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EVALUATION OF SOME POTENTIAL CHEMICALS FOR REDUCING SAPBURN INJURY IN MANGO

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Abstract

Sapburn is a serious quality concern for local mango industry. During this study, physiological mature green fruits of cultivars Sindhri and Chaunsa were used. Pedicels of harvested fruits were cut back and immediately treated with aqueous solution of one of the chemicals: 1% calcium hydroxide (lime), 1% Sodium Carboximethyl Cellulose (CMC), mixtures of Lauryl Sulfate Sodium (LS) (0.1%) with CMC (1%), Tween-20 (1%), Tween-80 (1%), vegetable oil (1%) and 0.1% LS along with 0.04% detergent and simple water together with an untreated control. The treated fruits were transported to the lab and stored (14°C and 85% RH) for 7 days and 14 days for cultivar Sindhri and Chaunsa respectively. Sapburn injury score was observed after 24, 48 and 72 hrs during storage. It was found that maximum injury developed within 24 hrs of sap contact in case of cv. Sindhri while in case of cv. Chaunsa injury development continued even after 72 hrs of sap contact. Sapburn injury was significantly reduced by Tween-80 and de-stemming under Ca $(OH)_2$. Wiping fruits with edible vegetable oil significantly controlled sapburn injury, however it caused blotchiness, poor fruit ripening and induced off-flavour in mango.

Key words: *Mangifera indica,* Sapburn injury development, Calcium hydroxide, Sodium Carboximethyl Cellulose, Lauryl Sulfate Sodium, Tween-80

INTRODUCTION

The mango is known as "the apple of the tropics" and is as important as are apples in the temperate zone. The mango (*Mangifera indica* L.) is the most economically important fruit crop in the Anacardiaceae (Cashew or poison ivy family). The family contains 73 genera and about 600-700 species (Mukherjee et al., 1951), distinguished by their resinous bark and caustic oils in leaves, bark, and fruits. Most of them are wild while 13 of them bear edible fruit of minor importance (Gangolly et al. 1957) but none of these species have a cultivar of organoleptic quality except that of indica.

Mango is the 2nd largest fruit of Pakistan grown after citrus and occupies about 16% of the total fruit area of 652,000 hectares. From the total area of 1, 03,000 hectares around 52.4% is in the Punjab with Multan and Bahawalpur being prominent. Sindh's share is 45.6% with Hyderabad and Mirpurkhas forming the main tracts. Of the total 1.67 million tonnes production,

Punjab's share is 66% and Sindh 32.5%. Balochistan and NWFP share the remaining less than 2% (Khan, 2005).

It is unfortunate that mango is subjected to a large number of disorders right from the plants in the nursery to the fruit in transit and storage, which ultimately result in low yield with poor quality fruit (Chacko, 1991). For the production of superior quality fruit, many problems need to be overcome. Our mango producers and exporters are facing problems of sapburn injuries which results downgrading and lowering the price of fruit especially in international markets. The Pakistani mangoes fetch $315 per tonne compared to mangoes from other major countries ($850 per tonne) (Anonymous, 2006).

The sap/latex of the mango fruit is a transparent fluid (viscous clear or slightly milky liquid with aroma characteristics of ripe fruit), that oozes out instantaneously from unripe fruit as soon as the fruit is detached from the stalk. Sap has long been known for its ability to produce skin damages on mango fruit and allergic contact dermatitis among workers during harvesting of mature green fruit. The latex is caustic and can also inflict serious eye injury (Campbell, 1992; Loveys et al., 1992). The mango sap can be separated into two distinct fractions: oil and a protein-polysaccharide fraction. Injury occurs wherever the oil fraction makes contact with and enters the mango skin, which is normally via the lenticels. A major component of this oil fraction is terpinolene which gave characteristic symptoms of sapburn injury when applied to the fruit skin (O'Hare and Prasad, 1991).

In the past no work has been done on sapburn management in commercial mango cultivars of Pakistan. Therefore, the need for sapburn management in the commercial mango cvs. was felt by the local industry to improve cosmetic quality of fruit and to earn maximum profits by exporting premium quality mangoes to the international markets.

Under the initiative of "*'Mango Quality Improvement Project"* funded by Pakistan Horticulture Development and Export Board (PHDEB), the Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan carried out two year studies. The objective of the current study was to evaluate the efficacy of various chemicals for reducing sapburn injuries in two commercial cvs. Sindhri and Chaunsa.

MATERIALS AND METHOD

Uniform mango fruits of two cvs. Sindhri and Chaunsa were harvested at physiological maturity with a 4-5 cm fruit stalk attached from a commercial orchard located in District Multan, Punjab province. After harvest fruits were de-stemmed and immediately treated with one of the chemical solutions as under.

Chemical compounds and handling systems for cv. Sindhri

Treatments	Chemical	Handling system	Concentration (%)
T_1	Simple water (Control)	cut + dip	-
T_2	Detergent pre-treatment	dip + cut	0.04
T_3	Sodium Carboximethyl Cellulose (CMC)	dip + cut	1.0
T_4	Lauryl Sulfate Sodium (LS)	dip + cut	0.1
T_5	CMC + LS	dip + cut	1.0+0.1
T_6	Vegetable oil	Dabbing	1.0
T_7	Tween-80	cut + dip	1.0
T_8	De-stemming under Ca $(OH)_2$	-	1.0

Chemical compounds and handling systems for cv. Chaunsa

Treatments	Chemical	Handling system	Concentration (%)
T_1	Control	-	-
T_2	Simple water	cut + dip	
T_3	Detergent pre-treatment	dip + cut	0.04
T_4	Sodium Carboximethyl Cellulose (CMC)	dip + cut	1.0
T_5	Lauryl Sulfate Sodium (LS)	dip + cut	0.1
T_6	CMC + LS	dip + cut	1.0 + 0.1
T_7	Tween-80	cut + dip	1.0
T_8	De-stemming under Ca $(OH)_2$	-	1.0
T_9	Calcium hydroxide	cut + dip	1.0
T_{10}	CMC + LS + Lime	cut + dip	0.5+0.05+1.0
T_{11}	Tween-20	cut + dip	1.0

Fruits were dipped in solution for 45-60 seconds then air dried and packed in corrugated boxes. The treated fruit were transported to the lab and stored (14°C and 85% relative humidity) for 7 days and 14 days for cvs. Sindhri and Chaunsa respectively. Incidence of sapburn injury was observed after 24 hrs, 48 hrs and 72 hrs. Damage was scored from nil to dark brown depending on the level of injury (no change to severe) (Brown et al., 1986). All data were analyzed statistically by ANOVA using the Complete Randomized Design (CRD) using mango fruits a replication, performed by SPSS (SPSS® Illinois, USA) and Duncan's Multiple Range test (DMR) were used to compare differences between treatments at 99% confidence level of each variable.

RESULTS AND DISCUSSION

a) Sapburn injury score in cv. Sindhri

In this experiment sapburn injury score after using various chemicals was recorded. The statistical analysis showed that mean maximum injury development took place within 24 hrs (1.49) of sap contact; however the injury development continued to increase even after 48 hrs (1.67) and the mean maximum sapburn injury was recorded after 72 hrs (1.71) during storage (Figure 1). The results in case of reduction of sapburn injury after 24 hrs during storage illustrate that de-stemming under Ca $(OH)_2$ was found superior to all other treatments (0.16) followed by vegetable oil (0.40), while LS (2.96) proved to be the least effective treatment in reducing sapburn injury in mango cv. Sindhri (Table 1a). Wiping fruits with edible vegetable oil significantly controlled sapburn injury; however, it caused blotchiness, poor fruit ripeness and induced off-flavour in mango as earlier reported by (Lim and Kuppelweiser, 1993). In a previous study (O'Hare et al., 1992) it was reported that de-stemming mango fruit in a 1% Cold Power® (detergent) solution reduced sap injury to the fruit, but not as effective as 1% calcium hydroxide solution.

b) Sapburn injury score in cv. Chaunsa

The results regarding sapburn injury in cv. Chaunsa were recorded after 24 hrs, 48 hrs and 72 hrs during storage after application of treatments. The statistical analysis showed that mean maximum injury development took place within 24 hrs (2.09) of sap contact; however the injury development continued to increase even after 48 hrs (2.34) and the mean maximum sapburn injury was recorded after 72 hrs (2.40) during storage (Figure 1). The results regarding reduction of sapburn injury after 24 hrs during storage demonstrate that the minimum sapburn injury score was observed in fruits which were de-stemmed under Ca $(OH)_2$ (0.27) followed by Tween-80 (0.33) as compared with control (4.0). In case of cv. Chaunsa LS effectively reduced sapburn injury (0.33) but the fruits remained hard and green as at the time of harvest even after three weeks of storage. Tween-20 and CMC also showed better results against sapburn injury (1.47) and (1.60), respectively (Table 1b). In this context, Holmes and Ledger (1992) demonstrated that mango

sapburn injury can be reduced by a number of methods: a) using detergent dips and sprays prior to de-stemming, b) de-stemming under water using lime, c) picking without stems onto a harvesting aid and dipping or spraying detergent onto the fruit immediately.

CONCLUSION

The results showed that the maximum sapburn injury took place within first 24 hrs of sap contact however, the injury may continue even after 72 hrs of sap contact in both the cultivars of mango. Therefore, extra care must be taken during first 24 hrs of harvest. De-stemming under Ca $(OH)_2$, Tween-20 and Tween-80 proved to be the most effective treatments against sapburn injury in both the cultivars.

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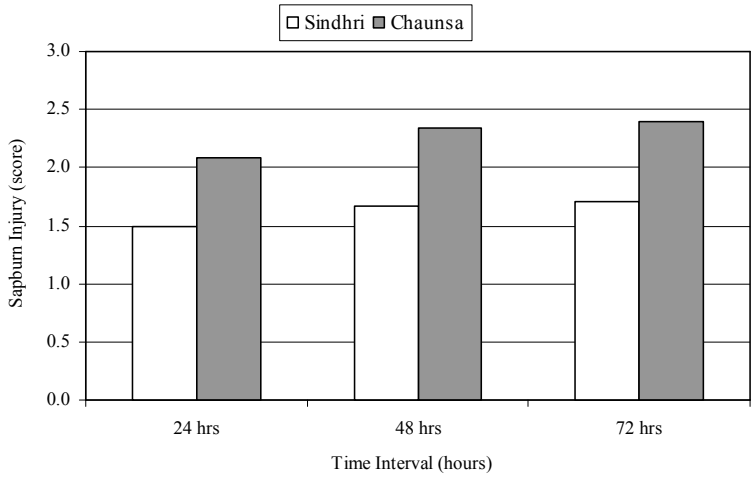
Table 1: Effect of different chemicals on sapburn injuries in two cultivars of mango

Treatments	24hrs	48hrs	72hrs
a) Sapburn injury score in cv. Sindhri			
T_1	1.40c	1.40c	1.40c
T_2	2.10bc	2.20b	2.30b
T_3	2.46ab	2.73ab	2.80ab
T_4	2.96a	3.20a	3.33a
T_5	2.03bc	2.33b	2.33b
T_6	0.40d	0.87cd	0.90cd
T_7	0.43d	0.47d	0.50d
T_8	0.16d	0.17d	0.17d
b) Sapburn injury score in cv. Chaunsa			
T_1	4.0a	4.0a	4.0a
T_2	1.92c	2.59cd	2.67cd
T_3	3.80a	4.0a	4.0a
T_4	1.60c	2.06d	2.33de
T_5	3.13b	3.17bc	3.20bc
T_6	0.33d	0.60e	0.60f
T_7	0.33d	0.67e	0.80f
T_8	0.27d	0.27f	0.27f
T_9	3.40ab	3.17bc	3.60ab
T_{10}	2.80b	2.87c	2.93cd
T_{11}	1.47c	2.0d	2.0e

Any two means not sharing a common letter differ significantly at 1% level of probability



Figures 1: Sapburn injury development in mango cv. Sindhri and Chaunsa