Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(2): 838-841
Received: 17-01-2021
Accepted: 26-02-2021

Ashish Kumar Lamba
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh, India

Sachin Kumar
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh, India

Satya Prakash
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh, India

Vipin Kumar
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh, India

Corresponding Author:
Ashish Kumar Lamba
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh, India

Effect of pre-harvest application of chemicals and pesticide on total soluble solids (TSS) in mango under ambient condition

Ashish Kumar Lamba, Sachin Kumar, Satya Prakash and Vipin Kumar

Abstract
Mango (*Mangifera indica* L.) is the most important crop among the tropical and subtropical fruits grown in more than 90 countries of the world. The mango, because of its great utility, occupies a pre-eminent place among the fruit crops grown in India and is acknowledged as the “King of Fruits” of this country. Mango possesses unique nutritional, medicinal and industrial qualities apart from being a rich source of important nutrients (calcium, magnesium, iron, zinc, phosphorus, potassium etc) and vitamins (A and C). It also contains good amount of carbohydrates at different stages of maturity. It is consumed fresh as either green or mature ripe, and processed into numerous products. Among the pre-harvest treatments, the highest levels of soluble solids (19.78 ^{o}brix) were recorded in fruits treated with 3% Dehydrated Calcium chloride + 0.1% Carbendazim. The data also revealed that incorporation of Carbendazim in the treatments significantly increased the levels of soluble solids. In comparison with Dehydrated Calcium chloride, the Calcium chloride was found to be less effective in increasing the soluble solids contents in fruits.

Keywords: Total soluble solids (TSS), mango, ambient condition

Introduction
Mango (Mangifera indica L.), in India is one of the most acclaimed tropical fruits recognized for its richness in flavor and aroma throughout the world. Being a seasonal fruit, mango is available only during the summer months from 87 commercial mango producing countries in the world. Eastern India and Burma, is the place of origin of mango, has given India a distinct place in the world mango market due to its diverse genetic resources. India is the largest producer of mango in the world, with about 30 mango cultivars under commercial cultivation, of which only a few cultivars have demand in the International market . Among the cultivars in India, mango cv. Alphonso is considered as King of mango because of its unique flavor, size, shape, keeping quality and superior canning property . Due to improper postharvest practices during harvesting, packaging, and storage approximately 20-25% of fruits are wasted. Major challenges affecting mango trade are short shelf life, high susceptibility to chilling injury, uneven ripening postharvest diseases and consumer demand for improved fruit quality. This wastage can be reduced to some an extent through a proper understanding of fruit ripening using scientific methods. Fruit ripening is a highly coordinated, genetically programmed and an irreversible developmental process involving specific biochemical and physiological changes, in turn dictating fruit quality. Use of artificial ripening agent like ethylene gas at the commercial level is an expensive affair. Hence, mango sellers use a cheaper substitute for ethylene, calcium carbide (CaC_2) which in the presence of moisture releases acetylene gas, a weak analog of ethylene. CaC_2 is a greyish black lump used for artificial induction of ripening process in fruits. But there are statements that CaC_2 treated fruits affect the nervous system in humans causing a burning sensation in the chest and the abdomen, vomiting, nausea, and diarrhoea due to the presence of arsenic (As) or phosphorus (P). Chronic exposure to the CaC_2 is carcinogenic and could lead to peptic ulcers were reported. In addition, symptoms of arsenic (As) or phosphorus (P) exposure like diarrhoea, thirst, and irritation in the eyes, mouth, nose and throat were also reported from previous studies. Inhalation of acetylene decreased haemoglobin, red blood cells, white blood cells, and premature ventricular contraction. Although the use of CaC_2 for fruit ripening is banned in most countries, CaC_2 is available in the market because of wider application in the field of chemical and steel industries. Thus, in the market the practice of using CaC_2 as a ripening agent in mango is still continuing among fruit sellers in India. Rising food safety concerns warrants researchers to assess the risks associated with the consumption of foods contaminated by pesticides, heavy metals or toxins.

However, owing to its rapid action on increasing fruit appeal, commercial usage of CaC_2 is still prevalent. Hence, an investigation was carried out to understand the changes in physical, physiological, biochemical parameters including enzymatic activity and free radical scavenging potential in mango cv. Alphonso fruits treated with the laboratory grade (LG) and commercial grade (CG) CaC_2 at the reported highest acceptable dose of 1 g kg^{-1} for mango fruits and EDX results to support the hypothetical statement of presence of hazardous trace elements in pouched CaC_2 which would serve as a basis towards developing biosensors for detecting CaC_2 treated mangoes.

Materials and Methods

The present study was conducted in an experimental orchard and post-harvest laboratory of Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The experimental orchard which was located in Horticultural Research Centre (HRC) of the University was maintained healthy following proper orchard management practices. The university is situated on Meerut-Roorkee road (Near Modipuram), about 11 km away from the Meerut city. Geographically, experimental field is located at 290 01 North latitude, 770 45' East longitude and at an altitude of 237.75 meter above mean sea level.

Climate and weather condition

The climate of this region is sub-tropical with maximum temperature of about 42˚C during summer (April to October) and a minimum temperature of about 7˚C during winter (November to March). Frost occasionally occurs in this region during winter from December to February. The monsoon generally begins during the last week of June and ceases by the end of September. The average annual rainfall in the region is about 862.7 mm and the annual relative humidity varies from 67 to 83 per cent.

Meteorological data

The meteorological data (mean temperature, relative humidity and total rainfall) for the experimental period of 2013-14 were recorded from the meteorological observatory of Indian Institute of Farming Systems Research (IIFSR), Modipuram, Meerut (Uttar Pradesh) which is located just near the experimental site.

Experimental Materials

Selection of experimental trees

The bearing trees of uniform size and vigour were selected randomly for the study. The selected trees were properly tagged before the application of treatments.

Pre-harvest application of treatment

The treatments consisted of foliar sprays of different chemicals and fungicides were applied on the selected trees twice at 12 days interval. For control treatment, only water was sprayed. All sprays were applied to the fruits and foliage on the trees.

Use of wetting agent in the spray solution

In all the spray solution including control the wetting agent, polyoxyethylene sorbiton monolaurate was added @ 0.01%.

Preparation of stock solution

The stock solution of each chemical was prepared as per the procedure described by Prakash (1984) [5]. The pH of the stock solution except of carbendazim was adjusted at 7. The final volume of each stock solution was made up to 1000 ml. The spray solution of different concentrations was prepared by dilution method. For dilution of chemical solution the distilled water was used.

Method of application

All sprays were applied by means of Knapsack Hans sprayer which was thoroughly washed before spraying to avoid contamination.

Treatments

There were a total of 13 treatments including control in the experiment. The details of treatments are given at 3.5.2.

Time of foliar spray

The pre-harvest chemical spray was done in the morning hours in a windless day. The first spray was done on 20/05/2014, while the second spray was applied on 03/06/2014, i.e. 12 days after first spray and 35 days before anticipated harvest date.

Harvesting of fruits

Physiologically matured fruits were harvested in the morning hours from the treated branches on 8th July 2014 i.e. after 35 days of second spray.

Desaping

Just after harvesting, the fruits were kept upside down for two hours for desaping so that latex flows out from the fruits completely.

Cleaning of fruits

After desaping, the fruits were cleaned properly.

Technical programme: The details of experimental design, treatments, replication, unit per treatment sample size etc are given as under:

Experimental design: Randomized Block Design

Replication and unit per treatment: The pre-harvest treatments were replicated four time and two trees served as unit of a treatment.

Treatments: 13

S. N.	Treatments
1	Control (Fresh water)
2	Calcium Chloride 2%
3	Calcium Chloride 3%
4	Calcium Chloride 2% + Carbendazim 0.1%
5	Calcium Chloride 3% + Carbendazim 0.1%
6	Dehydrated Calcium Chloride 2%
7	Dehydrated Calcium Chloride 3%
8	Dehydrated Calcium Chloride 2% + Carbendazim 0.1%
9	Dehydrated Calcium Chloride 3% + Carbendazim 0.1%
10	Silver Nitrate 100 ppm
11	Silver Nitrate 200 ppm
12	Silver Nitrate 100 ppm + Carbendazim 0.1%
13	Silver Nitrate 200 ppm + Carbendazim 0.1%

Cultivar used: Dashehari

Results and Discussion

The levels of total sugars in pre-harvest treated fruits were significantly affected due to the application of pre-harvest treatments as compared to the sugars content in control fruits (Table & fig. 4.1.9). The levels of totals sugars in pre-harvest treated fruits ranged from 11.73 to 14.75 percent .The application of 3% Dehydrated Calcium chloride + 0.1% Carbendazim resulted in higher levels of total sugars (15.08%) followed by Dehydrated Calcium chloride (14.23%), Silver nitrate (13.95%), and Calcium chloride (13.47%). During ripening, lowest levels of sugars were recorded in control fruits (12.15%). Among the treatments of Dehydrated Calcium chloride, Calcium chloride and Silver nitrate, Dehydrated Calcium chloride was comparatively more effective in increasing the levels of sugars in pre-harvested treated fruits at ripening time than Calcium chloride and Silver nitrate. In the study, the presence of Carbendazim in treatments significantly affected the content of total sugars in pre-harvested treated fruits. For example, fruits treated with treatments having Carbendazim had higher level of sugars (13.63 to 15.08%) than the treatments having no Carbendazim (13.17 to 14.23%). Percent increase in total sugars content in fruits over control was also found to be maximum with 3% dehydrated calcium chloride + 0.1% carbendazim (+ 28.55%), while the minimum increase of 12.27% in total sugars content in fruits over control was recorded with 2% calcium chloride. When compared the combined effect of treatments and their concentrations on total sugars content in fruits, it was 3% dehydrated calcium chloride + 0.1% carbendazim treatment which resulted in higher level of total sugars in fruits.

While examining the effect of pre-harvest application of chemical and pesticides on total soluble solids and total sugars contents in fruits, the highest level of total soluble solids and total sugars were recorded in fruits treated 3% Dehydrated Calcium chloride + 0.1% carbendazim followed by 200ppm Silver nitrate + 0.1% carbendazim. Bhatt *et. al.* (2012) [1] also found higher levels of total soluble solids and sugars in pre-harvest treated fruits. Similar observations were also noticed by Rani and Brahmachari (2003) [6] who reported improvement in the soluble solids with higher concentration of Calcium salts. The positive effect of pre-harvest application of Calcium salts on total soluble solids and total sugars contents in the current study was also observed by Singh *et al.* (2012) [7] who had recorded higher levels of total soluble solids and total sugars in Calcium treated fruits. Silver nitrate treated fruits in the present study contained lesser levels of soluble solids and total sugars in comparison with Dehydrated Calcium chloride containing treatments might be because of the fact that silver nitrate is known to delay the metabolic activity of fruits during ripening and storage (Fan *et al.* 2012) [2]. The inhibitory effect of silver ion also led to incomplete metabolic changes. Incorporation of carbendazim in the treatments in the current study significantly increased the levels of soluble solids and total sugars in fruits when compared with treatments containing no carbendazim. The significant role of carbendazim in improving the chemical composition of fruits was also confirmed by Sreejith Vijayan Ramakrishna *et al.* (2015) [9] who reported that carbendazim treated fruits contained higher levels of total sugars at the end of storage period. Another pre-harvest study revealed that foliar spray of 2% $CaCl_2$ combined with bagging was effective in improving the storage quality of fruits in terms of total soluble solids and sugars (Jakhar and Pathak 2014) [4]. Improvement in storage quality of Baneshan mango in respect of total soluble solids and sugars was also observed when $CaCl_2$ was applied in combination with carbendazim (Sudhavani and Sankar 2002) [10]. Significantly higher levels of total soluble solids and sugars were also observed in Totapari mango when trees were sprayed with 1.50% $CaCl_2$ at 30 days before harvesting (Patil *et al.* 2003). The findings of the present study was further supported by Hojo *et al.* (2009) [3] who advocated that higher concentrations of $CaCl_2$ influenced the total soluble solids in pre-harvest fruits. Singh (2014) [8] also stated that pre-harvest application of 2% calcium salts significantly increased the levels of total soluble solids and total sugars in fruits.

Table 1: Effect of pre-harvest application of chemicals and pesticide on total soluble solids (TSS) in mango under ambient condition.

Treatments	Total Soluble Solids (ºbrix) At ripening	Per cent increase (+) or decrease (-) in total soluble solids over control
Control (Fresh water)	15.34	-
Calcium Chloride 2%	16.52	(+)7.69
Calcium Chloride 3%	17.41	(+)13.49
Calcium Chloride 2% + Carbendazim 0.1%	16.61	(+)8.27
Calcium Chloride 3% + Carbendazim 0.1%	18.12	(+)18.12
Dehydrated Calcium Chloride 2%	16.41	(+)6.97
Dehydrated Calcium Chloride 3%	18.31	(+)19.36
Dehydrated Calcium Chloride 2% + Carbendazim 0.1%	17.84	(+)16.29
Dehydrated Calcium Chloride 3% + Carbendazim 0.1%	19.78	(+)28.94
Silver Nitrate 100 ppm	15.62	(+)1.82
Silver Nitrate 200 ppm	18.25	(+)18.97
Silver Nitrate 100 ppm + Carbendazim 0.1%	16.56	(+)7.95
Silver Nitrate 200 ppm + Carbendazim 0.1%	18.46	(+)20.33
LSD (<0.05%)	0.691	

References

1. Bhatt A, Mishra NK, Mishra DS, Singh CP. Foliar application of potassium, calcium, zinc and boron enhanced yield, quality and shelf life of mango. Hort. Flora Research Spectram 2012;1(4):300-305.
2. Fan X, Blankenship SM, Mattheis JB. 1-MCP inhibits apple ripening. J Amer. Soc. Hort. Sci 2012;124:690-695.
3. Hojo RH, Sao Jose AR, Hojo ETD, Alves JFT, Reboucas TNH, Dias NO. Quality of 'Tommy Atkins' mangoes in post-harvest with calcium chloride spray use in the pre-harvest period. Revista Brasileira de Fruticultura 2009;31(1):62-70.
4. Jakhar MS, Pathak S. Enhancing quality of mango (*Mangifera indica* L.) fruits cv. Amrapali with pre-harvest foliar spray and fruit bagging. Annals of Agri. Bio Research 2014;19(3):488-491.
5. Prakash S. Effect of plant growth regulators and chemicals on fruit retention and fruit quality of mango (*Mangifera indica* L.) cv. Chausa. G.B.P.U.A. & T., Ph.D. thesis submitted to Pantnagar 1984.

6. Rani R, Brahmachari VS. Effect of foliar application of chemicals on quality characters of mango during storage. Progressive Horticulture 2003;35(2):216-218.
7. Singh AK, Singh CP, Kushwaha PS, Chakraborty B. Efficacy of post-harvest treatments on fruit marketability and physico-chemical characteristics of Dashehari mango. Progressive Horticulture 2012;44(2):215-219.
8. Singh CPP. Response of pre-harvest spray of chemicals on shelf life and quality of mango (*Mangifera indica* L.) cv. Dashehari. International Journal of Basic and Applied Agricultural Research 2014;12(3):374-378.
9. Sreejith Vijayan Ramakrishna BM, Sreenivas KN, Shankarappa TH, Krishna HC. Impact of pre-harvest spraying of fungicides on postharvest development of anthracnose and quality of mango fruits. Environment and Ecology 2015;33(1A):261-266.
10. Sudhavani V, Sankar CR. Effect of pre-harvest sprays on the shelf life and quality of Baneshan mango fruits under cold storage. South Indian Horticulture 2002;50(1-3):173-177.