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Effect of pre-harvest spray of calcium chloride and calcium nitrate on shelf life of aonla (*Phyllanthus emblica* L.) cv. NA-7

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ABSTRACT

The studies on shelf life of aonla was conducted at Research Farm and Laboratory Horticulture, Regional Research Station, Bawal. The selected plants were sprayed with calcium nitrate and calcium chloride @ 1.0 and 1.5 % at 10 and 20 days before harvest. After harvesting uniform fruit from different treatments were stored at room temperature. The fruit were analyzed for PLW, decay loss, TSS, titratable acidity and ascorbic acid during storage period. Lowest PLW and decay loss was recorded in the fruit sprayed with calcium nitrate @ 1.5% before 20 days of harvest. TSS increased up to 6th day of storage, while titratable acidity and ascorbic acid decreased continuously during storage. Highest TSS, lowest titratable acidity and maximum ascorbic acid content was recorded in fruit of calcium nitrate sprayed (1.5%) plants at 20 days of storage however, lowest B: C ratio was observed in control.

Introduction

Aonla (*Phyllanthus emblica* L syn. *Emblica officinalis* Gaertn), is gaining popularity because of its high yield, good returns, hardy nature, drought tolerance, prolific bearing and suitability for growing under marginal lands. It also has a tremendous export potential due to its medicinal, therapeutic and high nutritive value. However, fruit are highly perishable in nature and cannot be transported far off places. The quality of fruit has direct impact on marketing as well as on transportation and export potential of fruit in turns influences profit of the grower. The exogenous application of calcium partly delays the senescence process and finally improved the quality of the fruit. The soil application of calcium is unable to increase calcium content in fruit, as it is immobile in plant system. Calcium helps in the formation of calcium –pectate, increase rigidity of middle portion and cell wall of the fruit. Pre-harvest application and post-harvest dip of calcium compound minimize weight loss; reduce respiration, transpiration and rotting of mango fruit (Singh *et al.,* 1998). However, no much information are available in aonla. Therefore, present study was conducted to improve the quality of aonla fruit with pre-harvest application of calcium.

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Materials and Methods

The study was conducted at Research Farm and Laboratory of Horticulture, Regional Research Station, Bawal. Fifteen-year-old forty uniformly grown healthy plants of NA-7 were selected randomly for pre-harvest spray of calcium in the form of calcium nitrate and calcium chloride in the month of August in randomize block design with four replications. These plants were sprayed thoroughly with calcium nitrate and calcium chloride @ 1.0 and 1.5 % and pure water (control) at 10 and 20 days before harvest with tractor mounted spray pump. Fruit from these plants were harvested at maturity stage in the last week of November. Undersized, oversized, diseased and damaged fruit were discarded and healthy fruit of almost same size were selected for storage study in complete randomized design with four replications. Fruit were packed in perforated polythene bags of size two kg and stored at ambient temperature. The fruit were analyzed for changes in PLW, decay loss, TSS, titratable acidity and ascorbic acid at alternate day during the storage period. Physiological loss in weight (PLW) was determined on initial weight basis and it was expressed in percentage.

PLW (%) = [(initial weight - weight at sampling date / initial weight)] x 100.

Decay loss was calculated by weighing the decayed fruit (fungal infection/ spoiled) and it was divided by initial weight and unit was expressed in percentage. Total soluble solids (TSS) of fruit juice was estimated by hand refractometer and expressed in degree brix (°B). Titratable acidity and ascorbic acid were estimated by using the method described in AOAC (2000).

Results and Discussion

Physiological loss in weight (PLW) and decay loss increased with the increase in storage period of fruit in all the treatments; however, no change in PLW and decay loss was noticed up to two and 4 days of storage, respectively. Maximum PLW and decay loss was recorded in fruit harvested from water sprayed plants (control) as compared to the fruit harvested from calcium sprayed plants up to 10 days of storage. PLW and decay loss was recorded minimum in fruit sprayed with calcium nitrate @ 1.5% before 20 days of harvest (Table 1). Physiological loss in weight of fruit might be due to evaporation, transpiration, and loss of dry matter by respiration. Calcium spray might have strengthened cell walls/ maintained fruit firmness and tissue rigidity which reduces fruit softening, respiration, ripening processes, fruit infection by decreasing the enzyme activities caused disintegration of cellular structure resulted in less weight loss and decay loss during storage (Levy and Poovaiah, 1979). These results are supported by the findings of Selvan and Bal (2005) in guava and Singh *et al.* (2008) in ber. Pre-harvest spray of calcium nitrate was better as compared to calcium chloride.

At the time of harvest, no remarkable change in TSS and titratable acidity was observed in the fruit sprayed with different solutions of calcium but TSS contents increased and titratable acidity decreased with the increase in storage period. TSS was maximum on 6th day of storage and thereafter it starts decreasing in all the treatments while titratable acidity decreased continuously in all the treatments up to last day of storage.

Among the different treatments, the highest TSS was recorded in the fruit sprayed with calcium nitrate @ 1.5% before 20 days of harvest (Table 2). During the storage, TSS might be increased due to hydrolysis of starch and other complex molecules into sugars (Wills *et al.* 1980). The higher TSS was observed in calcium nitrate sprayed (1.5%) fruit during storage as it may maintaining the lowest metabolic activity. These results are in line of the findings of Selvan and Bal (2005) in guava and Mahajan and Dhatt (2004) in pear. Titratable acidity decreased least in fruit sprayed with calcium nitrate 1.5 % at 10 and 20 days before harvest, (Table 3). Lowest titratable acidity was recorded in the control as compared different treatments. The less reduction of titratable acidity in fruit during storage may be due to delayed ripening process and slow down the respiration rate by $Ca(NO_3)_2$ spray. Similar finding were also reported by Goutam *et al.* (2010) on guava.

Ascorbic acid content during the storage of aonla was recorded higher in all the treatments as compared to control. Among the treatments, higher ascorbic acid content was recorded in the fruit sprayed with calcium nitrate in comparison to calcium chloride. However, highest ascorbic acid content was recorded in fruit up to 10 days of storage with the spray of calcium nitrate @ 1.5 percent at 20 days before harvest (Table 3). Decrease in ascorbic acid during storage may be due to oxidizing enzymes like ascorbic acid oxidase, peroxidase, catalase and polyphenol oxidase (Singh *et al.* 2005). Similar finding were reported by Ahmed and Singh (2000) and Singh *et al.* (2008) in mango and ber fruit, respectively. Calcium treated fruit had minimum degradation of ascorbic acid contents (Laufmann and Sams, 1989)

The benefit-to-cost (B:C) ratio was higher with pre-harvest sprays of calcium chloride and calcium nitrate at 1.0% and 1.5% applied 10 and 20 days before harvest. Among these treatments, the highest B :C ratio was observed with a 1.5% calcium nitrate spray applied 20 days before harvest. In contrast, the lowest B:C ratio was found in the control (water spray).

Table 1. Effect of pre-harvest spray of calcium on PLW (%) and decay loss (%) of the anola cv NA 7 during storage (Pooled data 2018-19, 2019-20 & 2020-21)

Treatments	Spray (days before harvest)	Physiological loss in weight (%)					Decay loss (%)				
		Storage period (days)					Storage period (days)				
		2	4	6	8	10	2	4	6	8	10
$Ca(NO_3)_2$ @ 1.0%	10	1.2	1.5	1.9	2.2	2.7	0.0	0.0	2.5	3.1	3.9
	20	1.2	1.3	1.8	2.0	2.6	0.0	0.0	2.0	2.8	3.6
$Ca(NO_3)_2$ @ 1.5%	10	1.0	1.3	1.7	2.1	2.5	0.0	0.0	1.5	2.5	3.4
	20	1.0	1.2	1.4	1.8	2.2	0.0	0.0	1.0	2.0	2.7
CaCl2 @ 1.0%	10	1.5	1.8	2.1	2.6	3.2	0.0	0.0	3.5	4.0	4.7
	20	1.5	1.7	1.9	2.3	3.0	0.0	0.0	3.0	3.7	4.4
CaCl2 @ 1.5%	10	1.3	1.6	2.1	2.5	2.8	0.0	0.0	2.5	3.2	4.1
	20	1.3	1.6	1.9	2.2	2.7	0.0	0.0	2.0	3.1	3.9
Control	10	1.7	2.2	2.9	3.5	4.1	0.0	2.0	5.1	6.5	6.9
	20	1.8	2.3	2.8	3.4	4.0	0.0	2.0	5.2	6.6	6.8
CD (P=0.05)		NS	0.2	0.2	0.2	0.2	-	-	0.3	0.4	0.5

Table 2. Effect of pre-harvest spray of calcium on TSS (°B) of the anola cv NA 7 during storage (Pooled data 2018-19, 2019-20 & 2020-21)

Treatments	Spray interval/ storage (days)	Storage period (days)						B : C ratio
		0	2	4	6	8	10	
$Ca(NO_3)_2$ @ 1.0%	10	9.07	9.11	9.13	9.14	9.03	8.92	7.28
	20	9.09	9.15	9.18	9.20	9.12	8.98	7.17
$Ca(NO_3)_2$ @ 1.5%	10	9.11	9.18	9.20	9.22	9.13	9.05	7.89
	20	9.23	9.25	9.26	9.28	9.19	9.14	8.37
$CaCl_2$ @ 1.0%	10	8.83	9.11	9.16	9.20	9.01	8.81	6.67
	20	8.87	9.00	9.05	9.10	9.01	8.85	6.58
$CaCl_2$ @ 1.5%	10	8.92	9.10	9.13	9.14	9.01	8.86	7.28
	20	9.01	9.15	9.16	9.17	9.02	8.84	7.17
Control	10	8.81	9.29	9.35	8.25	8.51	8.20	5.67
	20	8.80	9.30	9.34	8.25	8.50	8.21	5.66
CD (P=0.05)		NS	0.05	0.05	0.04	0.05	0.08	NA

Table 3. Effect of pre-harvest spray of calcium on titratable acidity (%) and ascorbic acid (mg/100g) content in juice of the anola cv NA 7 during storage (Pooled data 2018-19, 2019-20 & 2020-21)

Treatments	Spray days before harvest	Titratable acidity (%)						Ascorbic acid (mg/100g)					
		Storage period (days)						Storage period (days)					
		0	2	4	6	8	10	0	2	4	6	8	10
$Ca(NO_3)_2$ @ 1.0%	10	2.25	2.13	2.06	2.01	1.92	1.86	517	496	482	470	462	455
	20	2.25	2.15	2.07	2.02	1.95	1.91	517	499	483	475	469	461
$Ca(NO_3)_2$ @ 1.5%	10	2.24	2.16	2.11	2.05	1.99	1.94	519	503	499	488	478	470
	20	2.24	2.18	2.13	2.08	2.03	1.97	521	510	503	494	485	477
CaCl2 @ 1.0%	10	2.24	2.11	2.01	1.91	1.86	1.80	515	495	484	465	458	447
	20	2.25	2.14	2.03	1.94	1.89	1.81	516	547	486	468	460	449
CaCl2 @ 1.5%	10	2.24	2.13	2.07	1.97	1.90	1.84	517	502	492	472	464	455
	20	2.25	2.14	2.09	2.01	1.94	1.87	517	505	497	480	470	460
Control	10	2.16	2.03	1.97	1.85	1.81	1.73	515	484	479	465	450	429
	20	2.15	2.01	1.98	1.84	1.82	1.72	515	482	480	466	451	430
CD (P=0.05)		NS	0.03	0.03	0.04	0.05	0.06	NS	2	3	5	5	6

Conclusion

The results of the experiment demonstrated that the conditions in Banswara were ideal for banana cultivation, with yield and fruit quality comparable to those at other commercially practiced banana-growing locations in the country. Among the various locations studied, Arjun (AF1) and Anil (AnF2) were found to be the most feasible for banana cultivation.

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