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STUDIES ON EFFECT OF BAGGING AND FOLIAR APPLICATION OF DIFFERENT CHEMICALS ON PHYSICO-CHEMICALCHARACTERISTICS AND POST-HARVEST QUALITY OF MANGO FRUITS (*MANGIFERA INDICA* L.) CV. AMRAPALI

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ABSTRACT

The present investigation was carried out during the year 2020-2021 at Main Experimental Station, Department of Fruit Science, College of Horticulture & Forestry, A.N.D.U.A.&T., Narendra Nagar (Kumarganj), Ayodhya, Uttar Pradesh, India. The treatments comprised of spraying various chemicals and bagging with eco-friendly materials to study the various physico-chemical properties and effect of the above treatments on the quality and storage behaviour of mango fruit cultivar Amrapali.The experiment was laid down in randomized block design (RBD) with (08) treatments and (03) replications.The experiment consists of 8 treatments including control, T_1 (Calcium Chloride @ 2%), T_2 (Salicylic acid @ 0.03%), T_3 (Calcium Chloride @ 2% + Salicylic acid @ 0.03%), T_4 (Calcium chloride @ 2%+ Bagging), T_5 (Salicylic acid @ 0.03% + Bagging), T_6 (Calcium Chloride @ 2% + Salicylic acid @ 0.03% + Bagging), T_7 (Bagging), T_8 (Control) was used for this study. The results revealed that the foliar application of Calcium Chloride @ 2% + Salicylic acid @ 0.03% + Bagging was most effective in chemical properties of mango fruits like Total Soluble Solids (TSS), Vitamin C (Ascorbic acid), reducing sugar, non-reducing sugar, Total sugars and less acidity in quality point of view, Shelf life, Cost: Benefit ratio, minimized physiological loss weight (PLW).

Key words : Bagging, Foliar, Chemicals, Physiological Loss weight**,** Mango.

Introduction

Mango (*Mangifera indica* L.), often offered as the king of fruits, is the most important tropical fruit crop of the world after banana and plantation crops. It belongs to the family Anacardiaceae, and genus *Mangifera*, having a basic chromosome number of 10 (2n = 4x = 40). The fruit is highly valued for its excellent flavour, appealing aroma, delicious taste, attractive colour and high nutritive value. Despite higher coverage and higher production of mango fruits, the productivity of the crop in the country is still quite low (7.3 t/ha) as compared to other fruit crops like papaya, banana, apple, grape, citrus etc. This might be due to the biennial bearing habit of the crop, low fruit set development of abscission layer and deficiency of different nutrients in different parts of the country. Hence, there is huge scope to improve the national productivity of mango by rectifying all the production problems. Moreover, the domestic as well as the export market has a massive demand for mango fruits. Although India is the largest mango-producing country in the world its export in the world market is less than one percentage of total production. The main reason behind this is the quality of the fruit. The international as well as domestic mango markets are facing different issues regarding the management of mango fruit at the post-harvest stage (Malik *et al*., 2010). Amrapali is one of the most suitable varieties for national as well as overseas markets and processing industries. Anthracnose (*Colletotrichum gloeosporioides*) and stem-end rot (*Dioplodia natalensis*) are the major post-harvest diseases of mango

fruits, which cause black spots on fruit skin during ripening and storage. Bagging, a physical protection technique, not only protects fruits from pests and disease but also influences production by changing the environment of fruits during development (Son and Lee, 2008). Salicylic acid belongs to phytohormone which is classified as a phenyl propanoid compound and stimulated by biotic and abiotic stress to induce defence responses. Moreover, it is also classified as an ethylene inhibitor (Gerailoo and Ghasemnezhad, 2011).

It has been observed that Amrapali is late maturing variety. Generally, maturity coincide with monsoon therefore, fruit remains green in colour even after repining and black spot-on skin is the major problem of this cultivar. Pre harvest application of Bagging, $CaCl_2$ and Salicylic acid may play an important role to minimize these problems. Therefore, present investigation has been selected.

Materials and Methods

The present investigation was carried out on the orchard of Mango cv. Amrapali at Main Experimental Station of Horticulture and Fruit Science Laboratory, College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, during the 2020-21. The treatments comprised of spraying various chemicals and bagging with eco-friendly materials to study the various physico-chemical properties and effect of the above treatments on the quality and storage behaviour of mango fruit cultivar Amrapali. The experiment was laid down in randomized block design (RBD) with (08) treatments and (03) replications. The experiment consists of 8 treatments including control, T_1 (Calcium Chloride @ 2%), T_2 (Salicylic acid @ 0.03%), T_3 (Calcium Chloride @ 2% + Salicylic acid @ 0.03%), T_4 (Calcium chloride @ 2% + Bagging), T_5 (Salicylic acid @ 0.03% + Bagging), T_6 (Calcium Chloride @ 2% + Salicylic acid @ 0.03% + Bagging), T_7 (Bagging), T_8 (Control) was used for this study.

Chemical characteristics

Total Soluble Solids (%) : Total soluble solids of the fruits were recorded with the help of a hand refractometer of the 0-32 per cent range. A small amount of fruit pulp was taken in a muslin cloth and crushed to obtain the juice. The refractometer was wiped clean with a moist muslin cloth. A drop of juice of crushed pulp was taken on the prism of the refractometer. The reading was corrected to 20°C with the help of the temperature correction table (A.O.A.C., 2000) and expressed as a percentage.

Acidity (%) : The known quantity of the fruit pulp (g) was macerated and diluted in a small amount of distilled water and filtered through muslin cloth. The volume was made up to 100 ml. A 5 ml aliquot was taken for titration against 0.1N sodium hydroxide solution using a phenolphthalein indicator. The end point was marked by the appearance of a light pink colour which persisted for at least 15 seconds (Ruck, 1969).

The results were expressed as citric acid per 100 g of fruit pulp.

$$\text{Acidity (\%)} = \frac{\text{Tritrate value} \times \text{Normality of Alkaline} \times 64 \times \text{volume made up}}{\text{Aliquot taken} \times \text{Weight of sample} \times 1000} \times 100$$

Ascorbic acid (mg/ 100 g pulp) : Ascorbic acid content was determined by titrating known volume of aliquot prepared in 3% meta-phosphoric acid solution against indophenols solution till the end point that was marked by appearance of pink colour (Rangana, 1986). The content of ascorbic acid as mg/100g sample was calculated using following formulae:

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{Titrate value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot taken} \times \text{Weight of sample taken}} \times 100$$

Reducing Sugars (%) : To determine the reducing sugars, 100g pulp was crushed with distilled water, filtered with muslin cloth and volume was maintained up to 100 ml. 5ml aliquot was taken with 5ml of each Fehling's 'A' and 'B' solutions and was titrated against 1.0% glucose in boiling condition using Methyl Blue as indicator. A blank with 5ml of each Fehling's 'A' and 'B' was also run. The results were expressed as per cent of reducing sugars:

$$\text{Reducing sugar (\%)} = \frac{(\text{Blank tritrate value} - \text{Sample titre value}) \times \text{Volume made up}}{\text{Aliquot taken} \times \text{Weight of sample taken}} \times 100$$

Non–reducing sugar (%) : For estimating non-reducing sugar, the value of reducing sugar was subtracted from total sugars and the resultant was multiplied by 0.95. Following formula was used for estimating non-reducing sugar-

Non-reducing sugar = (Total sugars % – Reducing sugar %) × 0.95

Total sugars (%) : The sum of reducing and non-reducing sugar was expressed as total sugars. Total sugars (%) = Reducing sugar (%) + Non-reducing sugar (%).

Physiological loss in weight (PLW) : To determine the weight loss of the fruit during post-harvest storage,

both treated and control fruits were weighed at different sampling intervals of 0, 3, 6, 9, 12 and 15 days after harvesting of fruit. Then weight loss was calculated as the difference between initial fruit weight and the fruit weight at the time of measurement and expressed in percentage.

$$\text{P.L.W.} = \frac{\text{Initial weight} - \text{Final weigh}}{\text{Initial weight}} \times 100$$

Results and Discussion

Randomly 6 fruits per treatment had been collected from the experimental farm and the following observations recorded during the investigation in Department of fruit Science, College of Horticulture and Forestry, Kumarganj, Ayodhya (U.P.), India.

Chemical parameters

The mango cv. Amrapali recorded significantly maximum TSS (22.00%), total sugars (17.40%), reducing sugar (2.62%), non-reducing sugar (14.78%), ascorbic acid (30.90mg/100gm) and the minimum acidity (0.14%) when trees were sprayed with (Calcium chloride (2%) + Salicylic acid (0.03%) + Bagging) at 45 days before harvest (Table 1), while those results were TSS (17.00%), total sugars {(14.30%), reducing sugar (2.15%), non. reducing sugar (12.15%)}, ascorbic acid (25.80mg/ 100gm), and the maximum acidity (0.19%)) and pulp stone ratio (4.21%) in control.

The TSS content of fruit increases during ripening might be due to hydrolysis of insoluble starch into soluble sugars and loss of moisture Koksal *et al*. (1994). Peter *et al*. (1999) treated various fruits with several calcium sources and proved calcium chloride has a faster sugar conversion capacity from starch than other compounds. The increase in the sugar content of mango fruits could be due to the normal ripening process that leads to senescence and the transformation of some carbohydrate's components from starch to sugars by the enzymatic activities. The increase in the sugars of fruits has been recorded by Wahdan *et al*. (2011). Similarly, the pre-harvest spray of calcium chloride has been reported to improve the total sugar content of fruits by Singh *et al*. (1998) in Amrapali mango and guava fruits Wali and Kumar (2006). The pre-harvest spray of $CaCl_2$ 1.50% has been reported to improve the reducing sugar content of fruit by Karemera and Habimana (2014) in mango fruits cv. Alphonso. The present result is also supported by the result obtained earlier by Kaur *et al*. (2015). Pre-harvest and post-harvest treatments of calcium and shrink film packaging on plum cv. Satluj Purple exhibited the best fruit quality by maintaining a palatability rating, reducing sugar and non-reducing sugar. (Patel *et al*., 2017).

The ascorbic acid content of mango fruits significantly decreased with the advancement of the storage period, probably due to the rapid conversion of L-ascorbic acid into dehydro-ascorbic acid in the presence of ascorbinase enzyme (Mapson, 1970). The above results are very close to the findings of Watanawan *et al*. (2008) in mango. Mishra *et al*. (2017) reported that pre-harvest treatment of polythene bag + calcium chloride @2%, before harvesting on guava fruits showed increasing ascorbic

Table 1 : Effect of different chemicals and bagging on chemical parametersof mango fruits cv. Amrapali.

S. no.	Treatments	TSS (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugar (%)	Ascorbic acid (%)	Acidity (%)
1	T_1, Calcium chloride (2%)	19.00	15.40	2.40	13.00	28.50	0.17
2	T_2, Salicylic acid (0.03%)	20.00	15.56	2.44	13.16	28.90	0.15
3	T, Calcium chloride (2%) + Salicylic acid (0.03%)	21.00	17.10	2.55	14.60	30.60	0.14
4	T_4, Calcium chloride (2%) + Bagging	18.56	14.60	2.25	12.43	27.10	0.16
5	T_5, Salicylic acid + Bagging	18.06	16.90	2.51	14.39	30.40	0.15
6	T_6, Calcium chloride (2%) + Salicylic acid (0.03%) + Bagging	22.00	17.40	2.62	14.78	30.90	0.14
7	T_7, Bagging	17.50	14.40	2.17	12.15	26.50	0.18
8	T_8, Control	17.00	14.30	2.15	12.15	25.80	0.19
SEm ±		**0.95**	**0.51**	**0.090**	**0.775**	**0.736**	**0.008**
CD at 5%		**2.90**	**1.55**	**0.274**	**2.351**	**2.233**	**0.025**

Table 2 : Effect of different chemicals and bagging on Physiological Loss weight (%) of mango fruits cv. Amrapali.

S. no.	Treatments	Symbol	PLW (%)					
			Days of storage					
			3	6	9	12	15	Mean
1	Calcium chloride (2%)	T_1	1.67	2.63	5.35	8.3	14.5	6.49
2	Salicylic acid (0.03%)	T_2	1.73	2.77	4.75	7.9	14.65	6.36
3	Calcium chloride (2%) + Salicylic acid (0.03%)	T_3	1.8	2.78	2.89	7.4	12.98	5.57
4	Calcium chloride (2%) + Bagging	T_4	1.77	2.78	2.95	8.12	13.45	5.81
5	Salicylic acid (0.03%) + Bagging	T_5	1.7	2.47	5.34	8.65	13.35	6.30
6	Calcium chloride (2%) + Salicylic acid (0.03%) + Bagging	T_6	1.71	2.74	2.53	7.23	12.5	5.34
7	Bagging	T_7	1.68	2.65	3.45	9.12	15.5	6.48
8	Control	T_8	2.19	3.2	4.9	12.73	16.5	7.90
Mean		1.78	2.75	4.02	8.68	14.8	6.28	

Characters	Treatments (T)	Duration (D)	T×D
SEm±	0.04	0.025	0.20
CD at 5%	0.11	0.0714	0.57

acid. Acidity of fruit decreases with the pre-harvest spray of nutrients, might be due to increase in translocation of carbohydrates and increase metabolic conversion from acidity to sugar by the reaction involving reversal of glycolytic way path used in respiration or both simultaneously. The similar results were also reported by Dhahiya *et al.* (2001) and Karemera and Habimana (2014).

Physiological loss weight

The data presented in Table 2 clearly reveals that the various treatments significantly influenced the physiological loss in weight. The maximum physiological loss weight on 3rd, 6th, 9th, 12th and 15th days of storage was recorded in control (7.90%), while minimum weight loss was found in Calcium chloride (2%) + Salicylic acid (0.03%) + Bagging (5.34%) followed by Calcium chloride (2%) + Salicylic acid (0.03%) 5.57%. There was a progressive and significant increase in PLW of fruits with an increase in storage duration. The decrease in weight loss by the application of calcium might be ascribed due to its consistency in the cell wall resulting in fruit firmness, retardation of respiratory rate and delay in senescence.

Similar results of low physiological loss of weight in fruits during storage by pre-harvest application of different chemicals and plant growth regulators on physical parameters and shelf life of mango (*Mangifera indica* L.) cv. Amrapali. The pre-harvest application of $CaCl_2$ 2% recorded a significant minimum physiological loss in weight (Vishwakarma *et al.* (2017**)** similarly, the minimum physiological loss in weight (PLW) (11.06%) was observed in Amrapali mango fruits treated with salicylic acid (200 ppm) **(**Reddy *et al.*, 2016).

Conclusion

From the ongoing summary of the present investigation, it can be inferred that fruit quality parameters *viz*. TSS, ascorbic acid, reducing sugar, non–reducing sugar and total sugars were recorded maximum in T_6 Calcium chloride (2%) + Salicylic acid (0.03%) + Bagging besides acidity in the fruit was drastically reduced and also minimum physiological loss in weight. It can be concluded that all the treatments show good effects on increasing fruit quality as compared to control but T_6 was found more pronounced among all the treatments and can be used in increasing the quality of mango.

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