ACTA SCIENTIFIC AGRICULTURE (ISSN: 2581-365X)

Volume 3 Issue 3 March 2019

Research Article

Effect of Different Preharvest Applications on Physiological and Sensory Quality of Nectarine (Prunus persica var. nucipersica Schneid.) cvs. Snow Queen After Harvest

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Received: November 21, 2018 **Published:** February 18, 2019

Abstract

The present study was conducted in the experimental orchard of Horticultural Research Station, Kandaghat, Solan, India to see the effect of preharvest application of growth regulators, nutrients and fungicides on physiological and sensory quality of nectarine fruit. All the preharvest treatments showed a beneficial effect on different physiological and sensory parameter of fruits in comparison to control. Among the preharvest treatments, 1.5% calcium chloride, 0.45% Neem leaves extract, 3000 ppm salicylic acid and 15 ppm CPPU proved to be most effective in maintaining fruit quality and minimizing deterioration during 28 days storage at 3 ±1 °C temperature. These treatments were also effective in reducing the respiration rate and enzymatic activities, thereby reducing the overall ripening process and prolonging storage life. Effect of salicylic acid is to be reported first time on nectarine fruits in the study.

Keywords: *Nectarine; Snow Queen; Sensory Parameters; Salicylic Acid; CPPU; CaCl2; and Neem Leaves Extract*

Introduction

Nectarine (*Prunus persica* var. *nucipersica* Schneid.) is a smooth-skinned peach of the family Rosaceae. The word nectarine is derived from a Latin word which means 'Persian plum' although they are not plums. The origin of nectarine is a mystery. These has a smooth fruit in contrast to pubescent fruit of peach, was given a species status in the past, but Bailey [1] considered only a botanical variety (*Prunus persica* var. *nucipersica*). Being a climacteric fruit with high ethylene evolution rates, nectarine undergoes rapid changes during ripening and softens immediately after harvest. Nectarines, like other stone fruits, therefore cannot endure long post-harvest handling periods at normal atmospheres [2,3]. It is a delicate crop, well known for its poor shelf life.

Preharvest application of growth regulators, nutrients and fungicides can modify the pace and direction of biochemical changes in developing fruit and have the potential to transform its quality at harvest [2-4]. The present study was therefore carried out to improve the nectarine fruit variety Snow Queen quality at harvest and retain it during storage by the application of various pre-harvest treatments. Effect of salicylic acid is first time reported on nectarine in this study.

Methodology

Well grown uniform trees were selected to see the effect of preharvest treatments on physiological and sensory quality of nectarine cultivar Snow Queen was laid out in the experimental orchard of Horticultural Research Station, Kandaghat, India. All the selected tree were maintained under a standardized schedule of cultural operations throughout the season and subjected to different preharvest treatments (Table 1).

Treatments	Chemicals	Concentration	Time of application
T_1	CPPU	5 ppm	Pea stage
T_2	CPPU	10 ppm	Pea stage
T_3	CPPU	15 ppm	Pea stage
T_4	Salicylic acid	1000 ppm	Pea stage
T_5	Salicylic acid	2000 ppm	Pea stage
T_6	Salicylic acid	3000 ppm	Pea stage
T_7	$CaCl_2$	0.5%	10-15 days before harvest
T_8	$CaCl_2$	1.0%	10-15 days before harvest
T_9	$CaCl_2$	1.5%	10-15 days before harvest
T_{10}	Neem leaves extract	0.15%	10-15 days before harvest
T_{11}	Neem leaves extract	0.30%	10-15 days before harvest
T_{12}	Neem leaves extract	0.45%	10-15 days before harvest
T_{13}	Control	-	Water spray

Table 1: Detail of different preharvest treatments along with concentration and time of application.

Physiological analysis

Respiration rate

The rate of respiration was measured as carbon-dioxide evolved per unit weight of fruit per unit time. Known weight of fruit was enclosed in an airtight container of known volume for a known time and the carbon dioxide evolved due to respiration was measured with the help of Gas data analyzer (GFM series 30-1/2/3, Gas Data Ltd. Coventry UK) and was expressed as ml CO_2/ kg/hr.

Enzyme activities

Polygalacturonase activity (PG) was determined by the method described by Mahadevan and Sridar [5] while the Pectin methyl esterase (PME) activity was using 0.02 N NaOH [6].

Sensory analysis

Consumer preferences for the experimental fruit samples were found out through sensory evaluation performed at different intervals during storage by some experts consisting of students and staff members. The panelists were given coded samples consisting of whole fruits and slices for giving their views on overall acceptability of the fruit on the basis of appearance, texture, flavour, and texture. The evaluation was done by using the 9 – point hedonic scale for each attribute [7].

Statistical analysis

Statistical analysis of the data was conducted using the online software OPSTAT and data analysed for Randomized Block Design (RBD) with three replications. Data pertaining to sensory evaluation from all the experiments were analysed by RBD [8].

Results and Discussions

Respiration rate

A steady increase in respiration rate of fruits observed up to 21 days followed by a sharp decline toward the last sampling date (Table 2). However, this pattern was relatively faster in control fruits, reaching peak values for respiration after 14 days. The lowest mean respiration rate (37.45 ml CO_2/kg/hour) was observed in response to $CaCl_2$,1.5 per cent and it was followed by treatments containing lower concentrations of $CaCl_2$ (T_8 and T_7) whereas the control fruits exhibited the highest respiration rate (43.56 ml CO_2/ kg/hour).

Treatment (T)	Respiration rate					
	Storage intervals in days (2012)					
	0	7	14	21	28	Mean
T_1 (CPPU 5 ppm)	16.15	30.64	42.76	63.19	54.51	41.45
T_2 (CPPU 10 ppm)	16.20	30.73	42.84	63.24	54.56	41.51
T_3 (CPPU 15 ppm)	16.25	30.80	42.91	63.30	54.60	41.57
T_4 (Salicylic acid 1000ppm)	15.45	28.11	41.20	61.48	52.79	39.81
T_5 (Salicylic acid 2000ppm)	15.37	28.02	41.14	61.42	52.72	39.73
T_6 (Salicylic acid 3000ppm)	15.32	27.94	41.08	61.37	52.67	39.67
T_7 ($CaCl_2$ 0.5%)	14.72	25.93	38.87	58.07	50.35	37.59
T_8 ($CaCl_2$ 1.0%)	14.64	25.83	38.82	58.00	50.30	37.52
T_9 ($CaCl_2$ 1.5%)	14.57	25.73	38.78	57.94	50.24	37.45
T_{10} (Neemazal 0.15%)	16.10	30.70	42.73	63.06	54.37	41.39
T_{11} (Neemazal 0.30%)	16.03	30.62	42.67	63.01	54.32	41.33
T_{12} (Neemazal 0.45%)	15.93	30.53	42.61	62.97	54.26	41.26
T_{13} (Control)	19.21	39.74	64.41	52.37	42.07	43.56
Mean	15.84	29.64	43.14	60.72	52.13	
$CD_{0.05}$						
	T					0.05
	I					0.03
	T×I					0.12

Table 2: Effect of pre-harvest treatments on respiration rate (ml CO_2/kg/hr) of Snow Queen nectarine fruit during storage at 3±1°C temperature.

Enzyme activity

An increase in the activities of pectin methyl esterase (PME) and polygalacturonase (PG) was observed upto 21 days and thereafter the activity of these enzymes declined during the remaining storage period under all the treatments (Table 3). However, these changes were observed to occur at a slower rate in $CaCl_2$ treated fruits,

whereas they were faster in control fruits. The minimum mean PME and PG activities were therefore recorded with 1.5% $CaCl_2$ treatment and was followed by 1.0% calcium chloride treatment.

Treatment (T)	Pectin methyl esterase activity						Polygalactouranase activity					
	Storage intervals in days (I)						Storage intervals in days (I)					
	0	7	14	21	28	Mean	0	7	14	21	28	Mean
T_1 (CPPU 5 ppm)	0.82	1.09	1.35	1.54	1.42	1.24	17.20	19.46	20.74	22.02	21.19	20.12
T_2 (CPPU 10 ppm)	0.84	1.11	1.37	1.56	1.44	1.26	17.23	19.49	20.78	22.05	21.22	20.15
T_3 (CPPU 15 ppm)	0.88	1.14	1.39	1.58	1.46	1.29	17.26	19.51	20.80	22.07	21.43	20.21
T_4 (Salicylic acid 1000ppm)	0.99	1.27	1.49	1.68	1.52	1.39	17.35	19.61	20.93	22.21	21.40	20.30
T_5 (Salicylic acid 2000ppm)	0.97	1.25	1.47	1.65	1.51	1.37	17.30	19.58	20.90	22.18	21.38	20.27
T_6 (Salicylic acid 3000ppm)	0.94	1.22	1.45	1.62	1.49	1.34	17.28	19.56	20.87	22.16	21.36	20.25
T_7 ($CaCl_2$ 0.5%)	0.86	1.07	1.33	1.51	1.40	1.23	17.19	19.44	20.73	22.02	21.20	20.11
T_8 ($CaCl_2$ 1.0%)	0.84	1.04	1.30	1.49	1.38	1.21	17.16	19.42	20.70	21.98	21.17	20.09
T_9 ($CaCl_2$ 1.5%)	0.81	1.02	1.28	1.46	1.36	1.19	17.14	19.39	20.68	21.95	21.14	20.06
T_{10} (Neemazal 0.15%)	0.82	1.31	1.52	1.71	1.55	1.38	17.36	19.63	20.95	22.24	21.44	20.32
T_{11} (Neemazal 0.30%)	0.99	1.29	1.50	1.68	1.52	1.40	17.32	19.60	20.92	22.20	21.41	20.29
T_{12} (Neemazal 0.45%)	0.98	1.27	1.48	1.66	1.50	1.38	17.28	19.58	20.89	22.17	21.39	20.26
T_{13} (Control)	1.06	1.41	1.73	1.59	1.50	1.46	17.39	19.69	22.33	21.60	21.10	20.42
Mean	0.91	1.19	1.44	1.59	1.47		17.26	19.53	20.94	22.06	21.29	
$CD_{0.05}$												
	T					0.03						0.05
	I					0.02						0.03
	T×I					0.06						0.12

Table 3: Effect of pre-harvest treatments on pectin methyl esterase activity (as ml of 0.02 N NaOH used) and polygalactouranase activity (as% loss in viscosity of substrate) of Snow Queen nectarine fruit during storage at 3 ± 1ºC.

Polyphenol oxidase catalyses the oxidation of mono and diphenols to o-quinones, which polymerize to produce brown pigments. At harvest, the total phenolics content was considerably enhanced by CPPU and salicylic acid treatments in comparison to other treatments. Yao., *et al*. [9] also reported similar findings in sweet cherry fruit where salicylic acid stimulated phenylalanine ammonia lyase activity with consequent production of the main phenolic compounds and the synthesis of new polyphenolic substances. Huang., *et al*. [10] also reported that higher total phenolics, and total flavonoids in the pulp and peel of Cara Cara Navel Orange was maintained by preharvest salicylic acid treatments. Increase in phenols might be due to the fact that salicylic acid provides disease resistance by showing direct fungitoxicity and significantly inhibits fungal growth and spore germination of the pathogen *In vitro*. Hence, pre-storage or preharvest application of salicylic acid may provide a useful means of controlling post-harvest decays and extending fruit postharvest life during storage [11].

Sensory characteristics

As the storage period increased the overall acceptability of the fruits, as evaluated on the basis of then appearance, flavour and texture, showed a marked improvement under all treatments up to 21 days before declining during the remaining storage period, with the control fruits being rated as least acceptable (Figure 1-4). Fruits treated with 1.5 per cent $CaCl_2$ recorded the highest acceptability value followed by treatment T_8. Among the pre-harvest treatments 1.5% calcium chloride, 0.45% neem leaves extract (Neemazal), 3000 ppm salicylic acid and 15 ppm CPPU proved to be most effective in maintaining fruit quality and minimizing deterioration during 28 days storage at 3 ±1°C of temperature.

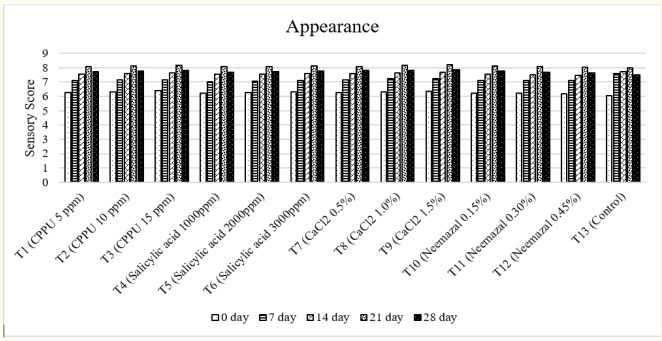

Figure 1: Effect of pre-harvest treatments on appearance rating (on a 9 point hedonic scale) of Snow Queen nectarine fruit during storage at 3±1°C temperature.

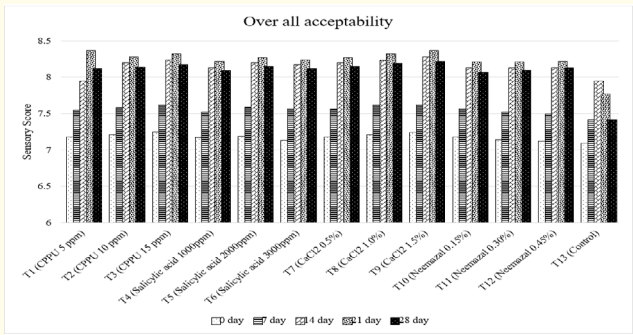

Figure 4: Effect of pre-harvest treatments on over all acceptability (on a 9 point hedonic scale) of Snow Queen nectarine fruit during storage at 3±1°C temperature.

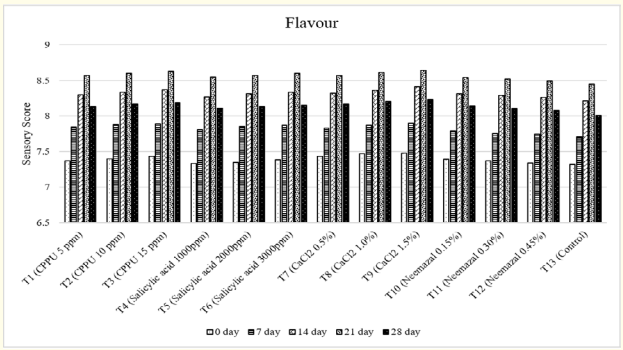

Figure 2: Effect of pre-harvest treatments on flavour rating (on a 9 point hedonic scale) of Snow Queen nectarine fruit during storage at 3±1°C temperature.

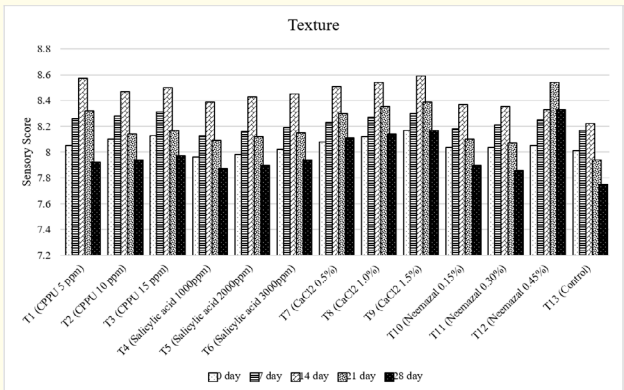

Figure 3: Effect of pre-harvest treatments on texture rating (on a 9 point hedonic scale) of Snow Queen nectarine fruit during storage at 3±1°C temperature.

The highest mean sensory evaluation scores for most attributes were recorded in the fruits treated with calcium chloride, although salicylic acid, CPPU and neem leaves extract treatments also gave substantially better sensory ratings than the control fruits. Retention of better quality in fruits treated with various chemicals might be due to reduction in physiological weight loss, respiration rates of fruits and consequently a reduction in the rates of utilization of respirable substrates, as such fruits contained relatively higher TSS (Total Soluble Solids) and sugar contents on the 21st day of storage, eventually resulting in better acceptability rating of such fruits. The results are in confirmation with the earlier study of calcium sprays have a beneficial effect on the sensory attributes (aroma, texture, flavour and appearance) of peach fruits [12]. Fruit texture changes in fruits during the postharvest period are due to changes in cell walls and pectic substances in the middle lamella [13]. Fruit flavour is mostly a balance between the content of sugars and organic acids [14] as well as aromatic volatiles. The increase in soluble sugars is a major change during nectarine fruit ripening and sweetness is the most important compositional change related to nectarine flavour.

Conclusion

The study showed that the respiration rate, enzymatic activity and sensory quality of nectarine fruit Cv. Snow Queen were improved significantly with the pre-harvest applications. Calcium chloride applied at 1.5% (T_9) proved to be the most effective in maintaining the quality during storage of nectarine fruit cv. Snow Queen. In overall among the pre-harvest treatments 1.5% calcium chloride, 0.45% Neem leaves extract, 3000 ppm salicylic acid and 15 ppm

CPPU proved to be most effective in maintaining fruit quality and minimizing deterioration during 28 days storage at 3 ± 1°C temperature. As the storage period increased, the overall acceptability of the fruits, as evaluated on the basis of then appearance, flavour and texture, showed a marked improvement under all treatments up to 21 days before declining during the remaining storage period, with the control fruits being rated as least acceptable.

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