International Journal of Farm Sciences **5(4)** : 132-138, 2015

Effect of pre-harvest chemical treatments and mulching on quality of mango, *Mangifera indica* L cv Amrapali fruits

LIPSA PRIT BHUSAN and CHINTAMANI PANDA

Department of Vegetable Science, College of Agriculture
Orissa University of Agriculture and Technology, Bhubaneswar 751003 Odisha, India
Email for correspondence: anniee_19@yahoo.com

ABSTRACT

Ten year old mango cv Amrapali plants with uniform vigor and size were given seven treatments comprising black LDPE mulching 100 micron thickness (during September) and pre-harvest chemical spray of $CaCl_2$ (2.0, 4.0 and 6.0%), Ca $(No_3)_2$ (4.0%), borax (1.0%) in combination with mulching and control (water spray without mulching) at 30 days before the anticipated date of harvest. The spraying of 2.0 per cent $CaCl_2$ along with black LDPE mulching was found to minimize the physiological loss of weight (15.13%) on 12th day of storage whereas the treatment of borax (1.0%) + mulching was found to increase the TSS (18.81^{o}Brix, 22.10^{o}Brix), reducing sugar (3.27%, 5.14%), total sugar (12.12%, 19.03%) and decrease the acidity (0.34%, 0.19%) at the time of harvest and end of the storage period respectively. Therefore the use of black LDPE mulch material in September along with borax (1.0%) spray 30 days prior to harvest was found to improve fruit quality and $CaCl_2$ (2.0%) was found to reduce physiological loss in weight in Amrapali mango.

Keywords: Amrapali; boron; calcium chloride; calcium nitrate; mulching; quality

INTRODUCTION

Mango (*Mangifera indica* L) the king of fruits is grown in our country since time immemorial and is native of southeast Asia. Among the cultivars Amrapali a cross of Dashehari and Neelum is more popular in the state of Odisha for its regular bearing capacity and dwarfness. The cultivar takes about 115 to 120 days from fruit set to fruit maturity. Assured quality and perishability of mango are the two major problems faced by the farmers of the state 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 worthwhile to develop a low cost technology to extend the quality of mango by increasing the storability to

suit 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 shelf-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 in Dashehari, Dutta 2004 in Himsagar, 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). The present research was carried out to select suitable pre-harvest chemical treatments for prolonging the shelf-life, improving quality of mango cv Amrapali.

MATERIAL and METHODS

The Field experiment was carried out during 2013-14 at 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 of Odisha. It is situated at about 62 Km away from Bay of Bengal at an elevation of 25.5 m amsl. The orchard soil is mainly alfisol with acidic reaction. The climate is hot and humid subtropical one with a mild and versatile winter. Twenty-eight healthy mango cv Amrapali trees of comparable age (10 year old) were selected from the orchard for the investigation. The trees were well spread in all the directions and fully exposed to sunlight. The experiment was conducted in randomized block design (RBD) 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%) and T_7: control (water). The basins of selected plants were properly cleaned and a light hoeing of soil was done. On 28 selected plants black LDPE mulch of 100 micron was spread on 10 September 2013. Spraying was done 30 days before anticipated harvest date ie on 3 May 2013 with footsprayer. The fruits were harvested at full maturity on 2 June 2014. Five fruits with their pedicel from each side of plant were harvested; in total 560 fruits of uniform size were harvested from all the selected trees. Immediately after harvesting of fruit stalk was removed and weight of fruit was recorded. Biochemical parameters like TSS, acidity, reducing sugar and total sugar were evaluated and organoleptic evaluation was conducted by

panel of 5 judges by using rating and score test.

RESULTS and DISCUSSION

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 and 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 fruit 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 (Table 1) 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 per cent of physiological loss in weight than control (18.92%) on the 12^{th} day of storage. Fruits under treatment of 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 attributed to its consistency in the cell wall resulting in fruit firmness, retardation of respiratory rate and delay in senescence (Singh et al 1993). Similar results of low physiological loss of weight in fruits during storage by calcium treatment have been reported by Bender (1998), Sanjay et al (1998) in mango cv Amrapali and Kluge et al (1999) in Tommy Atkins mangoes. Singh et al (2012) recorded minimum physiological loss in weight (23.99%) in calcium chloride (2.0%) along with polythene mulching in Dashehari mango.

Total soluble solids in fruit determine its sweetness. In present study TSS content in ripe mango fruits increased continuously with the increase in storage period. The increase in TSS could be attributed to the accumulation of more soluble solids during the process of ripening in fruits as a consequence of poly saccharides (Gautam and Chundawat 1990). In the present investigation maximum TSS of 18.81°Brix and 22.10°Brix at harvest and at the end of storage period was recorded in black LDPE mulching + borax (1.0%) followed by 18.55°Brix and 21.06°Brix respectively in black LDPE mulching + $CaCl_2$ (2.0%) and both the treatments were found to be at par. These findings corroborate with that of Bhatt et al (2008) in mango cv Dashehari, Bhatt (2012) in mango and Singh et al (2012) in mango cv Dashehari. The results indicate that increase in TSS following boron application attributed to the rapid mobilization of sugars and other soluble

Table 1. Effect of pre-harvest chemical treatments and mulching on the physiological loss in weight of mango cv Amrapali during storage

Treatment	Storage period (days)			
	6	8	10	12
T_1	11.03	12.71	14.13	16.79
T_2	10.02	11.32	12.98	15.13
T_3	10.89	13.12	14.18	17.98
T_4	10.73	12.07	13.09	16.37
T_5	10.91	13.09	14.05	17.87
T_6	11.02	11.64	13.25	15.93
T_7	12.11	14.01	16.87	18.92
F-test	*	*	*	*
SEm±	0.15	0.15	0.19	0.13
$CD_{0.05}$	0.43	0.456	0.574	0.397

*Significant

solids to developing fruits. Results of boron treatment may be explained by the lower value at maturity.

The proportion of sugar and acid content in fruit pulp of mango determines its taste. The acid content in ripe fruit estimated during storage was found to decrease slowly with increase in maturity. The pre-harvest treatment of borax (1.0%) along with black LDPE mulching showed minimum acidity of 0.34 per cent at harvest and 0.19 per cent at the end of storage (Table 2). These findings corroborate with the findings of Rathore et al (2009) and Singh et al (2012).

The percentage of reducing sugar showed an increasing trend with the increase in storage period. Table 3 shows maximum reducing sugar of 3.27 per cent at harvest and 5.14 per cent at the end of storage period in the application of borax (1.0%) along with black LDEP mulching whereas minimum 4.18 per cent at the end of storage was recorded in control treatment. These results corroborates the finding of Bhatt et al (2008) in mango cv Dashehari, Bhatt (2012) in mango and Bhowmick et al (2012) in mango cv Amrapali.

Total sugar constitutes both reducing and non-reducing sugar. Table 3 reveals that total sugar content was affected significantly at the time of harvest and at the end of storage period. Maximum 12.12 per cent total sugar at harvest and 19.03

Table 2. Effect of pre-harvest chemical treatments and mulching on total soluble solids and acidity of mango cv Amrapali

Treatment	Total soluble solids (°Brix)		Acidity (percentage)	
	At harvest	At the end of storage period	At harvest	At the end of storage period
T_1	18.39	20.14	0.49	0.26
T_2	18.55	21.06	0.43	0.25
T_3	16.98	19.75	0.47	0.25
T_4	15.63	19.48	0.52	0.28
T_5	16.65	19.67	0.51	0.26
T_6	18.81	22.10	0.34	0.19
T_7	16.66	20.80	0.58	0.26
F-test	*	*	*	*
SEm±	0.179	0.326	0.009	0.005
$CD_{0.05}$	0.530	0.968	0.027	0.015

*Significant

Table 3. Effect of pre-harvest chemical treatments and mulching on reducing sugar, total sugar and organolaptic properties of mango cv Amrapali

Treatment	Reducing sugar (%)		Total sugar (%)		Organoleptic property
	At harvest	At the end of storage period	At harvest	At the end of storage period	
T_1	3.16	4.60	11.71	17.04	6.84
T_2	3.02	4.43	11.20	16.38	7.45
T_3	3.05	4.86	11.31	18.02	7.82
T_4	3.04	4.34	11.27	16.06	7.04
T_5	2.96	4.68	10.97	17.35	7.82
T_6	3.27	5.14	12.12	19.03	8.63
T_7	3.22	4.18	11.92	15.50	6.60
F-test	*	*	*	*	*
SEm±	0.019	0.036	0.070	0.136	0.123
$CD_{0.05}$	0.056	0.106	0.207	0.404	0.366

*Significant

per cent at the end of storage period was recorded with the treatment of borax (1.0%) with black LDPE mulching and lower 15.50 per cent at the end of storage with control treatment. These results are in agreement with the findings of Singh and Dhillon (1987) in mango cv Dashehari, Bhatt (2008) in mango cv Dashehari, Bhatt (2012) in mango and Singh et al (2012) in mango cv Dashehari. The increase in sugar may be due to breakdown of complete polymers into simpler substances by hydrolytic enzymes. Boron facilitates sugar transport within the plants and it was reported that borate reacts with sugar to form a sugar borate complex (Gauch and Dugger 1953).

The findings expressed in Table 3 indicate that the oragnoleptic score of fruits in terms of colour, flavor and texture was significantly minimum in control treatment 6.60 and maximum 8.63 in fruits treated with borax (1.0%) along with black LDPE mulching. This might be due to presence of more total soluble solids, sugar and less acid in it.

CONCLUSION

Due to imposition of ban on Indian mangoes by the European Union it has become a challenging task for the mango growers of our country to reduce the level of residual content of toxic chemicals used both at pre as well as postharvest stages of the crop and keeping them within the permissible limits. Spraying of 1.0 per cent borax along with black LDPE mulching significantly increased the TSS, reducing sugar, total sugar and decreased acidity and calcium chloride (2.0%) was found effective for decreasing physiological loss in weight of fruits. Polythene mulching should be practiced along with nutrient spray of calcium and boron to increase the yield and quality of fruits.

REFERENCES

Bender RJ 1998. Evaluation of CO_2 in controlled atmosphere storage and regulation of mango ripening. Annual Review of Phytopathology **7:** 97-112.

Bhatt A, Mishra NK, Mishra DS and Singh CP 2012. Foliar application of potassium, calcium, zinc and boron enhanced yield, quality and shelf-life of mango. HortFlora Research Spectrum **1(4):** 300-305.

Bhatt A, Mishra NK, Singh CP and Lal RL 2008. Studies on pre-harvest application of nutrients on yield, quality and shelf-life of mango cv Dashehari. Progressive Horticulture **40(1):** 41-47.

Bhowmick N, Banik BC, Hasan MA and Ghosh B 2012. Response of pre-harvest foliar application of zinc and boron on mango cv Amrapali under new alluvial zone of West Bengal. Indian Journal of Horticulture **69(3):** 428-431.

Dutta P 2004. Effect of foliar application on panicle growth, fruit retention and physicochemical characters of mango cv Himsagar. Indian Journal of Horticulture **61:** 265-266.

Gauch HG and Dugger WMJ 1953. The role of boron in the translocation of sucrose. Plant Physiology **28:** 457-68.

Gautam SK and Chundawat BS 1990. Post-harvest changes in sapota cv Kalipatti. II. Effect of

various post-harvest treatments on physico-chemical attributes. Indian Journal of Horticulture **47(3):** 264-269.

Jones R, Why G and Lunt OR 1970. The function of calcium in plant. Botanical Review **36:** 407-23.

Kluge RA, Scarpare JA and Sampaio VR 1999. Ripening of Tommy Atkins mangoes treated with Ca pre-harvest. Scientia Agricola **56(3):** 749-752.

Kumar D, Pandey V and Vishal N 2008. Effect of organic mulching and irrigation schedule through drip on growth and yield of Lat Sundari mango (*Mangifera indica* L) in eastern region of India. Indian Journal of Agricultural Sciences **78:** 385-88.

Mika A 1983. Studies on calcium penetration in to apple fruits after post harvest treatment with calcium chloride. Acta Horticulturae **138:** 15-21.

Rathore N, Mishra NK, Lal RL and Mishra DS 2009. Effect of foliar application of nutrients on yield and quality of litchi cv Rose Scented. Indian Journal of Horticulture **66(4):** 524-525.

Sanjay S, Brahmachari VS, Jha KK and Singh S 1998. Effect of calcium and polyethylene wrapping on storage life of mango. Indian Journal of Horticulture **55(3):** 218-222.

Singh AK, Singh CP and Chauhan P 2012. Effect of pre-harvest chemical treatments and mulching on quality and marketability of Dashehari mango. Indian Journal of Horticulture **69(4):** 462-466.

Singh RP, Tandon DK and Kalra SK 1993. Changes in post-harvest quality of mangoes affected by pre-harvest application of calcium salts. Scientia Horticulturae **54(3):** 211-219.

Singh Z and Dhillon BS 1987. Effect of foliar application of boron on vegetative and panicle growth, sex expression, fruit retention and physico-chemical characters of mango (*Mangifera indica* L) cv Dashehari. Tropical Agriculture **64:** 305-308.

Yadav V, Singh PN and Yadav P 2013. Effect of foliar fertilization of boron, zinc and iron on fruit growth and yield of low-chill peach cv Sharbati. International Journal of Science and Research Publications **3(8):** 1-6.

Received: 11.3.2015 ***Accepted: 12.7.2015***