International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 297-301

Received: 19-07-2018
Accepted: 23-08-2018

Influence of pre-harvest sprays on physical and physiological parameters of custard apple cv. Balanagar

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Abstract
An experiment was conducted to study the influence of pre-harvest sprays on physical and physiological parameters of custard apple cv. Balanagar was carried out at KRC College of Horticulture, Arabhavi (UHS, Bagalkot) during 2016 and 2017. The treatments comprising of pre-harvest sprays *viz*., $CaCl_2$, borax, salicylic acid and potassium silicate were applied to the trees at one month before harvesting during both the years. Among the treatments, pre-harvest spray of 0.60 per cent potassium silicate and 2.0 per cent calcium chloride were found to be maximum fruit weight, length, breadth, volume, specific gravity, ripe fruit weight, pulp weight, pulp recovery, shelf life and minimum peel weight, seed weight, PLW and respiration rate when compared other treatments.

Keywords: custard apple, pre-harvest, PLW, physical and physiological

Introduction
The custard apple (*Annona squamosa* L.) is a small group of edible fruits. It is native to tropical America. Custard apple is mostly used as a desert fruit for its delicious taste and nutritive value. Due to its climacteric nature, it ripens fast and with the slightest pressure on the fruit easily get disintegrates into segments. Hence, the post-harvest loss is a great burning issue in exploiting full potential of the crop in increasing the production and farm income. Therefore, to enhance the post-harvest shelf life of the fruit is the most important factor for getting remunerative profit during off season. Thus, the present study was conducted to study the "influence of pre-harvest sprays on physical and physiological parameters of custard apple cv. Balanagar under ambient condition".

Materials and Methods
Field experiment was carried out in Horticultural Research Station, Tidagundi (Vijayapur) for two consecutive years during 2016 and 2017 to study the effect of different pre-harvest sprays on physical and physiological parameters of custard apple. The fruits from this experiment were harvested and brought to the laboratory of Department of Post-harvest technology, KRC College of Horticulture, Arabhavi, Gokak taluk, Belgaum district for further studies. The experiment was laid out in Completely Randomized Design (CRD) with three replications (5 tree/replication) and nine treatments. Selected trees were sprayed with different chemicals *viz*., $CaCl_2$ at 1 and 2 per cent, Borax at 0.2 and 0.3 per cent, Salicylic acid at 0.40 and 0.60 per cent and potassium silicate at 0.40 and 0.60 per cent. The pre-harvest sprays were applied to the trees at one month before harvesting during both the years (2016 and 2017). All the cultural operations like weeding, inter-culturing and irrigation were adapted uniformly to all experimental plants. Observations of physical parameters were recorded at initial stage and physiological parameter were recorded at 0, 2, 4 and 6 days of storage. The parameters were recorded *viz.* Fruit weight (g), length (mm), breadth (mm), ripe fruit weight (g), pulp weight (g), peel weight (g) and seed weight (g), pulp recovery (%) by using digital balance and digital vernier callipers. The physiological loss in weight (PLW) was determined by, five custard apple fruits from each replication were weighed at beginning of storage which was recorded as initial weight. On subsequent dates of observation, the fruits were weighted and recorded as

as final weight on two days interval was calculated and the PLW was expressed in per cent on fresh weight basis using below formula.

$$\text{Physiological loss in weight (\%)} = \frac{[P_0 - P_1 \text{ or } P_2 \text{ or } P_3 \text{ or } P_4 \text{ or } P_5]}{P_0} \times 100$$

Where,
P_0 – Initial weight
P_1 – Weight after 2 days
P_2 – Weight after 4 days
P_3 – Weight after 6 days

The rate of respiration was measured by static method using gas analyzer (PBI, DANSENSOR, and CHECKMATE 2). Known quantity of fruits was sealed hermetically in a 650 ml plastic container having a provision for hole and closed with septum for 30 min at ambient temperature. The syringe was inserted into the head space of the container to estimate the CO_2 released by the fruits. The change in the concentration of CO_2 was recorded as per cent (Plate 14e). The rate of respiration was calculated using the below formula

$$\text{Respiration rate (ml } Co_2\text{/kg/h)} = \frac{CO_2 \text{ concentration x Volume of the container}}{100 \text{ x weight of the fruit (Kg) x Time (h)}}$$

Result and Discussion

In 2016, 2017 and pooled data, the maximum fruit weight (159.33, 231.87 and 195.60 g) was recorded in the foliar spray of 0.60 per cent potassium silicate (T_9) whereas, the minimum fruit weight (127.00, 127.00 and 149.93 g) was recorded in control (Table 1), respectively. This may be due to application of silicon which helps to stimulate plants nutrients uptake and more photosynthesis (Smith, 2011) [25]. The increase in fruit weight was mainly due to cell division in the initial stages and later due to cell expansion associated with movement of water and other metabolites into the cell leading to increase in overall weight of the fruit (Young *et al.*, 1996) [28]. Similar findings have been reported by Mustaffa *et al.* (2004) [17] in banana, Bhavya (2010) [4] in grapes and Ravishankar (2016) [21] in banana.

There was a significant difference among the various treatments with regards to length, breadth, volume and specific gravity of fruits as presented in Table 1. In 2016 and 2017, the maximum fruit length (65.67 and 73.23 mm) was found in T_9 and which was on par with (T_3) foliar spray of 2.0 per cent calcium chloride (63.00 and 72.43 mm), respectively. The minimum fruit length (57.85 and 58.94 mm) was recorded in T_1 (control) during 2016 and 2017, respectively. The pooled data showed significantly maximum fruit length (69.45 mm) in T_9 (0.60 % potassium silicate) which was on par with T_3 (67.71 mm) whereas, minimum (58.39 mm) was found in control (T_1).

During 2016 and 2017, maximum fruit breadth (72.83 and 80.19 mm) was recorded in T_9 which was on par with T_3 (71.86 and 78.52 mm) and T_8 (70.18 and 78.19 mm) whereas, significantly minimum fruit breadth (66.83 and 69.11 mm) was found in control (T_1), respectively. In pooled data, significantly maximum and minimum (76.51 and 67.97 mm) fruit breadth was found in T_9 and T_1, respectively (Table 1).

In 2016, 2017 and pooled, the maximum volume of the fruit (141.68, 208.00 and 174.84 ml) was observed in T_9 whereas, significantly minimum (119.33, 164.00 and 141.67ml) was recorded in control (T_1). In pooled data, significantly maximum specific gravity (1.12 g/cc each) was found in T_9 and T_3 whereas, the minimum (1.06 g/cc) was recorded in control (Table 1). The higher length, breadth, volume and specific gravity of fruit may be due to the increase in cell division in the initial stages and later due to cell expansion associated with movement of water and other metabolites into the cell causing increase in overall weight of the fruit (Young *et al.*, 1996) [28]. Similar findings were observed in grapes by Bhavya (2010) [4] who reported that, this might be due to beneficial effect of silicon which led to cell expansion.

Custard apple exhibited significant differences with respect to pulp recovery, ripe fruit, pulp, peel and seed weight during both the years of experimentation (Table 2). In 2016, 2017 and pooled, significantly maximum ripe fruit weight (130.00, 185.53 and 157.77 g) was noticed in T_9 (Foliar spray of 0.60 % potassium silicate). On the other hand, minimum fruit weight (101.00, 144.20 and 122.60 g) at ripe stage was observed in T_1 (control) during 2016, 2017 and pooled data, respectively.

Significantly, higher pulp weight (66.49, 109.82 and 88.15 g) was recorded in T_9 whereas, the fruit pulp weight was significantly lower in T_1 (28.00, 55.53 and 41.77 g). The minimum peel weight (49.01, 59.80 and 54.41g) was noticed in T_9 whereas, maximum (56.00, 70.00 and 63.00 g) was reported in T_1 during 2016, 2017 and pooled data, respectively. During 2016, 2017 and pooled data, minimum seed weight of 14.50, 15.92 and 15.21 g was noticed in T_9 whereas, the maximum seed weight (17.00, 18.67 and 17.83 g) was seen in T_1 (Control), respectively

The maximum pulp recovery (51.10, 59.18 and 55.14 %) was associated with the treatments T_9 whereas, minimum pulp recovery (27.61, 38.42 and 33.01 %) was noted in T_1 (control) during 2016, 2017 and pooled data, respectively (Table 3). The increase in pulp recovery may be due to beneficial role of silicon leading to production of higher quantities of photosynthates and their translocation to the growing fruits (Roshdy, 2014) [22]. These results are also in accordance with findings of Kaluwa *et al.* (2010) [9] in Avocado and Ravishankar (2016) [21] in banana.

Custard apple exhibited significant differences with respect to firmness during both the years of experimentation (Table 3). In 2016, 2017 and pooled data, significantly maximum firmness over all the treatments was noticed in T_3 (616.67, 553.40 and 585.03 g) which is on par with T_2 (598.00, 546.00 and 572.00 g) while, minimum firmness (191.70, 173.33 and 182.52 g) was observed in T_1 (control), respectively. Higher fruit firmness may be due to the calcium binding to free carboxyl groups of polygalacturonate polymer, stabilizing and strengthening the cell walls (Conway and Sams, 1983) [6]. The effect of calcium in tissue firmness was generally explained by complex cell wall and middle lamella of polygalacturonic acid residues imparting improvement in structural integrity (Morris, 1980) [16]. The de-esterified pectin chains may cross link with either endogenous calcium or added (exogenous) calcium to form a tightened and firmer structure (Grant *et al.*, 1973) [7]. However, calcium ions may also impact tissue firmness by contributing to increase membrane integrity and the consequent maintenance of cell turgor pressure (Mignani *et al.*, 2003) [14]. Picchioni *et al.* (1998) [19, 20] found that $CaC1_2$ (2%) kept the Golden Delicious apple firm during six months of storage as compared to untreated fruit. Similar findings reported by Jaishankar (2015) [8] in sapota and Manasa (2015) in mango.

The data revealed that there was a significant difference among treatments over storage period with respect to PLW of custard apple (Table 4). After 2 DAS, the significantly minimum PLW was recorded in T_9 (2.07, 1.99 and 2.03 %) which was on par with T_8 (2.18, 2.14 and 2.16 %) whereas, significantly maximum PLW was noticed in the treatment control (4.51, 4.34 and 4.42 %) during 2016, 2017 and pooled data, respectively. During 2016, 2017 and pooled data, T_9 (4.45, 5.44 and 4.94 %) with minimum PLW was at parity with T_8 (5.02, 5.76 and 5.39 %) whereas, maximum was associated with control (9.11, 10.15 and 9.63 %), respectively at 4 DAS. After 6 days of storage, all treatments were spoiled except T_2 (foliar spray of 1 % $CaCl_2$), T_3 (foliar spray of 2.0 % $CaCl_2$), T_8 (foliar spray of 0.40 % potassium silicate) and T_9 (foliar spray of 0.60 % potassium silicate). Hence, statistically not analysed because less degrees of freedom at 6 DAS. Among these four treatments, minimum PLW was recorded in T_9 (9.38, 10.69 and 10.03 %) followed by T_3 (9.82, 11.10 and 10.46 %) and maximum was noticed in the T_2 (10.48, 12.16 and 11.32 %) during 2016, 2017 and pooled analysis, respectively.

In general, the respiration rate of custard apple fruits increased gradually reaching a peak and then declined later in all the treatments (Table 4). At initial stage, respiration rate was recorded 101.20 (2016) and 91.41 ml CO_2/kg/h (2017). After 2 DAS, significantly minimum respiration rate was recorded in T_9 (123.30 and 112.34 ml CO_2/kg/h) which was statistically equal to T_3 (145.99 and 129.99 ml CO_2/kg/h) whereas, the maximum respiration rate was noticed in the treatment T_1 (234.23 and 227.20 ml CO_2/kg/h) during 2016 and 2017, respectively. In the pooled analysis, significantly lowest respiration rate was found in T_9 (117.82 ml CO_2/kg/h) and highest was recorded in T_1 (230.71 ml CO_2/kg/h). After 4 DAS, the minimum respiration rate was significantly recorded in T_9 (176.18, 156.00 and 166.09 ml CO_2/kg/h) which was statistically closely associated with T_3 (178.85, 163.60 and 171.23 ml CO_2/kg/h) while, significantly maximum respiration rate was noticed in the treatment T_1 (265.72, 254.10 and 259.91 ml CO_2/kg/h) during 2016, 2017 and pooled data, respectively. After six days of storage, minimum respiration rate was recorded in T_9 (251.20 and 245.11 ml CO_2/kg/h) followed by T_3 (251.98 and 242.61 ml CO_2/kg/h) and maximum was found in T_2 (262.26 and 247.52 ml CO_2/kg/h) during 2016 and 2017 at 6 DAS, respectively. In the pooled data, least respiration rate was found in T_3 (247.29 ml CO_2/kg/h) and T_9 (248.15 ml CO_2/kg/h) whereas, maximum was noticed in T_2 (254.89 ml CO_2/kg/h).

Maximum rate of respiration (respiration peak) was seen at ripe stage of fruits in almost all the treatments (at 4 DAS) indicating the vigorous process of ripening (Table 4) and it declined subsequently as the senescence approached in both the years of experiment. The minimum PLW and respiration rate was noticed in the treatments T_9 (foliar spray of potassium silicate @ 0.60 %) and T_3 (foliar spray of calcium chloride @ 2.0 %) when compared to all other treatments. These two treatments had no much significant differences between them throughout the course of study. The minimum respiration rate in potassium silicate sprayed fruits was mainly due to its antisenescence properties and inhibition of ethylene biosynthesis (Babak and Majid, 2011) or reduced rate of metabolism. The results are in conformity with report of Kaluwa *et al*. (2010) [9] and Stamatakis *et al*., (2003) in tomato; Barbang *et al*. (2002) and Ravishankar (2016) [21] in banana.

The lower physiological loss in weight and respiration rate in calcium sprayed (2.0 %) custard apple was attributed to membrane functionality and integrity maintenance with lower losses of phospholipids, proteins and reduced ion leakage which could be responsible for lower weight loss. Similar results were also observed in muskmelons (Lester and Grusak, 1999). Calcium maintains the cell wall structure in fruits by interacting with the pectic acid in the cell wall to form calcium pectate. Ca^{2+} forms cross-links between pairs of negatively charged homogalacturonans, thus tightened the cell wall (Picchioni *et al.*, 1998) [19, 20]. Calcium helps to bind polygalactonic acid each other and make the membrane strong and rigid. The similar results were reported by Benavides *et al.* (2002) [3], Vali *et al.*, (2011) [27] and Casero *et al.* (2004) [5] in apple; Mahmad *et al.* (2008) [12] in papaya; Monica *et al.* (2013) [15] in litchi; Jaishankar (2015) [8] in sapota; Manasa (2015) [13] in mango.

In general, shelf life of custard apple fruits differed significantly during both the seasons and even after pooling the two years data (Table 3). The treatments T_9, T_8, T_3 and T_2 recorded significantly the highest shelf life in 2016 (6 days each) and 2017 (6.67, 6.00, 6.33 and 6.00 days) as well as in pooled analysis (6.33, 6.00, 6.17 and 6.00 days) when compared to all other treatments, respectively. The shortest shelf life was in the control (T_1) fruits (4 days each) for 2016, 2017 and pooled data, respectively. Custard apple plant sprayed with 0.60 per cent potassium silicate recorded 6.33 days shelf life followed by 2 per cent calcium chloride (6.17 days) before 30 days of harvesting enhance the shelf life with better physical and physiological parameters during ambient storage. The results are in conformity with report of Shi *et al*. (2012) [24] in Longan fruit and Ravishankar (2016) [21] in banana with respect to shelf life enhanced by potassium silicate. The effect of calcium chloride on shelf life was confirmed by report of Nagaraja *et al*. (2011) [18] in custard apple; Lal *et al*. (2011) [10] in apricot; Sahar (2014) [23] in guava; Jaishankar (2015) [8] in sapota and Manasa (2015) [13] in mango.

Table 1: Influence of different pre-harvest sprays on fruit weight, length, breadth, volume and specific gravity (at mature stage) of custard apple

Treatments	Fruit weight (g)			Length of the fruit (mm)			Breadth of the fruit (mm)			Volume of the fruit (ml)			Specific gravity (g/cc)		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1	127.00	172.87	149.93	57.85	58.94	58.39	66.83	69.11	67.97	119.33	164.00	141.67	1.06	1.05	1.06
T_2	140.27	200.20	170.23	59.50	69.41	64.46	69.23	75.90	72.57	135.67	183.67	159.67	1.04	1.09	1.07
T_3	154.27	210.33	182.30	63.00	72.43	67.71	71.86	78.52	75.19	139.00	192.33	165.67	1.11	1.09	1.12
T_4	133.53	182.00	157.77	58.67	68.53	63.60	67.17	72.28	69.72	132.00	170.33	151.17	1.01	1.07	1.04
T_5	142.47	198.20	170.33	59.50	70.73	65.11	69.89	76.19	73.04	136.67	183.00	159.83	1.05	1.08	1.09
T_6	127.00	173.87	150.43	58.33	64.27	61.30	67.50	70.85	69.18	121.67	164.00	142.83	1.04	1.06	1.06
T_7	127.07	175.67	151.37	59.17	66.70	62.93	68.83	73.03	70.93	124.33	164.68	144.51	1.02	1.07	1.05
T_8	146.40	219.53	182.97	59.67	70.95	65.31	70.18	78.19	74.19	137.00	203.00	170.00	1.07	1.08	1.08
T_9	159.33	231.87	195.60	65.67	73.23	69.45	72.83	80.19	76.51	141.68	208.00	174.84	1.12	1.11	1.12
Mean	139.70	196.06	167.88	60.15	68.35	64.25	69.37	74.92	72.14	131.93	181.45	156.69	1.06	1.08	1.08
S.Em±	2.49	2.57	1.81	1.04	1.84	1.05	0.65	0.80	0.43	3.27	2.29	1.61	0.03	0.02	0.01
C.D. @ 1 %	10.12	10.47	7.38	4.23	7.48	4.28	2.65	3.24	1.76	13.31	9.31	6.53	NS	NS	0.04

NS – Non significant

T_1 - Control T_2 - $CaCl_2$ (1.0%) T_3 - $CaCl_2$ (2.0%)
T_4 - Borax (0.2%) T_5 - Borax (0.3%) T_6 - Salicylic acid (0.40%)
T_7 - Salicylic acid (0.60%) T_8 - Potassium silicate (0.40%) T_9 - Potassium silicate (0.60%)

Table 2: Influence of different pre-harvest sprays on ripe fruit weight, pulp weight, peel weight and seed weight of custard apple

Treatments	Fruit weight (g)			Pulp weight (g)			Peel weight (g)			Seed weight (g)		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1 – Control	101.00	144.20	122.60	28.00	55.53	41.77	56.00	70.00	63.00	17.00	18.67	17.83
T_2 - $CaCl_2$ (1.0%)	114.27	171.87	143.07	45.21	92.52	68.87	52.69	62.67	57.68	16.37	16.68	16.53
T_3 - $CaCl_2$ (2.0%)	127.93	182.00	154.97	61.30	104.49	82.89	51.07	61.33	56.20	15.57	16.18	15.87
T_4 - Borax (0.2%)	107.20	163.33	135.27	35.20	76.75	55.98	55.00	69.67	62.33	17.00	16.92	16.96
T_5 - Borax (0.3%)	116.47	172.20	144.33	45.63	87.42	66.53	54.00	68.00	61.00	16.83	16.78	16.81
T_6 - Salicylic acid (0.40%)	101.00	144.87	122.93	28.00	57.20	42.60	56.00	69.00	62.50	17.00	18.67	17.83
T_7 - Salicylic acid (0.60%)	101.07	147.67	124.37	28.07	60.42	44.24	56.00	68.67	62.33	17.00	18.58	17.79
T_8 - Potassium silicate (0.40%)	118.73	174.20	146.47	52.03	97.28	74.66	51.00	60.83	55.92	15.70	16.08	15.89
T_9 - Potassium silicate (0.60%)	130.00	185.53	157.77	66.49	109.82	88.15	49.01	59.80	54.41	14.50	15.92	15.21
Mean	113.07	165.10	139.09	43.33	82.38	62.85	53.42	65.55	59.49	16.33	17.16	16.75
S.Em±	3.21	3.73	1.87	3.53	4.06	1.91	0.84	1.27	0.84	0.43	0.46	0.33
C.D. @ 1 %	13.06	15.18	7.61	14.38	16.54	7.76	3.41	5.18	3.43	1.76	1.87	1.36

Table 3: Influence of different pre-harvest sprays pulp recovery, firmness (at ripe stage) and shelf life of custard apple cv. Balanagar

Treatments	Pulp recovery (%)			Firmness (g)			Shelf life (Days)		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1 – Control	27.61	38.42	33.01	191.70	173.33	182.52	4.00	4.00	4.00
T_2 - $CaCl_2$ (1.0%)	39.52	53.80	46.66	598.00	546.00	572.00	6.00	6.00	6.00
T_3 - $CaCl_2$ (2.0%)	47.88	57.23	52.56	616.67	553.40	585.03	6.00	6.33	6.17
T_4 - Borax (0.2%)	32.61	46.99	39.80	223.27	200.00	211.63	4.00	4.00	4.00
T_5 - Borax (0.3%)	39.16	50.76	44.96	245.00	206.37	225.69	4.00	4.00	4.00
T_6 - Salicylic acid (0.40%)	27.40	39.33	33.36	554.87	465.37	510.12	4.33	4.67	4.50
T_7 - Salicylic acid (0.60%)	27.61	40.86	34.24	566.79	470.00	518.40	5.00	5.00	5.00
T_8 - Potassium silicate (0.40%)	43.67	55.84	49.75	568.73	470.00	519.37	6.00	6.00	6.00
T_9 - Potassium silicate (0.60%)	51.10	59.18	55.14	572.72	487.02	529.87	6.00	6.67	6.33
Mean	37.39	49.16	43.28	459.75	396.83	428.29	5.04	5.19	5.11
S.Em±	2.31	1.62	1.04	10.86	19.32	12.85	0.11	0.19	0.12
C.D. @ 1 %	9.41	6.58	4.24	44.21	78.67	52.33	0.45	0.78	0.51

Table 4: Influence of different pre-harvest sprays on physiological loss in weight and respiration rate of custard apple cv. Balanagar under ambient storage

Treatments	Physiological loss in weight (%)									Respiration rate (ml CO_2/kg/h)								
	Days after storage									Days after storage								
	2			4			6			2			4			6		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1	4.51	4.34	4.42	9.11	10.15	9.63	*	*	*	234.23	227.20	230.71	265.72	254.10	259.91	*	*	*
T_2	2.31	2.68	2.50	5.72	6.19	5.96	10.48	12.16	11.32	178.87	164.87	171.87	215.81	202.17	208.99	262.26	247.52	254.89
T_3	2.30	2.39	2.34	5.08	5.94	5.51	9.82	11.10	10.46	145.99	129.99	137.99	178.85	163.60	171.23	251.98	242.61	247.29
T_4	4.41	3.17	3.79	9.11	9.88	9.49	*	*	*	228.25	183.41	205.83	263.36	254.06	258.71	*	*	*
T_5	4.29	3.17	3.73	8.92	9.80	9.36	*	*	*	221.39	181.57	201.48	261.75	249.34	255.55	*	*	*
T_6	3.98	3.37	3.68	8.08	8.88	8.48	*	*	*	208.51	179.36	193.93	246.18	249.64	247.91	*	*	*
T_7	3.84	3.09	3.46	7.95	8.12	8.03	*	*	*	192.92	168.60	180.76	245.06	249.58	247.32	*	*	*
T_8	2.18	2.14	2.16	5.02	5.76	5.39	10.07	11.51	10.79	165.80	143.42	154.61	210.73	194.19	202.46	254.86	245.11	249.99
T_9	2.07	1.99	2.03	4.45	5.44	4.94	9.38	10.69	10.03	123.30	112.34	117.82	176.18	156.00	166.09	251.20	245.11	248.15
Mean	3.32	2.93	3.12	7.05	7.80	7.42	9.94	11.37	10.65	188.81	165.64	177.22	229.29	219.19	224.24	255.08	245.09	250.08
S.Em±	0.28	0.32	0.18	0.25	0.23	0.16	-	-	-	8.09	5.24	4.93	4.27	7.23	3.65	-	-	-
C.D. @ 1 %	1.13	1.31	0.74	1.02	0.92	0.66	-	-	-	32.93	21.33	20.08	17.40	29.42	14.87	-	-	-

* No observation was recorded as the fruits lost their keeping quality. Initial value of respiration rate is 101.20 (2016) and 91.41 (2017) ml CO_2/kg/h.

T_1 - Control T_2 - $CaCl_2$ (1.0%) T_3 - $CaCl_2$ (2.0%)
T_4 - Borax (0.2%) T_5 - Borax (0.3%) T_6 - Salicylic acid (0.40%)
T_7 - Salicylic acid (0.60%) T_8 - Potassium silicate (0.40%) T_9 - Potassium silicate (0.60%)

Conclusion

Pre-harvest sprays of potassium silicate (0.60 %) and calcium chloride (2.0 %) extend the shelf life up to 6.33 and 6.17 days, respectively by maintaining the physical and physiological parameters under ambient storage condition.

Acknowledgment

The authors extend thanks to Department of Science and Technology (DST), Ministry of Science & Technology, Government of India, New Delhi and UHS, Bagalkot for providing financial support and necessary facilities for conducting the research work.

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