

Original Research Article

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Response of Pre and Post-Harvest Chemical Applications on Storage Life, Quality and Cost Economics of Mango cv. Dashehari in Tarai Region of Uttarakhand, India

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ABSTRACT

Keywords

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The present investigation was undertaken on mango cv. Dashehari with the objective to find out suitable treatments for better storage life, quality and net profit of mango fruits. The experiment was laid out in factorial completely randomized design comprising of 8 pre and 10 post-harvest treatments. The pre harvest application of GA₃ @ 15 ppm + CaCl₂ @ 2.0% and post-harvest dipping with GA₃ @ 400 ppm + CaCl₂ @ 6.0% and hot water + CaCl₂ @ 6.0% resulted in minimum physiological loss in weight (10.30 % and 10.67%, respectively) and maximum shelf life (13.25 days), total sugars (18.76% and 17.76%, respectively), ascorbic acid (45.78 mg100g⁻¹ and 46.47mg100g⁻¹, respectively) and β – carotene (1.983 mg100g⁻¹ and 1.971 mg100g⁻¹, respectively).

Introduction

Mango is well established for international trade due to its superb quality. The export market for mango has become highly lucrative. Domestic and international trade of fresh mango has been limited by its highly perishable nature and susceptibility to post-harvest diseases and physical injuries. Post-harvest losses have been estimated in developed countries from 5-25%, while in developing countries it is near to 20-50% (Cisneros-Zevallos, 2003). The losses after harvesting of fruits are more due to mismanagement of produce and unfavourable physiological, biological and environmental factors.

Therefore, it is essential to overcome the problems associated with the produce by proper handling and care after harvesting of fruits. Many attempts have been made to increase the shelf life and maintain the post-harvest health of fruit which includes hot water treatment, irradiation, use of fungicides, growth regulators, nutrients, packaging and storage at low temperature.

Materials and Methods

The present investigation was conducted at Horticulture Research Centre, Patherchatta, G.B.P.U.A.T, Pantnagar, Uttarakhand, India (29.5o N latitude and 79.3o E longitude) during two successive seasons of 2012 and

2013 on mango cv. Dashehari. The climate of the area is humid subtropical with dry hot summers (32^oC -45^oC) and cool winters (0^oC-9^oC). Frost can be expected from last week of December to middle of February. Rainy season is usually from 2nd week of June to 2nd week of September with heavy rainfall (1400 mm). The experiment was laid out in CRD factorial comprising of 8 pre and 10 post-harvest treatments (mentioned in tables) and each treatment replicated thrice. The pre-harvest foliar spray of chemicals on 25 years old trees of mango cv. Dashehari was done 20 days before harvesting of fruits, while, the post-harvest treatment in form of dipping in different chemicals dipping was done after harvesting and kept in ventilated CFB boxes and stored at ambient temperature (30-36^oC) for further studies. Fruit setting was started in February- March. And fully matured fruits were picked in last week of June. During maturation phase (from 18 to 25 standard week) maximum temperature varied from 38.3 to 34.1^oC and 36.1 to 41.1^oC, minimum 22.0 – 25.6^oC and 18.6 to 27.8^oC, relative humidity varied from 63-82% (morning) to 31-61% (evening) and 47-66% (morning) to 18-41% (evening), sunshine hours from 6.6 to 9.5 hrs and 3.3 to 10.6 hrs during 1st and 2nd season, respectively. The total rainfall during this period was 156.6mm and 21.2 mm.

Treatment wise, the mango fruits of both the experiments were stored in a clean, hygienic and well ventilated room at ambient condition (temperature 31±1 °C and humidity 60± 5%). Observations on storage life (D), total sugars (%), ascorbic acid (mg100g⁻¹) and β – carotene (mg100g⁻¹) were recorded. The total sugars, ascorbic acid and β – carotene was determined as per AOAC (1990), while, economics was calculated on the basis of market rate prevailed at that period. The data was statistically analysed to know the significance among the mean values of the treatments.

Results and Discussion

The data on storage life and total sugars are summarized in Table 1. The pre harvest spray and post-harvest dipping of chemicals enhanced storage life of fruits under all the treatments over control. The storage life of fruits treated with chemicals could be extended up to 13 days over 7 days of untreated ones (control). The longest storage life (13.25 days) was observed with the pre harvest application of GA₃ @ 15 ppm + CaCl₂@ 2.0% and post-harvest dipping with GA₃ @ 400 ppm + CaCl₂ @ 6.0% (T₃) and hot water + CaCl₂ @ 6.0% (T₉).

The increase in storage life might be due to less weight loss, spoilage, shrivelling and enhanced fruit firmness, which provide improved fruit colour, better appearance, glossiness and enhanced market acceptability (Choudhury *et al.*, 2003).

During the storage durations, the total sugar contents of the fruits increased gradually with advancement of storage period and reached to the maximum levels (18.76% and 17.76%, respectively) on 9th day of storage with the pre harvest spray of GA₃ @ 15 ppm + CaCl₂ @ 2.0% (T₃) (0.291%) and post-harvest dipping with hot water + CaCl₂ @ 6.0% (T₉) (0.310%). The increase in total sugar may be due to breakdown of complex polymers in to simple substances by hydrolytic enzymes (Mahajan *et al.*, 2004; Wahdan *et al.*, 2011).

The data on ascorbic acid (mg100g⁻¹) and β – carotene (mg/100g) are summarized in Table 2. The pre harvest spray of GA₃ @ 15 ppm + CaCl₂@ 2.0% (T₃) and post-harvest dipping with GA₃ @ 400 ppm + CaCl₂ @ 6.0% (T₃) registered a very low and gradual decline in ascorbic acid content with advancement of storage period and was recorded 45.78 mg100g⁻¹ and 46.47mg100g⁻¹, respectively on the day of harvest.

Table.1 Effect of pre and post-harvest treatments on storage life and total sugar percent of mango cv. Dashehari during storage (Pooled analysis)

Treatments (T)	Storage Life(D)	Total Sugars (%)						
		Storage intervals in days (D)						
		0	3	6	9	12	14	Mean
		Preharvest						
T ₁ :CaCl ₂ @ 2%	12.00	9.02	10.93	14.56	16.90	16.47	15.81	13.95
T ₂ :GA ₃ @ 15ppm	11.17	9.10	11.13	14.78	17.12	16.66	16.04	14.14
T ₃ :GA ₃ @ 15 ppm + CaCl ₂ @ 2.0%	13.25	9.51	12.77	15.95	18.76	18.33	17.75	15.51
T ₄ :Bavistin @ 0.5%	9.00	9.20	11.69	14.59	16.74	16.30	15.64	14.03
T ₅ :Bavistin @ 0.5% + CaCl ₂ @ 2.0%	10.08	9.65	13.02	15.75	17.81	17.38	16.75	15.06
T ₆ :Indoneem @ 500 ppm	8.00	9.37	12.19	14.94	17.07	16.61	15.96	14.36
T ₇ :Indoneem @ 500 ppm + CaCl ₂ @ 2.0%	8.00	9.53	12.69	15.69	17.68	16.72	16.05	14.73
T ₈ :Control	7.00	8.78	13.88	17.22	14.99	13.61	12.50	13.50
Mean	-	9.27	12.29	15.44	17.13	16.51	15.81	14.41
CD at 5% (T x D)	0.728	0.185						
		Post-harvest						
T ₁ :CaCl ₂ @ 6%	12.17	9.37	11.51	13.91	16.71	16.08	15.12	13.78
T ₂ :GA ₃ @ 400ppm	11.17	9.38	11.65	14.33	16.45	15.84	14.83	13.74
T ₃ :GA ₃ @ 400 ppm + CaCl ₂ @ 6.0%	13.25	9.58	11.33	13.54	17.35	16.85	16.00	14.11
T ₄ :Bavistin @ 0.1%	11.17	9.67	11.39	13.69	16.99	16.43	15.56	13.95
T ₅ :Bavistin @ 0.1% + CaCl ₂ @ 6.0%	12.00	9.57	11.35	13.80	17.10	16.52	15.69	14.00
T ₆ :Indoneem @ 500 ppm	8.50	9.53	11.91	15.29	15.92	15.21	14.03	13.65
T ₇ :Indoneem @ 500 ppm + CaCl ₂ @ 6.0%	9.58	9.66	11.84	15.03	16.05	15.38	14.27	13.70
T ₈ :hot water	13.00	9.40	11.17	13.33	17.58	17.08	16.27	14.14
T ₉ :hot water + CaCl ₂ @ 6.0%	13.25	9.38	11.04	13.13	17.76	17.31	16.44	14.18
T ₁₀ :Control	7.00	9.22	13.34	16.40	14.96	14.24	13.07	13.54
Mean	-	9.47	11.65	14.24	16.69	16.09	15.13	13.88
CD at 5% (T x D)	0.678	0.087						

Table.2 Effect of pre and post-harvest treatments on the Ascorbic acid and β -Carotene of mango cv. Dashehari during storage (Pooled analysis)

Treatments (T)	Ascorbic acid (mg100g ⁻¹)							β -Carotene (mg100g ⁻¹)							
	Storage intervals in days (D)							Storage intervals in days (D)							
	0	3	6	9	12	14	Mean	0	3	6	9	12	14	Mean	
	Pre harvest														
T ₁ :CaCl ₂ @ 2%	43.85	38.64	31.47	27.09	22.81	20.31	30.69	0.294	0.875	1.562	1.947	1.928	1.904	1.418	
T ₂ :GA ₃ @ 15ppm	43.99	38.84	31.75	27.36	23.67	21.02	31.10	0.298	0.885	1.583	1.957	1.936	1.909	1.428	
T ₃ :GA ₃ @ 15 ppm + CaCl ₂ @ 2.0%	45.78	40.55	35.00	30.47	26.05	23.51	33.56	0.293	0.918	1.641	1.983	1.967	1.948	1.458	
T ₄ :Bavistin @ 0.5%	44.20	37.53	32.01	27.72	23.80	21.03	31.05	0.287	0.880	1.566	1.952	1.938	1.916	1.423	
T ₅ :Bavistin @ 0.5% + CaCl ₂ @ 2.0%	45.15	39.90	33.33	30.15	25.67	22.14	32.72	0.289	0.913	1.629	1.974	1.955	1.926	1.447	
T ₆ :Indoneem @ 500 ppm	43.09	37.29	30.23	26.17	21.32	19.00	29.52	0.288	0.868	1.531	1.935	1.914	1.891	1.404	
T ₇ :Indoneem @ 500 ppm + CaCl ₂ @ 2.0%	43.62	38.09	30.99	26.73	23.31	20.52	30.54	0.283	0.907	1.546	1.943	1.923	1.901	1.417	
T ₈ :Control	43.54	34.78	29.18	24.51	19.66	17.87	28.26	0.281	1.147	1.815	1.789	1.760	1.727	1.420	
Mean	44.15	38.20	31.75	27.52	23.29	20.68	30.93	0.289	0.924	1.609	1.935	1.915	1.890	1.427	
CD at 5% (T x D)	0.559								0.004						
	Post-harvest														
T ₁ :CaCl ₂ @ 6%	44.52	39.25	34.77	25.88	22.05	19.46	30.99	0.252	0.874	1.401	1.910	1.891	1.872	1.366	
T ₂ :GA ₃ @ 400ppm	45.76	41.22	36.32	27.62	22.09	21.32	32.39	0.260	0.852	1.378	1.958	1.942	1.926	1.386	
T ₃ :GA ₃ @ 400 ppm + CaCl ₂ @ 6.0%	46.47	41.90	36.50	28.02	23.71	21.60	33.03	0.260	0.846	1.370	1.971	1.956	1.941	1.391	
T ₄ :Bavistin @ 0.1%	44.86	39.52	34.55	26.04	22.14	19.92	31.17	0.257	0.868	1.390	1.928	1.907	1.893	1.374	
T ₅ :Bavistin @ 0.1% + CaCl ₂ @ 6.0%	45.26	39.94	35.17	26.53	22.28	20.20	31.56	0.255	0.863	1.368	1.943	1.925	1.908	1.377	
T ₆ :Indoneem @ 500 ppm	44.10	38.44	33.44	24.78	21.20	18.71	30.11	0.252	0.886	1.420	1.890	1.870	1.849	1.361	
T ₇ :Indoneem @ 500 ppm + CaCl ₂ @ 6.0%	44.63	39.16	34.08	25.28	21.26	19.42	30.64	0.253	0.879	1.413	1.898	1.877	1.858	1.363	
T ₈ :hot water	44.04	38.39	33.25	23.16	20.48	19.02	29.72	0.251	0.908	1.440	1.862	1.840	1.818	1.353	
T ₉ :hot water + CaCl ₂ @ 6.0%	43.96	38.29	33.63	24.68	20.61	18.51	29.94	0.251	0.899	1.430	1.878	1.857	1.836	1.358	
T ₁₀ :Control	44.20	36.33	30.36	23.90	20.46	17.82	28.85	0.254	1.132	1.764	1.740	1.716	1.692	1.383	
Mean	44.78	39.24	34.21	25.59	21.63	19.60	30.84	0.254	0.901	1.437	1.898	1.878	1.859	1.371	
CD at 5% (T x D)	0.363								0.010						

Table.3 Cost economics of different pre and post-harvest treatments on mango fruits cv. Dashehari (Pooled)

Treatments (T)	Fruit spoilage on 12 th day (per cent)	Good quality mango (per cent)	Sale rate of 100 mangos (Rs.)	Sale price of good quality fruits (Rs.)	Total cost of treatments (Rs.)	Net Profit (Rs.)	Profit over control (Rs.)
	Pre harvest						
T ₁ :CaCl ₂ @ 2%	30.52	69.48	600	416.88	36.49	380.39	147.15
T ₂ :GA ₃ @ 15ppm	27.85	72.85	550	400.67	35.29	365.38	132.14
T ₃ :GA ₃ @ 15 ppm + CaCl ₂ @ 2.0%	25.44	74.56	550	410.08	38.45	371.63	138.39
T ₄ :Bavistin @ 0.5%	18.29	81.29	600	487.74	33.48	454.26	221.02
T ₅ :Bavistin @ 0.5% + CaCl ₂ @ 2.0%	19.14	80.86	600	485.16	36.64	448.52	215.28
T ₆ :Indoneem @ 500 ppm	33.43	66.57	500	332.85	43.33	289.52	56.28
T ₇ :Indoneem @ 500 ppm + CaCl ₂ @ 2.0%	34.11	65.89	500	329.45	49.94	279.51	46.27
T ₈ :Control	41.69	58.31	400	233.24	0.00	233.24	0.00
	Post-harvest						
T ₁ :CaCl ₂ @ 6%	30.12	69.88	600	419.28	42.81	376.47	177.47
T ₂ :GA ₃ @ 400ppm	29.86	70.14	600	420.84	85.73	335.11	136.11
T ₃ :GA ₃ @ 400 ppm + CaCl ₂ @ 6.0%	28.50	71.50	600	429.00	95.21	333.79	134.79
T ₄ :Bavistin @ 0.1%	18.33	81.67	650	530.85	33.36	497.49	298.49
T ₅ :Bavistin @ 0.1% + CaCl ₂ @ 6.0%	18.93	81.07	650	526.95	42.84	484.11	285.11
T ₆ :Indoneem @ 500 ppm	30.78	69.22	500	346.10	43.33	302.77	103.77
T ₇ :Indoneem @ 500 ppm + CaCl ₂ @ 6.0%	32.01	67.99	500	339.95	52.81	287.14	88.14
T ₈ :hot water	17.09	82.91	700	580.37	33.33	547.04	348.04
T ₉ :hot water + CaCl ₂ @ 6.0%	14.80	85.20	700	596.40	42.81	553.59	354.59
T ₁₀ :Control	50.25	49.75	400	199.00	0.00	199.00	0.00

The decrease in ascorbic acid is due to oxidative destruction of ascorbic acid in the presence of molecular oxygen by ascorbic acid oxidase enzyme (Kirmani *et al.*, 2013).

β -carotene content of the fruits treated with chemicals increased up to 9th day and after attaining the respective peaks, it declined with advancement of storage period till 14th day of storage. The maximum β -carotene content was obtained by pre harvest spray of Gibberellic acid @ 15 ppm + Calcium chloride @ 2.0% (T₃) (1.983 mg100g⁻¹) and post-harvest dipping with GA₃ @ 400 ppm + CaCl₂ @ 6.0% (T₃) (1.971 mg100g⁻¹) on 9th day of storage. The decline in β -carotene might be due to their utilization in evapo-transpiration and other biochemical activities (Bhatt *et al.*, 2012; Yadav *et al.*, 2010).

Estimation of profit for 100 fruits over control (Table 3) indicated that maximum net profit (Rs.221.02 and Rs.354.59, respectively) was obtained from fruits of pre-harvest treatment Bavistin @ 0.5% (T₄) and post-harvest treatment Hot water dipping + Calcium chloride @ 6.0% (T₉). Net profit of control fruits was taken as Rs. 0.00 for comparison with all treated fruits.

Thus, it may be concluded that the pre harvest spray with Gibberellic acid @ 15 ppm + Calcium chloride @ 2.0% and post-harvest dipping with GA₃ @ 400 ppm + CaCl₂ @ 6.0% and Hot water + Calcium chloride @ 6.0% are the most effective treatments for increased net profit, storage life as well as maintained fruit quality of mango cv. Dashehari.

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