Banik (3) on guava.

The findings on appearance of guava fruit at different interval (Table 3) clearly indicates that on harvest day fruits were rated with maximum appearance (7.81) under T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%) followed by 7.71 in T_6 (calcium chloride @ 0.2% + boric acid @ 0.2, whereas, minimum rating for appearance (6.28) was in fruits from T_9 (control). Similarly, maximum flavour (6.87) was rated under treatment T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%) followed by 6.75 in T_1 (calcium chloride @ 0.2%) and 6.64 in T_7 (calcium chloride @ 0.4% + boric acid @ 0.1%) compared to control (5.57). In similar manner the fruits on harvest day were rated for maximum texture (6.21) in T_8 (calcium chloride @ 0.4% + boric acid @ 0.2%). Guava fruits treated with calcium and boron spray develops good appearance, desirable flavour, which might be due to loss of organic acids during senescence and change in carbohydrates, proteins, amino acids, lipids and phenolic compounds. The fruit softening (textural integrity) becomes faster with foliar spray of calcium chloride, this softening is due to deterioration in the cell structure, the cell wall composition and the intracellular materials. The above findings were in conformity with the results of Seymour *et al.*(8) and Bhat *et al.* (1).

Table 1. Effect of foliar spray of calcium chloride and boric acid on physiological loss of weight and chemical parameters in guava.

Treatment	PLW (%)					Chemical parameters									
						TSS (ºB)					Acidity (%)				
	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean
T_1 Calcium chloride @ 0.2%	0.00 (0.00)	9.33 (17.77)	17.33 (24.58)	27.60 (31.67)	13.57 (18.51)	8.43	8.93	9.20	9.65	9.05	0.36	0.33	0.29	0.26	0.31
T_2 Calcium chloride @ 0.4%	0.00 (0.00)	8.86 (17.34)	16.25 (23.76)	26.59 (31.02)	12.93 (18.02)	8.70	9.21	9.47	9.86	9.31	0.30	0.29	0.26	0.23	0.27
T_3 Boric acid @ 0.1%	0.00 (0.00)	9.66 (18.09)	17.94 (25.05)	27.99 (31.92)	13.90 (18.76)	9.50	9.70	10.30	10.70	10.05	0.29	0.27	0.24	0.22	0.25
T_4 Boric acid @ 0.2%	0.00 (0.00)	10.20 (18.62)	18.94 (25.78)	29.14 (32.66)	14.57 (19.26)	10.10	10.65	10.74	10.87	10.59	0.23	0.21	0.19	0.18	0.20
T_5 Calcium chloride @ 0.2% + Boric acid @ 0.1%	0.00 (0.00)	10.62 (19.01)	19.72 (26.35)	30.34 (33.41)	15.17 (19.69)	9.50	9.80	10.10	10.33	9.93	0.29	0.27	0.25	0.23	0.26
T_6 Calcium chloride @ 0.2% + Boric acid @ 0.2%	0.00 (0.00)	9.64 (18.07)	20.89 (27.18)	32.14 (34.52)	15.67 (19.94)	11.70	11.23	11.31	11.45	11.27	0.38	0.34	0.29	0.26	0.31
T_7 Calcium chloride @ 0.4% + Boric acid @ 0.1%	0.00 (0.00)	9.38 (17.82)	17.42 (24.65)	28.14 (32.02)	13.74 (18.62)	10.63	10.76	1095	11.26	10.90	0.39	0.36	0.34	0.28	0.34
T_8 Calcium chloride @ 0.4% + Boric acid @ 0.2%	0.00 (0.00)	9.94 (18.37)	18.46 (25.42)	28.40 (32.19)	14.20 (18.99)	11.74	11.83	1.97	12.40	11.99	0.41	0.39	0.35	0.31	0.36
T_9 Control (water spray)	0.00 (0.00)	11.21 (19.55)	31.15 (33.91)	49.84 (44.89)	23.05 (24.58)	8.00	8.40	8.73	9.13	8.57	0.47	0.44	0.40	0.37	0.42
Mean	0.00 (0.00)	9.87 (18.29)	19.78 (26.30)	31.13 (33.81)	-	9.74	10.06	10.31	10.63	-	0.35	0.32	0.29	0.26	-
CD at 5%															
Treatments (T)			0.131					0.140					0.037		
Storage Interval (S)			0.087					0.210					0.25		
Interaction (T × S)			0.262					0.420					0.75		

*The data under parenthesis are angular transformed values.

Table 2. Effect of foliar spray of calcium chloride and boric acid on chemical parameters of guava fruits.

Treatment	Ascorbic acid (mg/100 g)					Reducing sugars (%)					Non-reducing sugars (%)					Total sugars (%)				
	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean
T_1 Calcium chloride @ 0.2%	180.0	178.5	176.8	175.0	177.6	3.57	3.60	3.62	3.65	3.61	3.80	3.79	3.81	3.82	3.81	7.37	7.39	7.43	7.47	7.42
T_2 Calcium chloride @ 0.4%	210.0	208.5	206.8	205.0	207.6	3.83	3.85	3.87	3.90	3.86	3.38	3.39	3.38	3.37	3.38	7.21	7.24	7.25	7.27	7.24
T_3 Boric acid @ 0.1%	225.0	223.5	221.8	220.0	222.6	3.11	3.14	3.15	3.17	3.14	3.74	3.77	3.79	3.79	3.77	6.85	6.91	6.94	6.96	6.92
T_4 Boric acid @ 0.2%	163.3	161.8	160.2	158.3	160.9	3.28	3.29	3.32	3.35	3.31	3.70	3.71	3.81	3.82	3.76	6.98	7.00	7.13	7.17	7.07
T_5 Calcium chloride @ 0.2% + Boric acid @ 0.1%	235.0	233.5	231.8	230.0	232.6	3.11	3.14	3.17	3.20	3.16	3.38	3.38	3.38	3.37	3.38	6.49	6.52	6.55	6.57	6.53
T_6 Calcium chloride @ 0.2% + Boric acid @ 0.2%	180.0	178.5	176.8	175.0	177.6	3.06	3.11	3.15	3.18	3.13	3.34	3.49	3.66	3.74	3.56	6.40	6.60	6.81	6.92	6.68
T_7 Calcium chloride @ 0.4% + Boric acid @ 0.1%	239.8	238.3	236.7	234.8	237.4	3.26	3.27	3.29	3.31	3.28	3.42	3.44	3.45	3.46	3.44	6.68	6.71	6.74	6.77	6.73
T_8 Calcium chloride @ 0.4% + Boric acid @ 0.2%	254.8	253.3	251.7	249.8	252.4	3.30	3.33	3.37	3.40	3.35	4.33	4.33	4.32	3.65	4.16	7.63	7.66	7.69	7.05	7.51
T_9 Control (water spray)	160.0	158.5	156.8	155.0	157.6	2.96	3.00	3.05	3.10	3.03	4.67	4.66	4.64	3.95	4.48	6.28	6.31	6.33	6.34	6.32
Mean	205.3	203.8	202.2	200.3	-	3.28	3.30	3.33	3.36	-	3.75	3.77	3.80	3.66	-	6.88	6.93	6.99	6.95	-
CD at 5%																				
Treatment (T)			2.14					0.10					0.12					0.16		
Storage interval (S)			3.21					0.67					0.08					0.14		
Interaction (T × S)			6.42					0.29					0.28					0.32		

*The data under parenthesis are angular transformed values.

Table 3. Effect of foliar spray of calcium chloride and boric acid on organoleptic parameters of guava fruits.

Treatment	Appearance					Flavour					Texture				
	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean	0 day	2nd day	4th day	6th day	Mean
T_1 Calcium chloride @ 0.2%	8.25	8.45	7.35	5.61	7.42	8.18	7.03	6.53	5.26	6.75	7.65	6.08	4.62	3.07	5.36
T_2 Calcium chloride @ 0.4%	8.10	8.31	7.2	5.46	7.27	8.14	7.00	6.5	5.24	6.72	8.34	6.78	5.32	3.77	6.05
T_3 Boric acid @ 0.1%	7.71	7.90	6.80	5.05	6.87	8.11	6.96	6.46	5.20	6.68	6.90	6.33	4.84	3.32	5.35
T_4 Boric acid @ 0.2%	7.51	7.70	6.60	4.86	6.67	7.40	6.25	5.75	4.49	5.97	7.85	6.28	4.82	3.27	5.56
T_5 Calcium chloride @ 0.2% + Boric acid @ 0.1%	7.35	7.55	6.45	4.71	6.52	7.85	6.70	6.20	4.94	6.42	8.10	6.53	5.02	3.52	5.79
T_6 Calcium chloride @ 0.2% + Boric acid @ 0.2%	8.55	8.75	7.64	5.91	7.71	7.75	6.60	6.10	4.84	6.32	7.55	5.98	4.52	2.97	5.26
T_7 Calcium chloride @ 0.4% + Boric acid @ 0.1%	8.31	8.50	7.40	5.66	7.47	8.23	7.08	6.25	5.00	6.64	7.80	6.22	4.77	3.22	5.50
T_8 Calcium chloride @ 0.4% + Boric acid @ 0.2%	8.65	8.84	7.75	6.01	7.81	8.34	7.20	6.60	5.32	6.87	8.50	6.93	5.47	3.92	6.21
T_9 Control (water spray)	7.11	7.31	6.21	4.47	6.28	7.00	5.85	5.34	4.09	5.57	7.14	5.57	4.11	2.56	4.85
Mean	7.95	8.15	7.04	5.30	-	7.89	6.74	6.19	4.93	-	7.76	6.30	4.83	3.29	-
CD at 5%															
Treatment (T)			0.10					0.09					0.07		
Storage interval (S)			0.16					0.14					0.10		
Interaction (T × S)			0.32					0.29					0.21		

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