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Effect of pre-harvest chemical treatments and mulching on marketability of mango (*Mangifera indica* L.) cv. Amrapali

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ABSTRACT

Ten-year-old mango plants cv. Amrapali with uniform vigor and size were given seven treatments comprising of black LDPE mulching 100 micron thickness (during September) and pre-harvest chemical spray of $CaCl_2$ at 2.0, 4.0 and 6.0%, $Ca(NO_3)_2$ at 4.0%, borax at 1.0% in combination with mulching and control (water spray without mulching) at 30 days before the anticipated date of harvest. It was revealed that spraying of 1.0% borax along with black LDPE mulching exhibited highest fruit weight (262.56g) followed by (248.67g) in $CaCl_2$ at 2.0% with mulching. On 12th day of storage the maximum fruit marketability (90.58%), minimum fruit decay (8.55%), minimum physiological loss of weight (15.13%) was recorded in treatment black LDPE mulching+borax at 1.0%. Therefore, the use of black LDPE mulching with borax at 1.0% spray is found to improve fruit size significantly, whereas $CaCl_2$ at 2.0% with mulching is found effective for improving fruit marketability, reducing decay percentage and reducing physiological loss in weight of the fruit during storage in Amrapali.

Keywords : Amrapali, boron, calcium chloride, calcium nitrate, mulching, shelf-life

Mango the king of fruits is grown in our country since time immemorial and is native of South East Asia. In India, it is grown in an area of 2500 thousand hectares with an annual production of 18002 thousand metric tonne and productivity of 7.2 metric tonnes ha^{-1}. In the state of Odisha mango occupies 14.23 thousand hacters area with production of 103.73 thousand metric tonne and productivity is 7.3 metric tonnes ha^{-1} (Indian Horticulture Database, 2013). Among the cultivars Amrapali a cross of Dashehari and Neelum is more popular in the state for its regular bearing capacity and dwarfness. It occupies more than 50% area. It takes about 115 to 120 days from fruit set to fruit maturity. It is a climacteric fruit whose shelf-life is less and post-harvest losses is about 30-40%. It is very important to extend the shelf-life for better economic return. Assured quality and perishability of mango are the two major problems faced by the farmers and other stakeholders to make the enterprise a lucrative one.

Owing to the imposement of ban on mangoes by Europian Union, it has become a challenge for the registered growers and exporters of our country to produce taintless fruits meeting the international standards for export. Further during storage there is every chance of deterioration of quality of the fruits, which ultimately leads to rotting, desiccation, shriveling and weight loss, which adds to the agony of mango growers. In view of these facts it is worth-while to develop a low cost technology to extend the shelf-life of mango by increasing the storability to suit to the economic condition of the growers, traders and consumers.

Among different nutrients calcium and boron are known to play very important role in improvement of quality and shelf life of various fruits. Scientists have also demonstrated that calcium plays a very important role in improvement of shelf life of fruits (Mika, 1983, Jones *et al*., 1970). Boron and calcium are responsible for increasing fruit quality and marketability of various tropical and subtropical fruits. There are several reports of increased self life and quality of fruits by mulching (Kumar *et al.*, 2008) and the pre-harvest chemical spray of calcium and boron (Singh and Dhillon, 1987; Dutta *et al*., 2000; Kar *et al.,*2002; Dutta, 2004; Bhatt *et al.,* 2012; Bhowmick *et al*., 2012; Singh *et al.*,2012 and Yadav *et al.*, 2013). The present research was carried out to select suitable pre-harvest chemical treatments for prolonging the shelf life, improving marketability of mango cv. Amrapali.

The Field experiment was carried out during 2013-14 in the Horticulture Research Station, Department of Fruit Science and Horticulture Technology, College of Agriculture, OUAT, Bhubaneswar, Odisha. Geographically the site of experiment lies between 20°15' N latitude and 85°52' E longitude in the subtropical humid coastal plane land of Odisha. It is situated at about 62 km away from Bay of Bengal at an elevation of 25.5m from the mean sea level. The characteristic of the orchard soil mainly alfisol with acidic reaction. The climate is hot and humid subtropical

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one with a mild and versatile winter. Twenty-eight healthy mango trees of comparable age (10 years old) cv. Amrapali, a regular variety were selected from the orchard for the investigation. The trees were well spread in all the direction and fully exposed to sunlight. The experiment was conducted in Randomized Block Design with seven different treatment combinations and four replications. The treatments were T_1: Black LDPE mulching, T_2: Black LDPE mulching + $CaCl_2$ @ 2.0%. T_3: Black LDPE mulching + $CaCl_2$ @ 4.0%, T_4: Black LDPE mulching + $CaCl_2$ @ 6.0%, T_5: Black LDPE mulching + Ca $(NO_3)_2$ @ 4.0%, T_6: Black LDPE mulching + borax @ 1.0%, T_7: Control water spray. The basins of selected mango plants were properly cleaned and a light hoeing of soil was done. Out of 28 selected mango plants on 24 plants black LDPE mulch of 100 micron were covered. Mulching was done on 10th September, 2013. Spraying was done 30 days before anticipated harvest date that is on 3rd May, 2013 with foot sprayer. The fruits were harvested at full maturity stage on 2nd June, 2014. Five fruits with their pedicel from each side of each plant were harvested; total 560 numbers of fruits of uniform size were harvested from all the selected trees. Immediately after harvest of fruit, stalk was removed and weight of fruit was recorded in grams. Biometrical observation of pulp, peel weight and storage period was recorded.

It was revealed from table 1, that significantly higher fruit weight 262.56 g was observed with the treatment of black LDPE mulching + borax @ 1.0 %, followed by 248.67 g with black LDPE mulching + $CaCl_2$ @ 2.0%.The appreciable improvement in fruit weight by boron application has also been reported by Singh and Dhillon (1987) in Dashehari; Dutta *et al.* (2000) in litchi; Dutta, (2004) in Himsagar; Pathak *et al*. (2011), Bhatt *et al.* (2012) in mango; Bhowmick *et al.* (2012) in Amrapali; Singh *et al.* (2012) in mango cv. Dashehari; Yadav *et al*. (2013) in peach cv. Sharbati. However, the increase in fruit weight with spray of borax might be due to involvement of the nutrient in hormonal metabolism, increased cell division and expansion of cells. Boron is also known to stimulate rapid mobilization of water and sugar in the fruits (Dutta, 2004). Significant variation was recorded among various treatments with respect to pulp weight. The maximum pulp weight 175.91g was recorded with treatment of black LDPE mulching + borax@ 1.0 %, followed by 163.67g with black LDPE mulching + $CaCl_2$ @ 2% and minimum 133.56 g pulp weight in control. Bhowmick *et al.* (2012) also recorded maximum pulp weight in Amrapali mango with 0.75% borax and Karemera *et al.* (2014) found pulp weight of fruit 215.56g when fruit trees were treated with 1.50% $CaCl_2$ at 30 days before harvesting in Alphonso, which is in agreement to the present study. Pulp content in ripe fruit is an important physical character so far processing and consumer acceptance are concerned. Significantly higher pulp percentage 67.48 with black LDPE mulching + borax @1.0%, followed by 65.81% in black LDPE mulching + $CaCl_2$ @ 2.0% spray, where as a minimum of 59.46% was recorded in control.These findings corroborate with the findings of Bhowmick *et al.,* 2012. It was indicated from table 1 that maximum stone weight 42.29 g in control, minimum stone weight of 39.61g in treatment black LDPE mulching + $CaCl_2$ @ 2.0% and peel weight of maximum 46.75g in control followed by 46.15g in treatment black LDPE mulching and minimum peel weight 43.87g with the treatment borax @ 1.0% along with black LDPE mulching was observed but there was no significance variation found among treatment on stone weight and peel weight of mango cv. Amrapali in present investigation.

The physiological loss in weight of ripe fruit represents its freshness and quality and influences its marketability. Fresh mango fruits contain high moisture at the time of harvest. Under normal conditions, in such perishable commodities loss of moisture is rapid which causes shrinkage and loss of turgidity. Fruits are living entities and consume oxygen for respiration, emit carbon dioxide, ethylene and water vapors. Mango being a climacteric fruit, the rate of respiration attains a peak after detachment from the mother plant as the temperature of fruits increases. Concentration of oxygen and carbon dioxide around the fruit is critical for its life process and longer shelf life. The studies in this regard indicated that the physiological loss in weight of Amrapali variety during storage was found to be highest in control treatment and lowest in fruits treated with black LDPE mulching + $CaCl_2$@ 2.0 %. The pre-harvest treatment with $CaCl_2$ @ 2.0 % along with mulching was most effective as it recorded only 15.13% of physiological loss in weight than control 18.92% on the 12th day of storage. Fruits under treatment black LDPE mulching + $CaCl_2$ @2.0% were found firm, fresh and with good marketing qualities till the end of storage period. The decrease in weight loss by the application of calcium may be attributable for its constituency in the cell wall resulting fruit firmness, retardation of respiratory rate and delay in senescence. (Singh *et al.,* 1993). Bender, 1998 also reported calcium 0.6-2% enhances the fruit quality of mango by improving shelf life and reducing the physiological loss in weight. Similar results of low physiological loss of weight in

fruits during storage by calcium treatment have been reported by Sanjay *et al.,* 1998 in mango cv. Amrapali. Kluge *et al.,* 1999 also concluded that weight loss was reduced by $CaCl_2$ treatment on Tommy Atkins mangoes. Singh *et al.,* 2012 recorded minimum physiological loss in weight (23.99%) in calcium chloride @ 2.0% along with polythene mulching.

The most important physical character of ripe mango fruit is decay percentage which greatly influences marketability of fruits. One of the reasons for decay of fruits during storage is rotting due to infection of pathogen, those carried out from the field as well as during transportation. Faust and Shear (1972) monitored that metabolic disorders are severely reduced if calcium is present in sufficiently high quantity in fruits. They suggested that calcium may regulate respiration and reduce decay percentage of fruits.

In present study fruit decay was found to be minimum in the treatment black LDPE mulching + $CaCl_2$ @ 2.0%, that is (6.24%, 7.40%, 7.80%, 8.55%) on 6th, 8th, 10th and 12th day of storage respectively. Whereas maximum fruit decay was noticed in control which was (11.82%, 12.45%, 12.85%, 13.21%) on 6th, 8th, 10th and 12th day of storage. Similar findings was found in Amrapali mango fruits by Singh *et al.* (1987).

Singh *et al.* (1993) reported that calcium level reduces respiration rate which ultimately reduce fruit decay percentage, mango fruits cv. Dashehari treated with calcium chloride as pre-harvest spray can be stored for 10 days instead of only 6 days as in control. Bender (1998) noted a reduced rate of respiration in calcium treated fruits which decreases fruit decay, Sanjay *et al.,* (1998) observed a reduced fruit decay percentage in Amrapali mango with $CaCl_2$@ 1.5%.

In the present study fruit marketability was also affected significantly by the mulching and pre-harvest application of nutrients, during different intervals of storage in comparison to untreated control. The treatment $CaCl_2$ along with mulching proved very effective for maintaining higher marketability standards of mango fruits. Significantly higher percentage of marketable fruit (95.51%, 94.63%, 93.63%, 90.58%) on 6th, 8th, 10th and 12th day of storage was recorded with fruits treated with black LDPE mulching + $CaCl_2$ @

Table 1: Effect of different treatments on fruit characters and physiological loss in weight of mango

Treatment	Fruit weight (g)	Pulp weight (g)	Pulp (%)	Stone weight (g)	Peel weight (g)	Physiological loss in weight (%)			
						Storage period (days)			
						6D	8D	10D	12D
T_1	223.94	136.60	60.99	41.43	46.15	11.03	12.71	14.13	16.79
T_2	248.67	163.67	65.81	39.61	44.57	10.02	11.32	12.98	15.13
T_3	233.31	148.07	63.47	40.95	44.02	10.89	13.12	14.18	17.98
T_4	228.67	141.77	61.99	41.16	45.73	10.73	12.07	13.09	16.37
T_5	234.91	150.34	63.99	39.93	43.87	10.91	13.09	14.05	17.87
T_6	262.56	175.91	67.48	40.70	45.94	11.02	11.64	13.25	15.93
T_7	222.61	133.56	59.46	42.29	46.75	12.11	14.01	16.87	18.92
SEm (±)	**5.89**	**4.646**	**0.340**	**1.060**	**1.397**	**0.15**	**0.15**	**0.19**	**0.13**
LSD(0.05)	**20.688**	**13.802**	**1.010**	**-**	**-**	**0.43**	**0.456**	**0.574**	**0.397**

Table 2: Effect of different treatments on the fruit decay and marketable fruit in mango

Treatment	Fruit decay %				Marketable fruit (%)			
	6D	8D	10D	12D	6D	8D	10D	12D
T_1	10.17	11.17	11.52	12.52	85.36	82.36	81.36	80.34
T_2	6.24	7.40	7.80	8.55	95.51	94.63	93.63	90.58
T_3	7.95	8.70	8.97	9.50	90.30	86.30	86.30	86.28
T_4	8.28	9.28	9.58	10.58	85.59	84.59	83.59	83.50
T_5	7.98	8.33	8.75	10.63	89.46	88.46	87.46	85.54
T_6	7.08	8.30	8.63	9.47	91.38	89.38	88.38	87.55
T_7	11.82	12.45	12.85	13.21	83.54	81.54	80.56	79.76
SEm (±)	**0.113**	**0.144**	**0.123**	**0.161**	**0.162**	**0.168**	**0.166**	**0.159**
LSD (0.05)	**0.334**	**0.429**	**0.365**	**0.478**	**0.481**	**0.499**	**0.493**	**0.472**

2.0%. Whereas, lower marketable fruit percentage was observed in control on 12th day of storage. Therefore the use of $CaCl_2$ @ 2.0% along with mulching seems to be more economical for improving fruit marketability that is shelf-life. Almost similar results were obtained by Singh *et al.* (2012) on Dashehari mango. By applying $CaCl_2$ @ 2.0% + mulching, they get maximum marketable fruit 90.01% on 10th day of storage. Karemera and Habimana, (2014) suggested that the shelf life of mango cv. Totapuri was extended to 25.89 days when sprayed with 1.50% $CaCl_2$ at 30 days before harvest. Similar trends of result was found by Karemera and Habimana, (2014) on mango cv. Alphanso.

Spraying of 1.0% borax along with black LDPE mulching significantly increased the fruit weight, pulp weight of mango cv. Amrapali. Spraying of calcium chloride @ 2.0% is found effective for improving fruit marketability (shelf-life) and decreasing physiological loss in weight. with LDPE mulching increased the shelf life of the fruits. Polythene mulching should be practised along with nutrient spray of calcium and boron to increase the yield and quality of fruits.

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