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Hemanshi P Purohit
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Dr. AM Butani
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Pradip Parmar
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Prof. RL Chitroda
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Kalapi D Dodiya
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Correspondence
Hemanshi P Purohit
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Response of pre harvest spray of calcium nitrate and gibberellic acid on physical parameters of guava CV. L-49

Hemanshi P Purohit, Dr. AM Butani, Pradip Parmar, Prof. RL Chitroda and Kalapi D Dodiya

Abstract
The objective of this study was to determine the effects of calcium nitrate, gibberellic acid and their interaction on physical parameters of guava cv. L-49. The selected trees were pre harvest sprayed with the different concentrations calcium nitrate and gibbrellic acid at the time of fruit set and 25, 15 days before harvesting during *kharif* season of the year 2018-19. Guava trees were sprayed with 0, 0.5, 1.0, and 1.5% of calcium nitrate and 0, 50, 100 and 150 ppm GA3. Generally higher concentration of calcium nitrate and medium concentration of gibberellic acid alone with T15 in combination of C3 + G2 were found superior over all the treatments.

Keywords: Guava, L-49, pre harvest spray, calcium nitrate and gibberellic acid

Introduction
Guava (*Psidium guajava* L.), the apple of tropics cultivated in many countries for their nutritive fruits. It is commercially cultivated in Uttar Pradesh, Madhya Pradesh, Bihar, Gujarat and Maharashtra. Guava can be grown in central and north Gujarat with higher profitability. Guava (*Psidium guajava* L.) is an important fruit of India, but its marketing potential suffers due to its limited shelf life. Thereby it becomes necessary to explore suitable methods to extend the shelf life of this popular fruit. The fruits of most of the cultivars can be stored only up to two days at room temperature (Chundawat *et al*., 1976) [8]. Large quantity of fruit is lost after harvest due to inherent bio-chemical changes. Calcium has been shown to affect a wide range of physiological processes in plants and fruits (Wyn Jones and Lunt, 1967) [26] and to inhibit specific aspects of abnormal senescence in numerous fruits (Shear, 1975) [20]. Calcium compounds extend the shelf-life of fruits by maintaining firmness, minimizing rate of respiration, protein breakdown, disintegration of tissues and disease incidence (Bangerth *et al*. 1972) [1] in apple. In recent years, Plant growth regulators have been used for improving the quality, delaying deterioration in storage and thereby increasing shelf life of various fruit crops including guava (Rai & Tiwari, 1987 and Singh, 1988) [19, 23]. Treated fruits gained more weight and volume also due to increase in cell volume and greater accumulation of water and foods materials as reported by Brahmachari and Rani (2000) [4] in Litchi fruits.

Materials and Methods
Experimental location
The present investigation was conducted at Khengar Vav Farm, Fruit Research Station, Department of Horticulture, Junagadh Agricultural University, Junagadh during kharif season of the year 2018-19.

Experimental material
In the present investigation, ten year old plants of guava cv.L-49, uniform in vigor and productivity, were selected as experimental material to find out the response of pre harvest application of calcium nitrate and gibberellic acid on fruiting and organoleptic characters of guava fruits.

Experimental details

Forty eight plants of guava cv. L-49 of uniform age and vigour were selected for the present studies in ten year old orchard tree spaced at 6 x 6 m. These plants were maintained under recommended schedule of fertilizer, irrigation and insect - pest control. The selected trees were pre harvest sprayed with the gibbrellic acid at the time of fruit set and 20, 10 days before harvesting with calcium nitrate of different concentrations. Total 16 Treatments of Factor A: Calcium nitrate (Ca (NO3)2) with different levels of C0: Calcium nitrate 0%, C1: Calcium nitrate 0.5%, C2: Calcium nitrate 1%, C3: Calcium nitrate 1.5% and Factor B: Gibberellic acid (GA3) with different levels of G0: Gibberellic acid 0 ppm, G1: Gibberellic acid 50 ppm, G2: Gibberellic acid 100 ppm, G3: Gibberellic acid 150 ppm. T1: C0G0, T2: C0G1, T3: C0G2, T4: C0G3, T5: C1G0, T6: C1G1, T7: C1G2, T8: C1G3, T9: C2G0, T10: C2G1, T11: C2G2, T12: C2G3, T13: C3G0, T14: C3G1, T15: C3G2 and T16: C3G3. Data is statically analyzed by factorial RBD with 3 replications.

Observations recorded

The length of six fruits per treatment was measured from stem end to calyx end and diameter from the centre of the fruits in centimeters at 0, 3, 6, 9 days interval with the help of vernier callipers. The volume of six fruit per treatment was taken at harvest and two-day interval up to 9 days from harvesting by the water displacement method. The weight of six fruit per treatment was taken at harvest and two-day interval up to 9 days from harvesting. Fruit weight was recorded in gram by using electrical weighing balance.

To assess the PLW, observations were recorded on 0, 3, 6 and 9 days during storage. The weight of six fruit per treatment was taken at harvest and two-day interval up to 9 days from harvesting. The loss in weight was calculated by following formula.

$$\text{PLW \%} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

The spoilage of fruit mainly due to over ripening and ultimately and it was judged on the basis of visual observation and expressed as percentage over total number of fruit.

$$\text{Spoilage (\%)} = \frac{\text{Number of rotted fruits}}{\text{Total number of fruits}} \times 100$$

For marketable fruits (%), the numbers of visually sound fruit that can be marketed were counted and express as percentage over the total number of fruits at a certain days of interval. The shelf life of fruit per treatment was recorded by keeping the fruits at room temperature i.e. ambient storage condition. Shelf life of fruit was considered as number of days from harvesting to marketable fruits or optimum eating (till the decaying of fruits started).

Results and Discussion

Significantly the maximum fruit length was recorded in calcium nitrate 1.5% (C3) (5.45, 5.43, 5.42 and 5.39 cm), gibberellic acid 100 ppm (G2) (5.61, 5.60, 5.58 and 5.55 cm) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (5.98, 5.96, 5.95 and 5.91 cm) on 0, 3rd, 6th and 9th days storage, respectively. Significantly the maximum fruit diameter was recorded in calcium nitrate 1.5% (C3) (5.64, 5.61, 5.59 and 5.54 cm), gibberellic acid 100 ppm (G2) (5.71, 5.68, 5.64 and 5.63 cm) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (5.98, 5.94, 5.91 and 5.87 cm) on 0, 3rd, 6th and 9th days storage, respectively. The mineral nutrients appear to have indirect role in hastening the process of cell division and cell elongation due to which the size of fruit might have improved. The research result was supported by Chandra *et al*. (1994) [5] in guava.

Table 1: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on fruit length of guava cv. L-49

Treatment	Fruit length (cm)			
	0 day	3rd day	6th day	9th day
Calcium nitrate				
C0	5.09	5.08	5.05	5.03
C1	5.19	5.17	5.16	5.13
C2	5.29	5.28	5.25	5.24
C3	5.45	5.43	5.42	5.39
S.Em.±	0.09	0.09	0.09	0.08
C.D. at 5%	0.25	0.25	0.25	0.24
Gibberellic acid				
G0	5.00	4.99	4.96	4.95
G1	5.26	5.24	5.21	5.19
G2	5.61	5.60	5.58	5.55
G3	5.15	5.13	5.12	5.10
S.Em.±	0.09	0.09	0.09	0.08
C.D. at 5%	0.25	0.25	0.25	0.24
Interaction				
T1 : C0G0	4.22	4.21	4.18	4.16
T2 : C0G1	5.42	5.41	5.38	5.36
T3 : C0G2	5.22	5.21	5.19	5.17
T4 : C0G3	5.50	5.49	5.46	5.44
T5 : C1G0	5.20	5.19	5.17	5.15
T6 : C1G1	5.40	5.38	5.36	5.35
T7 : C1G2	5.55	5.53	5.51	5.48
T8 : C1G3	4.60	4.58	4.57	4.55
T9 : C2G0	5.19	5.18	5.15	5.15
T10 : C2G1	5.03	5.02	4.98	4.97
T11 : C2G2	5.70	5.68	5.65	5.63
T12 : C2G3	5.25	5.24	5.21	5.19
T13 : C3G0	5.39	5.37	5.35	5.33
T14 : C3G1	5.18	5.17	5.14	5.10
T15 : C3G2	5.98	5.96	5.95	5.91
T16 : C3G3	5.24	5.23	5.22	5.20
S.Em.±	0.17	0.17	0.17	0.16
C.D. at 5%	0.50	0.50	0.50	0.47
C.V.%	5.75	5.77	5.69	5.46

The exogenous application of GA3 might have increased the indigenous level of growth promoting substances, which is turn stimulated cell division and elongation and consequently, rate of growth and development of fruit was enhanced.

Table 2: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on fruit diamater of guava cv. L-49

Treatment	Fruit diameter (cm)			
	0 day	3rd day	6th day	9th day
Calcium nitrate				
C0	5.19	5.15	5.13	5.12
C1	5.39	5.37	5.31	5.28
C2	5.56	5.53	5.50	5.48
C3	5.64	5.61	5.59	5.54
S.Em.±	0.09	0.08	0.10	0.09
C.D. at 5%	0.25	0.23	0.27	0.25
Gibberellic acid				
G0	5.26	5.24	5.18	5.15
G1	5.36	5.31	5.30	5.28
G2	5.71	5.68	5.64	5.63
G3	5.45	5.40	5.38	5.33
S.Em.±	0.09	0.08	0.10	0.09
C.D. at 5%	0.25	0.23	0.27	0.25
Interaction				
T1 : C0G0	4.37	4.34	4.33	4.32
T2 : C0G1	5.18	5.12	5.11	5.10
T3 : C0G2	5.58	5.54	5.50	5.49
T4 : C0G3	5.65	5.59	5.58	5.56
T5 : C1G0	5.68	5.66	5.49	5.45
T6 : C1G1	5.37	5.34	5.33	5.31
T7 : C1G2	5.43	5.43	5.39	5.38
T8 : C1G3	5.06	5.02	5.01	4.96
T9 : C2G0	5.69	5.68	5.65	5.63
T10 : C2G1	5.40	5.36	5.35	5.33
T11 : C2G2	5.84	5.83	5.77	5.77
T12 : C2G3	5.29	5.23	5.21	5.16
T13 : C3G0	5.30	5.29	5.27	5.22
T14 : C3G1	5.47	5.44	5.42	5.40
T15 : C3G2	5.98	5.94	5.91	5.87
T16 : C3G3	5.81	5.75	5.74	5.65
S.Em.±	0.17	0.16	0.19	0.17
C.D. at 5%	0.50	0.47	0.55	0.50
C.V.%	5.52	5.16	6.13	5.64

Table 3: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on fruit volume of guava cv. L-49

Treatment	Fruit volume (cm3)			
	0 day	3rd day	6th day	9th day
Calcium nitrate				
C0	92.50	91.17	89.33	86.83
C1	98.75	96.17	95.00	91.83
C2	106.00	103.25	100.08	98.33
C3	121.75	119.17	115.17	114.00
S.Em.±	1.80	1.82	1.77	1.85
C.D. at 5%	5.19	5.26	5.10	5.34
Gibberellic acid				
G0	95.42	93.92	89.92	88.33
G1	104.58	102.67	99.58	98.25
G2	114.50	110.83	109.92	106.92
G3	104.50	102.33	100.17	97.50
S.Em.±	1.80	1.82	1.77	1.85
C.D. at 5%	5.19	5.26	5.10	5.34
Interaction				
T1 : C0G0	87.33	87.00	84.67	82.00
T2 : C0G1	93.00	91.33	89.33	86.67
T3 : C0G2	94.33	92.67	90.33	88.67
T4 : C0G3	95.33	93.67	93.00	90.00
T5 : C1G0	94.00	92.00	89.33	87.33
T6 : C1G1	99.00	97.33	96.33	93.00
T7 : C1G2	98.00	93.67	95.00	91.33
T8 : C1G3	104.00	101.67	99.33	95.67
T9 : C2G0	96.67	94.67	90.00	89.00
T10 : C2G1	104.33	102.33	98.67	97.33
T11 : C2G2	125.67	121.00	119.00	115.67
T12 : C2G3	97.33	95.00	92.67	91.33
T13 : C3G0	103.67	102.00	95.67	95.00
T14 : C3G1	122.00	119.67	114.00	116.00
T15 : C3G2	140.00	136.00	135.33	132.00
T16 : C3G3	121.33	119.00	115.67	113.00
S.Em.±	3.59	3.64	3.53	3.70
C.D. at 5%	10.38	10.52	10.20	10.69
C.V.%	5.94	6.16	6.12	6.56

The present results are in corroboration with observation made by Maurya *et al.* (1973) [16] in mango. The fruit size (length and diameter) decreased with the increase in storage period as given in table (1 & 2). The decrease in fruit size during storage period may be due to shrinking of fruits caused by transpiration and application of chemicals. The research result was supported by Singh and Chouhan (1982) [21], Chandra *et al.* (1994) [5], Chandra (2004) [6], Katiyar *et al.* (2008) [13] and Goswami *et al.* (2012) [9] in guava.

Significantly the maximum fruit volume was recorded in calcium nitrate 1.5% (C3) (121.75, 119.17, 115.17 and 114 cm3), gibberellic acid 100 ppm (G2) (114.50, 110.83, 109.92 and 106.92 cm3) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (140.00, 136.00, 135.33 and 132.00 cm3) on 0, 3rd, 6th and 9th days storage, respectively.

Table 4: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on fruit weight of guava cv. L-49

Treatment	Fruit weight (g)			
	0 day	3rd day	6th day	9th day
Calcium nitrate				
C0	115.98	105.65	100.47	97.39
C1	130.83	120.17	114.26	111.28
C2	142.78	134.17	130.13	124.91
C3	157.30	149.52	145.92	138.94
S.Em.±	2.10	1.98	2.02	1.95
C.D. at 5%	6.07	5.71	5.82	5.65
Gibberellic acid				
G0	115.81	106.33	102.02	98.04
G1	128.82	119.87	115.10	110.40
G2	163.10	153.91	149.10	143.31
G3	139.18	129.40	124.56	120.77
S.Em.±	2.10	1.98	2.02	1.95
C.D. at 5%	6.07	5.71	5.82	5.65
Interaction				
T1 : C0G0	108.83	97.60	92.71	89.47
T2 : C0G1	113.37	102.06	97.00	94.13
T3 : C0G2	128.70	120.51	114.79	111.57
T4 : C0G3	113.03	102.42	97.36	94.37
T5 : C1G0	115.53	105.44	100.24	97.45
T6 : C1G1	123.17	114.10	108.50	105.73
T7 : C1G2	166.50	152.33	144.76	140.87
T8 : C1G3	118.13	108.81	103.52	101.09
T9 : C2G0	113.40	104.36	99.10	96.51
T10 : C2G1	127.97	119.40	113.66	110.83
T11 : C2G2	175.03	167.71	164.83	155.86
T12 : C2G3	154.73	145.19	142.92	136.46
T13 : C3G0	125.47	117.92	116.01	108.74
T14 : C3G1	150.77	143.91	141.22	130.93
T15 : C3G2	182.17	175.08	172.01	164.93
T16 : C3G3	170.80	161.17	154.45	151.14
S.Em.±	4.20	3.95	4.03	3.91
C.D. at 5%	12.13	11.42	11.65	11.29
C.V.%	5.32	5.37	5.69	5.73

Calcium decreases the loss of weight by maintenance of the fruit firmness, retardation of respiratory rate and delayed senescence (Yadav *et al*. 2009) [27]. The increase in fruit volume due to accelerated rate of cell division and cell enlargement and more intercellular space with the application of higher concentration of growth substances. Such findings are conformity with effect of GA3 in guava (Singh *et al*., 1984) [22].

Significantly the maximum fruit weight was obtained with calcium nitrate 1.5% (C3) (157.30, 149.52, 145.92 and 138.94 g), gibberellic acid 100 ppm (G2) (163.10, 153.91, 149.10 and 143.31 g) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (182.17, 175.08, 172.01 and 164.93 g) on 0, 3rd, 6th and 9th days storage, respectively. Calcium increase weight might be due to faster mobilization of metabolites in the fruits and

involvement in cell division and cell expansion as well as increase in the volume of intercellular space in mesocarpic cells. The above finding is in accordance with the results of Parkhe *et al*. (2015) [17] in guava. Gibberellic acid promotes the cell elongation and cell enlargement of fruit. Similar result was also reported by Jagtap *et al*. (2013) [10] in kagzi lime and Lal *et al*. (2013) [15] in guava.

The interaction was found significant due to minimum loss of moisture in fruit and maintenance of firmness of fruit by calcium which decreased the enzyme activity responsible for disintegration of cellular structure and decreased the gaseous exchange and the increased fruit weight following GA3 application might be due to greater size of fruit and certain changes in metabolism of fruit which reflected in more accumulation of water and enhanced deposition of soluble solids. The present investigation is in conformity with results reported by Jayachandran *et al*. (2005a) [11] and Biswas *et al*. (1988) [3] in guava.

The lowest PLW was found in calcium nitrate 1.5% (C3) (5.03, 7.26 and 11.88%), gibberellic acid 100 ppm (G2) (5.74, 8.83 and 12.28%) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (3.89, 5.57 and 9.91%) on 3rd, 6th and 9th days storage, respectively. Some chemical changes within the fruits, resulting in retention of more water against the rate of evaporation. This may be due to the role of calcium on limiting respiration which was attributed to altered membrane permeability were reported by (Bangerth, 1979) [2]. The reduction in weight loss by GA3 possibly due to reduced loss in moisture through transpiration, it may also be also be due to lower respiration rate and metabolic process. Similar results have also been reported by Kumar *et al*. (2005) [14] in aonla and Sudhavani and Ravishankar (2002) [24] in mango.

The lowest spoilage was noted with calcium nitrate 1.5% (C3) (10.00, 32.22 and 51.67%), gibberellic acid 100 ppm (G2) (15.00, 38.33 and 55.00%) and under the treatment calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (6.67, 28.89 and 44.45%) on 3rd, 6th and 9th days storage, respectively. The effect of calcium might be due to higher firmness of fruit which might have delayed the pathogen and other microorganism infection for longer period. These results are in accordance with the findings of Yadav *et al*. (2009) [27] in ber.

Table 5: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on physiological loss in weight of guava cv. L-49

Treatment	Physiological loss in weight (PLW) %		
	3rd day	6th day	9th day
Calcium nitrate			
C0	9.02	13.49	16.04
C1	8.12	12.66	15.14
C2	6.25	9.31	12.77
C3	5.03	7.26	11.88
S.Em.±	0.14	0.25	0.27
C.D. at 5%	0.41	0.73	0.78
Gibberellic acid			
G0	8.26	12.05	15.33
G1	7.14	10.96	14.43
G2	5.74	8.83	12.28
G3	7.28	10.88	13.79
S.Em.±	0.14	0.25	0.27
C.D. at 5%	0.41	0.73	0.78
Interaction			
T1 : C0G0	10.32	14.82	17.43
T2 : C0G1	9.97	14.45	17.02
T3 : C0G2	6.37	10.81	13.31
T4 : C0G3	9.40	13.86	16.39
T5 : C1G0	8.75	13.24	15.75
T6 : C1G1	7.36	11.90	14.37
T7 : C1G2	8.50	13.08	15.51
T8 : C1G3	7.89	12.43	14.94
T9 : C2G0	7.98	12.60	15.07
T10 : C2G1	6.68	11.17	13.59
T11 : C2G2	4.18	5.87	10.38
T12 : C2G3	6.16	7.63	12.04
T13 : C3G0	6.00	7.53	13.07
T14 : C3G1	4.56	6.32	12.74
T15 : C3G2	3.89	5.57	9.91
T16 : C3G3	5.66	9.62	11.80
S.Em.±	0.28	0.51	0.54
C.D. at 5%	0.82	1.47	1.57
C.V.%	6.93	8.23	6.74

Table 6: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on spoilage of guava cv. L-49

Treatment	Spoilage (%)		
	3rd day	6th day	9th day
Calcium nitrate			
C0	33.89	54.44	72.22
C1	26.67	50.00	67.78
C2	17.22	40.00	58.89
C3	10.00	32.22	51.67
S.Em.±	0.55	1.14	1.02
C.D. at 5%	1.59	3.29	2.95
Gibberellic acid			
G0	28.89	50.00	70.00
G1	24.44	45.56	65.00
G2	15.00	38.33	55.00
G3	19.44	42.78	60.56
S.Em.±	0.55	1.14	1.02
C.D. at 5%	1.59	3.29	2.95
Interaction			
T1 : C0G0	40.00	62.22	84.44
T2 : C0G1	40.00	60.00	75.55
T3 : C0G2	24.45	42.22	60.00
T4 : C0G3	31.11	53.33	68.89
T5 : C1G0	35.55	55.55	73.33
T6 : C1G1	28.89	55.56	71.11
T7 : C1G2	20.00	44.44	66.67
T8 : C1G3	22.22	44.45	60.00
T9 : C2G0	26.67	51.11	68.89
T10 : C2G1	17.78	31.11	55.55
T11 : C2G2	8.89	37.78	48.89
T12 : C2G3	15.55	40.00	62.22
T13 : C3G0	13.33	31.11	53.33
T14 : C3G1	11.11	35.55	57.78
T15 : C3G2	6.67	28.89	44.45
T16 : C3G3	8.89	33.33	51.11
S.Em.±	1.10	2.28	2.04
C.D. at 5%	3.19	6.58	5.90
C.V.%	8.71	8.93	5.65

Giberellic acid retarded ripening and reduced weight loss through controlled transpiration and respiration rates and delayed the disintegration of ripening. Similar results have also been reported by Patel *et al*. (2011) [18] in custard apple and Sudhavani and Ravishankar (2002) [24] in mango.

Table 7: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on marketable fruits of guava cv. L-49

Treatment		Marketable fruits (%)	
	3rd day	6th day	9th day
Calcium nitrate			
C0	66.11	45.56	27.78
C1	73.33	49.83	32.22
C2	82.78	59.97	41.11
C3	90.00	67.78	48.33
S.Em.±	0.55	1.14	1.02
C.D. at 5%	1.59	3.29	2.95
Gibberellic acid			
G0	71.11	50.00	30.00
G1	75.56	54.45	35.00
G2	85.00	61.64	45.00
G3	80.56	57.06	39.44
S.Em.±	0.55	1.14	1.02
C.D. at 5%	1.59	3.29	2.95
Interaction			
T1 : C0G0	60.00	37.78	15.56
T2 : C0G1	60.00	40.00	24.45
T3 : C0G2	75.55	57.78	40.00
T4 : C0G3	68.89	46.67	31.11
T5 : C1G0	64.45	44.45	26.67
T6 : C1G1	71.11	44.44	28.89
T7 : C1G2	80.00	55.56	33.33
T8 : C1G3	77.78	54.89	40.00
T9 : C2G0	73.33	48.89	31.11
T10 : C2G1	82.22	68.89	44.45
T11 : C2G2	91.11	62.11	51.11
T12 : C2G3	84.45	60.00	37.78
T13 : C3G0	86.67	68.89	46.67
T14 : C3G1	88.89	64.45	42.22
T15 : C3G2	93.33	71.11	55.55
T16 : C3G3	91.11	66.67	48.89
S.Em.±	1.10	2.28	2.04
C.D. at 5%	3.19	6.58	5.90
C.V.%	2.45	7.07	9.47

Significantly the maximum marketable fruits was obtained with calcium nitrate 1.5% (C3) (90.00, 67.78 and 48.33%), gibberellic acid 100 ppm (G2) (85.00, 61.64 and 45.00%) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) (93.33, 71.11 and 55.55%) on 3rd, 6th and 9th days storage, respectively.

Table 8: Effect of pre harvest spray of calcium nitrate, gibberellic acid and their interaction on shelf life of guava cv. L-49

Treatment	Shelf life (Days)
Calcium nitrate	
C0	6.25
C1	7.33
C2	8.58
C3	9.50
S.Em.±	0.14
C.D. at 5%	0.42
Gibberellic acid	
G0	6.83
G1	7.42
G2	9.08
G3	8.33
S.Em.±	0.14
C.D. at 5%	0.42
Interaction	
T1 : C0G0	4.33
T2 : C0G1	5.33
T3 : C0G2	8.33
T4 : C0G3	7.00
T5 : C1G0	6.33
T6 : C1G1	6.67
T7 : C1G2	7.67
T8 : C1G3	8.67
T9 : C2G0	7.33
T10 : C2G1	9.00
T11 : C2G2	10.00
T12 : C2G3	8.00
T13 : C3G0	9.33
T14 : C3G1	8.67
T15 : C3G2	10.33
T16 : C3G3	9.67
S.Em.±	0.29
C.D. at 5%	0.83
C.V.%	6.30

In general marketable fruits percentage decreased with the advancement of storage period. It might be due to calcium decrease the spoiling of fruit by reduction in process of respiration whereas, the calcium plays number of roles such as an increase the fruit firmness which leads benefits like slower ripening and increased the shelf life in mango (Karemera and Habimana 2014) [12]. Gibberellins decrease in production of ethylene which is responsible for the fast ripening of fruits improved fruit colour development and appearance in strawberry (Cheour *et al*., 1990) [7].

Significantly the maximum shelf life was obtained with the calcium nitrate 1.5% (C3) (9.50 days), gibberellic acid 100 ppm (G2) (9.08 days) and under calcium nitrate 1.5% + gibberellic acid 100 ppm (C3G2) 10.33 days. Calcium compounds extend the shelf-life of fruits by maintaining firmness, minimizing rate of respiration, protein breakdown, disintegration of tissues and disease incidence (Bangerth *et al*., 1972) [1]. Tirmazi and Wills (1981) [25] have also observed longer shelf-life in mangoes from the post-harvest application of growth regulators.

Conclusion

From the forgoing discussion, it can be concluded that pre harvest spraying of calcium nitrate and gibberellic acid, significantly influenced the physical parameters of guava cv. L- 49 under storage condition. Individual pre harvest spray of calcium nitrate i.e. C3 (Calcium nitrate 1.5%) and gibberellic acid i.e. G2 (Gibberellic acid 100 ppm) was found effective with respect to physical parameters. Regarding interaction, treatment C3G2 (Calcium nitrate 1.5% + gibberellic acid 100 ppm) was remained better for all parameters.

Hence, three spray of combined pre harvest application of calcium nitrate 1.5% + gibberellic acid 100 ppm, first at fruit set stage, second at 25 days before harvesting and third at 15 days before harvesting for obtaining better yield, quality and storage behavior of guava.

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