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Effect of pre-harvest application of chemicals and pesticide on total sugars in mango under ambient condition

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Abstract
The pre-harvest study was conducted in an experimental orchard and post-harvest laboratory of the department of Horticulture during 2013–14 with a view to investigate the effect of chemicals and pesticide application on ripening and fruit quality of mango under ambient condition. The levels of totals sugars in pre-harvest treated fruits ranged from 11.73 to 14.75 per cent. 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%).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.

Keywords: Mango, chemicals and sugar

Introduction
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. It plays a pivotal role in Indian diets and occupies premier position in Indian economy. The productivity of mango in India is 7.3 MT/ha (Saxena, 2013-14) [1]. The major mango producing states in India are Uttar Pradesh, Andhra Pradesh, Karnataka, Bihar, Gujarat, Tamil Nadu and Maharashtra. Among these major mango growing states in the country, Uttar Pradesh has the reputation in producing quality mango. The species of commercial importance belonging to mango family are cashew nut (*Anacardium occidentale* L.), pistachio nut (*Pistachia vera* L.), hog plum (*Spondias cythera* L.).gandaria (*Bouea gandaria*), marula (*Sclerocarya birrea*), yellow mombin (*Spondias mombin*), red mombin (*Spondias purpurea*), imbu (*Spondias tuberose*), dragon plums (*Dracontomelum spp.*), kaffir plum (*Harpepbyllum caffrum*) etc. Mangoes are harvested 12-16 weeks after fruit set depending upon the variety (Lakshminarayana *et al*., 1970; Tondan and Kalra, 1983 and 1993) [2, 4]. The determination of maturity in mango is known on the basis of skin and pulp colour, fruit growth, specific gravity, number of days from full bloom or fruit set, amount of heat units available, dry matter content, TSS, acidity, starch accumulation and amylase activity. The storage potentiality, marketable life and quality of mango fruits depend on stage of maturity at which it should be harvested. Poor quality and uneven ripening are caused by early harvesting and late harvesting results in extremely poor self life (Thompson, 1996) [5]. Maturity is based on measurement of various qualitative and quantitative factors. Various workers have correlated the maturity with various physical characteristics like skin colour, shape and size, shoulder growth, specific gravity. Some research workers have correlated it with chemical perameters like T.S.S., acidity, starch, phenolic compounds and carotenoids (Cheema and Dani, 1934; Singh *et al*., 1937) [6, 7]. Fruits harvested at late maturity stage result in reduced fruit quality with greater susceptibility to diseases upon ripening. It is a common practice in northern India to harvest mangoes at least 2-3 weeks before harvesting date to get premier price.

The premature fruits do not ripen properly under ambient condition. Though mangoes ripen on tree but better commercial quality and longer storage life are attained when harvesting is done at a slightly earlier stage of maturity. The physiology of ripening involves numerous metabolic activities resulting in sweet taste and development of pleasant aroma. Other changes observed during ripening are softening of texture, colour development, desired sugar: acid blend and characteristic flavour. All these biochemical changes take place during the short period of 6-10 days according to variety and ripening conditions. However, ripening process could be manipulated to some extent by various pre and post-harvest treatments. However, pre-harvest application of above chemicals has not been very effectively reduce post-harvest losses and improve fruit quality and storage life of commercial cultivars of north India.

Methods and Material: The present investigation entitled was conducted at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut [UP] -250 110 during the year 2013-14. The details of materials used, experimental procedure followed, techniques and the procedures adopted for statistical analysis during the course of investigation are described briefly in subsequent paragraphs of the chapter.

Experimental site and location
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 29^0 01 North latitude, 77^0 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 ^{0}C during summer (April to October) and a minimum temperature of about 7 ^{0}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 varies 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) [8]. The pH of the stock solution except of carbendazim was adjusted at 7. The final volume of each stock solution was made upto 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 on20/05/2014, 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 8thJuly 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.

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 1). 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.

Table 1: Treatment which resulted in higher level of total sugars in fruits

Treatments	Total Sugars (%) At ripening	Per cent increase (+) or decrease (-) in total Sugars over control
Control (Fresh water)	11.73	-
Calcium Chloride2%	13.17	(+)12.27
Calcium Chloride3%	13.47	(+)14.83
Calcium Chloride 2% + Carbendazim 0.1%	14.14	(+)20.54
Calcium Chloride3% + Carbendazim 0.1%	14.75	(+)25.74
Dehydrated Calcium Chloride2%	13.56	(+)15.16
Dehydrated Calcium Chloride3%	14.23	(+)21.31
Dehydrated Calcium Chloride2% + Carbendazim 0.1%	13.68	(+)16.62
Dehydrated Calcium Chloride3% + Carbendazim 0.1%	15.08	(+)28.55
Silver Nitrate 100 ppm	13.40	(+)14.23
Silver Nitrate 200 ppm	13.95	(+)18.92
Silver Nitrate100 ppm + Carbendazim 0.1%	13.63	(+)16.19
Silver Nitrate 200 ppm + Carbendazim 0.1%	14.47	(+)23.35
LSD (<0.05%)	1.008	

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