Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(2): 739-741
Received: 16-12-2020
Accepted: 05-02-2021

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Effect of pre-harvest spray of mineral nutrients on the storage behaviour of guava (*Psidium guajava* L.) cv. L-49 fruits

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DOI: https://doi.org/10.22271/phyto.2021.v10.i2j.13882

Abstract
An experiment was conducted to assess the effect of Calcium nitrate (0.5 and 1.0%), Zinc sulphate (0.2 and 0.4%) and Boric Acid (0.4 and 0.6%) on the storage behaviour of guava cv. L-49 fruits. Aquous solutions of these nutrients were sprayed on the plants, one month before harvesting during 15th Nov. of 2019 and 2020 and harvested fruits were stored at 10±1 ºC temperature. The mean of data for both years clearly revealed that pre-harvest spray of zinc sulphate at 0.4 per cent significantly reduced physiological loss in weight (%), spoilage (%), and acidity (%) and improved T.S.S., total sugars and ascorbic acid contents in guava cv. L-49 fruits under 10±1ºC storage during both years.

Keywords: Boric acid, calcium nitrate, guava, pre-harvest spray, storage quality, zinc sulphate

Introduction

Guava (*Psidium guajava* L.) belonging to the family Myrtaceae, is one of the most important fruit crops of India. It is one of the cheapest and good sources of vitamins. Fruits are consumed as fresh and in the form of products like Jam, Jelly, Juice, nector and R.T.S. Guava fruits and leaves also have important medicinal value in domestic and ayurvedic treatments.

Owing to the perishable nature of the fruits, guavas possess a serious problem in its storage and marketing. Large quantities of fruits are lost every year after harvesting due to inherent bio-chemical changes (Lakshminarayan and Subramanyam, 1970) [5]. Preservation in a fresh condition for extended storage period without loss in quality is of great significance. The pre harvest application of mineral nutrients like calcium, zinc and boron are known to play a crucial role in the development and quality build up of the fruit (Chaitanya, *et al.*, 1997) [2]. Therefore, it is essential to find out suitable nutrient with effective concentration to enhance the shelf life under storage condition.

Materials and methods

The present experiment was conducted on twelve years old budded and uniform healthy bearing trees of guava cv. L-49 during the year 2019 and 2020. There were seven treatments *viz.,* Calcium nitrate 0.5 and 1.0 per cent zinc sulphate 0.2 and 0.4 per cent, boric acid 0.4 and 0.6 per cent, including a control, replicated thrice in completely randomized design. Spraying was done one month before harvest (on November 15, 2019 and 2020) in the evening with the help of foot sprayer. Spray of distilled water was performed for control plants.

The fruits were harvested at edible maturity and stored at 10±1ºC in group of eight fruits. Different post harvest changes such as physiological loss in weight (PLW %), Spoilage (%), T.S.S. (ºBrix), titratable acidity, total sugars and ascorbic acid content were recorded during storage at three days intervals. For PLW (%), the weight of whole fruits in the treatment was recorded at three days intervals and the cumulative loss during storage was worked out in percentage. The fruit samples were observed at three days interval of storage period and the per cent spoilage was worked out under each treatment. TSS of fruits was recorded with the help of Erma hand refractometer. Total sugars (%), titratable acidity (%) and ascorbic acid (mg/100g of pulp) contents of fruits were estimated as per method described in A.O.A.C. (1980) [1].

Results and discussion

Data presented in Table-1, clearly revealed that different mineral nutrient treatments significantly reduced the physiological loss in weight under storage at 10±1 ºC up to twelve days during both years of investigation (2019 and 2020). The PLW was significantly minimum in the fruit treated with zinc sulphate at 0.4 per cent (1.87 and 1.91%, respectively) followed by boric acid at 0.6 per cent (both having 2.15%) during both years. The maximum PLW was recorded under control (3.82 and 3.86%, respectively). The pooled data for both years also revealed the minimum PLW with zinc sulphate 0.4 per cent treatment (1.89 %). These results are in agreement with the findings of Chaitanya *et al.*, (1997) [2] and Tripathi (2006) [9] in guava. It may be assumed that the higher rate of loss in weight in untreated fruits during storage might be due to higher energy required during storage where splitting of ATP occurs and the resulting evolution of ADP level accelerates respiration than the treated fruits.

There was no spoilage of fruits up to 6 days of storage in all treatments including control (Table-1). All the treatments showed lower percentage of spoilage as compared to control. The significantly, minimum per cent of spoilage during both years (1.63 and 1.67%, respectively) was recorded in the fruits sprayed with zinc sulphate at 0.4 per cent treatment after twelve days of storage at 10±1°C. The pooled data for both years also revealed the same pattern *i.e.*, 0.4 per cent of zinc sulphate treatment resulted in minimum spoilage (1.65%). The reduced percentage of spoilage in fruits with foliar application of 0.4 per cent zinc sulphate has also been reported by Tripathi (2006) [9] in guava. The maximum percentage of spoilage (3.86 and 3.90%, respectively) was recorded under control.

The maximum T.S.S. content of fruits after twelve days of storage was recorded in the fruits treated with zinc sulphate at 0.4 per cent (12.10 and 12.13º Brix, respectively) which was statistically at par with boric acid 0.6 per cent (11.94 and 11.98º Brix, respectively) treated fruits. These results are in conformity with the results of Rajput and Chand (1976) [6], Singh and Brahmachari (1999) [8] and Tripathi (2006) [9] in guava, who reported that pre-harvest spray of zinc sulphate treatments, increased the T.S.S content in guava. This increase in T.S.S. with zinc sulphate might be due to the fact that zinc is highly helpful in the process of photosynthesis, which leads to the accumulation of carbohydrate in the fruits. Besides this zinc also regulates the enzymatic activity and the enzyme metabolizes the carbohydrate into simple sugars.

The results of present investigations clearly showed (Table – 2) that at the end of storage, the fruits treated with 0.4 per cent zinc sulphate and 0.4 and 0.6 per cent boric acid significantly reduced the acidity per cent during both the years. The minimum acidity content (0.298 and 0.302%, respectively) was recorded in the fruits treated with 0.4 per cent zinc sulphate followed by 0.6 per cent of boric acid (0.315 and 0.319%, respectively) whereas, the maximum acidity (0.338 and 0.341%, respectively) was recorded in control. Rajput and Chand (1976) [6], Sharma *et al.* (1991) [7], Kundu and Mitra (1999) [4] and Tripathi (2006) [9] also recorded reduction in acidity during storage with the pre harvest applications of zinc sulphate in guava fruits.

The ascorbic acid content of guava fruits increased with the advancement of storage period under all treatments (Table-2). The significantly higher amount of ascorbic acid (216.08 and 216.12mg/100g of pulp, respectively) during both years of experimentation were recorded in the fruits treated with 0.4 per cent of zinc sulphate followed by 0.6 per cent boric acid treated fruits (201.01 and 207.05 mg/100g of pulp, respectively). However, the minimum contents were recorded under control (164.05 and 164.09mg/100g of pulp, respectively). The results of the present investigation are in accordance with the reports of Rajput and Chand (1976) [6], Singh and Brahmachari (1999) [8] and Tripathi (2006) [9] in guava. The increase in ascorbic acid content with zinc sulphate treatment might be due to the fact that zinc works as the stimulator of amino acids and appears to be helpful in the process of photosynthesis and in accumulation of carbohydrates. Zinc is also involved in the functioning of a number of enzymes *viz.*, catalase and polyphenoxidase, which ultimately promote the quality attributes.

The total sugar content of fruits continued to increase upto 12 days of storage and declined there after in all treatments during both years. The maximum total sugar content of fruits (8.75 and 8.79%, respectively) was observed under 0.4 per cent zinc sulphate treatment followed by 0.2 per cent zinc sulphate treatment (8.72 and 8.76%, respectively). These findings are in agreement with the reports of Rajput and Chand (1976) [6], Singh and Brahmachari (1999) [8], Tripathi (2006) [9] in guava and Chaturvedi *et al.*, (2005) [3] in strawberry. This increase in total sugar content with zinc sulphate treatment might be due to the fact that zinc is highly helpful in the process of photosynthesis, which leads to the accumulation of carbohydrates, which in ultimately converted into simple sugars due to metabolic process.

Table 1: Influence of different pre-harvest treatments on physiological loss in weight and spoilage (%) of guava fruit at 10 ±1ºC storage

Treatments	P.L.W (%)		Mean	Spoilage (%)		Mean
	2019	2020		2019	2020	
Calcium nitrate 0.5%	2.86	2.90	2.88	3.09	3.13	3.11
Calcium nitrate 1.0%	3.34	3.38	3.36	3.46	3.50	3.48
$ZnSO_4$ 0.2%	2.31	2.35	2.33	2.41	2.45	2.43
$ZnSO_4$ 0.4%	1.87	1.91	1.89	1.63	1.67	1.65
Boric acid 0.4%	2.55	2.59	2.57	2.68	2.72	2.70
Boric acid 0.6%	2.15	2.19	2.17	2.08	2.12	2.10
Control	3.82	3.86	3.84	3.86	3.90	3.88
CD at 5% level	0.06	0.07		0.04	0.05	

Table 2: Influence of different pre-harvest treatments on fruit quality characters of guava at 10 ±1ºC storage

Treatments	T.S.S. (ºBrix)		Mean	Titratable acidity (%)		Mean	Ascorbic acid (mg)		Mean	Total sugar (%)		mean
	2019	2020		2019	2020		2019	2020		2019	2020	
Calcium nitrate 0.5 %	11.22	11.46	11.34	0.340	0.344	0.342	181.90	181.94	181.92	8.09	8.13	8.11
Calcium nitrate 1.0 %	10.85	10.88	10.86	0.353	0.357	0.355	173.16	173.20	173.18	7.85	7.89	7.87
$ZnSO_4$ 0.2%	11.72	11.75	11.73	0.342	0.344	0.343	192.62	192.66	192.64	8.72	8.76	8.74
$ZnSO_4$ 0.4%	12.10	12.13	12.12	0.298	0.302	0.300	216.08	216.12	216.1	8.75	8.79	8.77
Boric acid 0.4%	11.22	11.25	11.23	0.333	0.337	0.335	190.63	190.67	190.65	8.28	8.32	8.30
Boric acid 0.6%	11.95	11.98	11.96	0.315	0.319	0.317	207.01	207.05	207.03	8.64	8.70	8.67
Control	10.63	10.66	10.65	0.338	0.341	0.339	164.05	164.09	164.07	7.79	7.83	7.81
CD at 5% level	0.80	0.81		0.003	0.004		0.83	0.84		0.04	0.05	

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