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Effect of pre-harvest chemical treatments and mulching on quality and marketability of Dashehari mango

A.K. Singh*, C.P. Singh and P. Chauhan
Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145, U.S. Nagar, Uttarakhand

ABSTRACT

Ten-year-old Dashehari mango trees of uniform vigour and size were given eight treatments comprising of polythene mulching (during September) and pre-harvest chemical spray of $CaCl_2$ at 2.0, 4.0 and 6.0%, $CaNO_3$ at 4.0%, K_2SO_4 at 1.0% and borax at 1.0% in combination with polythene mulching and control (water spray without mulching) at 30 days before anticipated harvest date. On the basis of pooled analysis of two years data, it was revealed that the treatment of 1.0% borax with mulching was found more effective for increasing the fruit weight (161.66 g) and yield (37.20 kg tree^{-1}). This treatment was also found effective for increasing the TSS (16.22 & 19.51°Brix), total sugars (8.98 & 15.94%) and for decreasing the acidity (0.32 & 0.16%) at time of harvest and end of storage period, respectively. At 10th day of storage, the maximum fruit marketability (90.01%) and minimum physiological loss in weight (23.99%) were observed with the treatment of 2.0% $CaCl_2$ in combination with mulching. The effects of $CaCl_2$ at 2 & 4% and $CaNO_3$ at 4% on fruit marketability (90.01, 86.12 and 85.45%) were found statistically at par. Therefore, the use of 2%$CaCl_2$ along with polythene mulch can be recommended for improving the fruit marketability (shelf-life). Thus, the study indicated that pre-harvest application of $CaCl_2$ at 2.0% is effective for improving the fruit marketability and decreasing the physiological loss in weight (PLW), whereas, the borax at 1.0% with mulching proved effective for improving the fruit quality of Dashehari mango.

Key words: *Mangifera indica*, calcium, potassium, shelf-life, fruit quality.

INTRODUCTION

Mango (*Mangifera indica* L.) is the 'national fruit' of India and main fruit of Asia and has developed its importance all over the world. The world market for fruits is expanding but the marketing of mangoes is restricted due to improper post harvest handling and inadequate storage and transport facilities resulting in poor fruit quality and short shelf-life. Storage at low temperature also has limitations as the mango fruit is susceptible to chilling injury. Calcium, potassium and boron are known to play very important role in improvement of quality and shelf life of various fruits. The previous workers have also demonstrated that calcium play a very important role in improvement of shelf life of fruits (Mika, 11; Jones *et al*., 8). Boron and potassium are responsible for increased fruit quality of various tropical and subtropical fruits. There are several reports of increased shelf-life and quality of fruits by mulching (Kumar *et al*., 9) and the pre-harvest foliar spray of calcium, potassium and boron (Tirmazi and Wills, 16; Wahid *et al*., 13; Singh *et al*., 15; Brahmachari *et al*., 2; Saha *et al*., 13; Kar *et al*., 10; Dutta, 5; Jayachandran *et al*., 7). The present report describes the effect of pre-harvest spray of nutrients (calcium, potassium and boron) along with mulching on fruit quality, physiological loss in weight (PLW) and marketability (shelf-life) of mango cv. Dashehari.

*Corresponding author's E-mail: aksashi@yahoo.co.in

MATERIALS AND METHODS

The experiment was conducted on 10-year-old mango trees of cv. Dashehari. All the trees selected for experiment were almost uniform in growth and vigour. The treatments were comprised of black polythene mulching (T_1), $CaCl_2$ @ 2% + mulching (T_2), $CaCl_2$ @ 4% + mulching (T_3), $CaCl_2$@ 6% + mulching (T_4), $CaNO_3$@ 4% + mulching (T_5), K_2SO_4@ 1% + mulching (T_6), borax @ 1% + mulching (T_7) and control: water spray (T_8) The treatments were imposed as pre-harvest chemical treatments and mulching to find the effect on physiological loss in weight (PLW), fruit marketability (shelf-life) and fruit quality of Dashehari mango. The mulching was done during the month of September, 2008 and pre-harvest chemical spray was done 30 days before anticipated harvest date during the year 2009 and 2010. The experiment was laid out in randomized block design (RBD) and the treatments were replicated four times and two trees served as a unit of a treatment. Twenty fruits were sampled from each tree and stored under ambient condition (32 ± 2°C) over muslin cloth in single layer. The chemical characteristics of fruits were assessed at harvest and at the end of storage period. The per cent physiological

loss in weight (PLW) was calculated on initial weight basis at two days interval from harvest. The fruit marketability (shelf-life) was assessed on the basis of surface colour, extended of shrinkage, firmness and fungal spot and was expressed in terms of percentage. Total soluble solids (TSS) in juice was measured with a hand refractometer (ERMA make). Titratable acidity and sugars were estimated by method as suggested by AOAC (1).

RESULTS AND DISCUSSION

The findings related to fruit weight and yield reveal that these parameter are affected significantly by various pre-harvest chemical treatments**.** The pooled data of two years (2009 & 2010) pertaining to fruit weight and yield (Fig. 1) show that significantly higher fruit weight (161.66 g) was observed with the treatment of borax (1.0%) + mulching (T_7) followed by T_2: $CaCl_2$ @ 2.0% + mulching (151.86 g). Appreciable improvement in fruit weight by borax application has been also reported by Dutta (5) in mango cv. Himsagar, and Brahmachari *et al.* (2) in litchi. The increase in fruit weight with the spray of borax was might be due to the involvement in hormonal metabolism, increased cell division and expansion of cell. Boron is also known to stimulate rapid mobilization of water and sugar in the fruit.

In the investigation it has been observed that the fruit yield was also affected significantly (Fig. 2) and

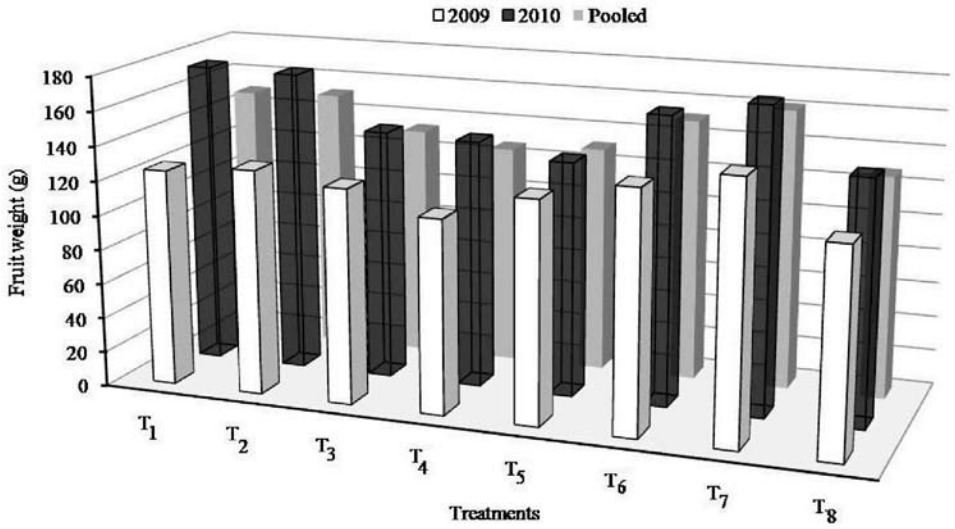

Fig. 1. Effect of pre-harvest chemical treatments and mulching on fruit weight (g) of mango cv. Dashehari.

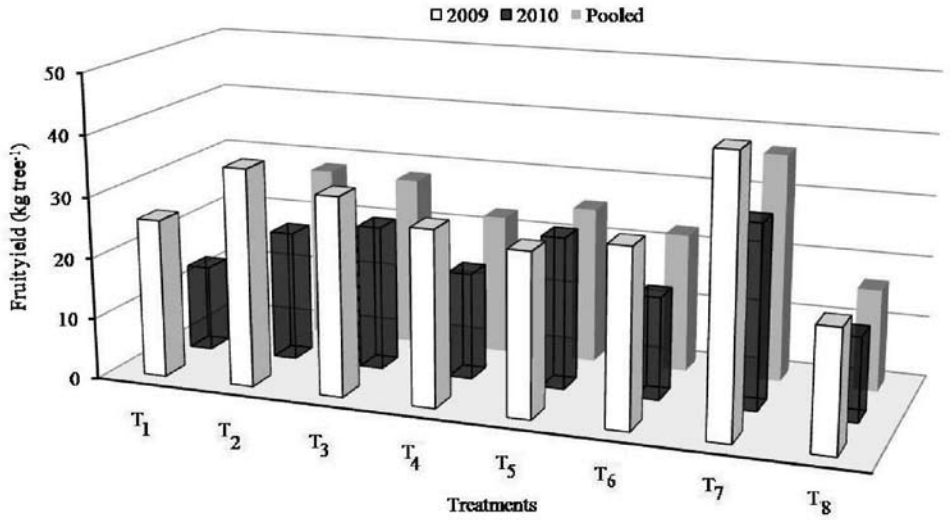

Fig. 2. Effect of pre-harvest chemical treatments and mulching on fruit yield (kg tree^{-1}) of mango cv. Dashehari.

the maximum fruit yield (37.20 kg tree^{-1}) was recorded with the treatment of borax (1.0%) + mulching (T_7) and minimum (16.67 kg tree^{-1}) in control (T_8). It is in full conformity with the results obtained by Wahid *et al.* (22) in guava in respect of pre-harvest application of nutrient on fruit yield. The significant increase in yield by boron application may be accredited to the positive effect of boron for increasing the rates of carbohydrate and RNA metabolism (Parr and Loughman, 12) as well as on accelerating the transportation of photosynthates from the leaves to developing fruits (Dugger, 4).

The pooled data of two years (Table 1) related to TSS recorded at the time of harvest and at the end of storage period show that the TSS was affected significantly by different treatments at harvest and at end of storage period. At harvest significantly maximum total soluble solids (16.22°Brix) was recorded with treatment of borax (1.0%) + mulching (T_7), whereas minimum (14.39°Brix) in control (T_8). At the end of storage period also higher TSS content (19.51°Brix) was recorded in the fruit treated with T_7. Similar results have been also obtained by Dutta (5) in mango. The present findings are in accordance with the findings of Brahmachari *et al.* (2), and Jayachandran *et al.* (7). The increase in TSS during storage period may be due to conversion of complex polymers into simple substances. The titratable acidity was also affected significantly by different treatments (Table 1). At harvest significantly minimum acidity (0.32%) was registered with the treatment of borax (1.0%) + mulching (T_7), whereas, maximum acidity (0.57%) was recorded in control (T_8). At the end of storage period also, minimum titratable acidity (0.16%) was observed with borax (1.0%) + mulching (T_7) and maximum (0.28%) with the treatment of $CaCl_2$ (6.0%) + mulching (T_4). Similarly, calcium treated mango fruits showed high acidity has been also reported by Tirmazi and Wills (16). There was a decrease in acid content during the storage period. This may be due to utilization of organic acids in respiration. The reduction in acidity level is probably due to more accumulation of sugars in fruits. The pooled data of two years (Table 1) reveal that total sugars content was also affected significantly at the time of harvest and at end of storage period. Significantly higher total sugars content (15.94%) was recorded with the treatment of borax (1%) + mulching (T_7) and lower (12.68%) with control (T_8). These results elucidated the findings of Kar *et al.* (10) and Dutta (5). The increase in sugar may be due to break down of complex polymers in to simple substances by hydrolytic enzymes. Boron facilitated sugar transport within the plant and it was also reported that borate react with sugar to form a sugar-borate complex (Gauch and Dugger, 6).

Table 1. Effect of pre-harvest chemical treatments and mulching on total soluble solids, titratable acidity and total sugars in mango cv. Dashehari.

Treatment	Total soluble solids (°Brix)						Titratable acidity (%)						Total sugars (%)					
	At harvest			At end of storage period			At harvest			At end of storage period			At harvest			At end of storage period		
	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled
T_1 : Mulching	15.53	15.58	15.55	17.00	17.64	17.32	0.48	0.49	0.48	0.27	0.26	0.26	8.56	8.86	8.71	14.08	13.95	14.02
T_2 : $CaCl_2$ (2.0%) + mulching	15.90	15.69	15.79	18.03	18.56	18.30	0.44	0.42	0.43	0.24	0.24	0.24	8.40	7.99	8.20	13.70	13.45	13.57
T_3 : $CaCl_2$ (4.0%) + mulching	15.23	15.17	15.17	17.26	18.63	17.94	0.47	0.47	0.47	0.25	0.26	0.25	8.24	8.37	8.30	15.12	14.94	15.03
T_4 : $CaCl_2$ (6.0%) + mulching	14.43	14.37	14.40	18.30	17.98	18.14	0.53	0.52	0.52	0.29	0.28	0.28	8.30	8.26	8.28	13.23	13.12	13.18
T_5 : $CaNO_3$ (4.0%) + mulching	15.03	14.99	15.01	17.40	18.67	18.03	0.52	0.51	0.52	0.25	0.25	0.25	8.15	8.01	8.08	14.40	14.44	14.42
T_6 : K_2SO_4 (1.0%) + mulching	15.96	16.04	16.00	18.00	18.97	18.48	0.41	0.41	0.41	0.27	0.26	0.26	8.26	8.42	8.34	13.83	13.71	13.77
T_7 : Borax (1.0%) + mulching	16.20	16.24	16.22	18.55	20.47	19.51	0.31	0.32	0.32	0.17	0.16	0.16	8.91	9.05	8.98	15.86	16.02	15.94
T_8 : Control (water spray)	14.40	14.38	14.39	16.83	20.23	18.53	0.58	0.57	0.58	0.26	0.25	0.26	9.15	8.97	8.90	12.60	12.76	12.68
CD at 5%	NS	0.69	0.83	0.88	NS	1.14	0.07	0.01	0.03	0.03	0.02	0.02	NS	0.22	0.49	1.02	0.45	0.48

The physiological loss in fruit weight of Dashehari mango is significantly affected by the pre-harvest application of nutrients in comparison to control at 6th, 8th and 10th day of storage. The pooled data of two years (Fig. 3) indicate that on 10th day of storage, minimum loss in physiological weight (23.99) was observed with the treatment of $CaCl_2$ (2.0%) + mulching (T_2) and maximum (27.92%) with control (T_8). However, the lower average physiological loss in weight (11.64%) was observed with treatment of borax 1% with mulching and higher (14.38%) with control (T_8). Similar results have been obtained by Siddiqui *et al.* (14) in *ber*, and Saha *et al.* (14) in litchi. The decrease in weight loss by the application of calcium may be due to its role in the maintenance of fruit firmness, retardation of respiratory rate and delayed senescence (Mika, 11; Jones *et al.*, 8).

The fruit marketability was also affected significantly by the mulching and pre-harvest application of nutrients at different intervals of storage in comparison to untreated control (Fig. 4). The treatment of $CaCl_2$ along with mulching proved very effective for maintaining higher marketability of mango fruits. The pooled data of two years clearly indicate that the significantly

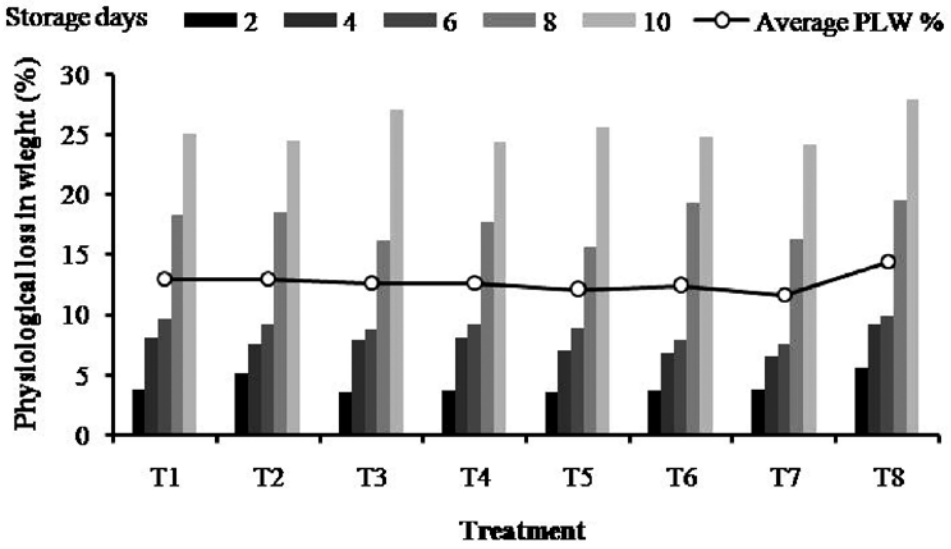

Fig. 3. Effect of pre-harvest chemical treatments and mulching on per cent physiological loss in weight (PLW %) in mango cv. Dashehari.

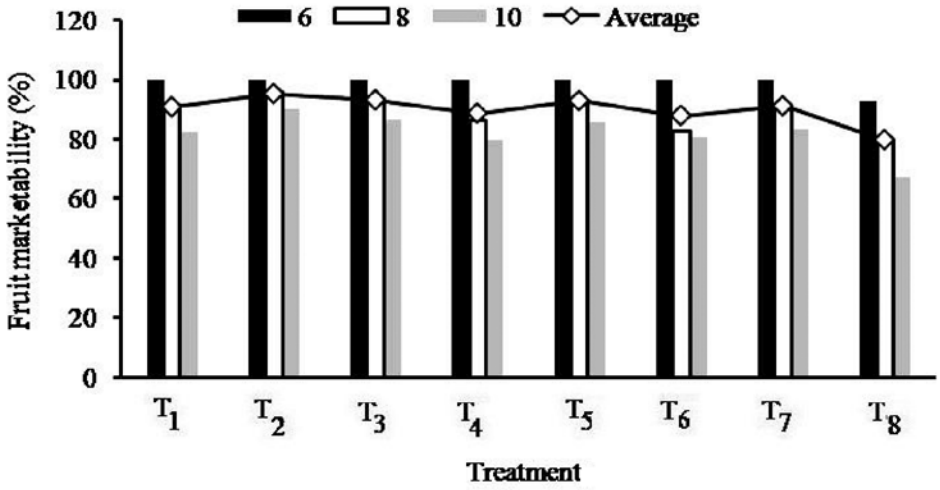

Fig. 4. Effect of pre-harvest chemical treatments and mulching on fruit marketability (shelf-life) of mango cv. Dashehari.

maximum marketable fruit (90.01%) on 10th day of storage was observed in the fruit treated with $CaCl_2$ (2.0%) + mulching (T_2). The effect of $CaCl_2$ at 2, 4 and $CaNO_3$ at 4% on fruit marketability (90.01, 86.12 and 85.45%) was found statistically at par. Also, the higher average fruit marketability (95.25%) was observed with $CaCl_2$ at 2% with mulching (T_2) and lower (79.64%) with control (T_8). Therefore, the use of $CaCl_2$ at 2.0% seems more economical for improving the fruit marketability (shelf-life). Significantly lower (66.79%) marketable fruit was observed in case of untreated control. Almost similar results were obtained by the Singh *et al.* (15) in Dashehari mango. Tirmazi and Wills (16) have also observed longer shelf-life in mangoes from the post harvest application of calcium. The increase in fruit marketability might be due increase in concentration of calcium of middle lamella of cell wall which provide physical strength to cell wall and improved fruit colour development and appearance (Cheour *et al.*, 3). The study indicated that pre-harvest application of $CaCl_2$ at 2.0% with polythene mulching is effective for improving the fruit marketability and decreasing the physiological loss in weight (PLW), whereas, the borax at 1.0% with mulching proved effective for improving the fruit quality of Dashehari mango.

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