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IMPACT OF PRE-HARVEST APPLICATION OF DIFFERENT CHEMICALS ON STORAGE LIFE AND QUALITY OF ANOLA FRUITS CV. NA7

Ankit Pandey[1,*], Neeru Dubey[1] and Shailendra K. Dwivedi[2]
[1]AIHSR, Amity University, Noida (UP)
[2]Department of Post-harvest Technology, RVSKVV, Campus, College of Horticulture, Mandsaur (MP)

Abstract

The present investigation was carried out on research farm of College of Horticulture, Mandsaur, Madhya Pradesh during 2015-16 and 2016-2017. The Full bloom in crop was observed on 20th April in NA-7. The days from full bloom to harvest for the sampling durations of fruits in the cultivar NA-7 ranged between 178 to 238 days. Total sixteen different combination of byleton, Bavisten, Planofix and nimbicidine were applied on fruits of aonla during their fruit development stages for the post harvest life of fruits. Fresh fruits of each cultivar from all sampling dates were stored at ambient temperature and observations were recorded at weekly interval. A progressive and significant increase in the physiological weight loss of fruits was observed in all the treatments with an increase in storage duration up to 28 days. The most effective treatments in reducing PWL was observed with application of 1.5 per cent calcium nitrate. A gradual decrease in moisture content was observed till end of experimentation. Among the various treatments 1.5 per cent $Ca(N0_3)_2$ resulted for retention of maximum moisture content. During the first week of sampling no rotting was observed under any treatment except the control fruit (T16) which also exhibited only negligible spoilage. Bayleton @ 0.15 per cent was the most effective in controlling spoilage in NA-7. In general the overall acceptability of fruits, which was evaluated on the basis of appearance and texture decreased with passage of time.

Key words: Aonla, NA7, Preharvest treatments, storage life, Physiological loss in weight, fruit size, TSS, acidity, spoilage, quality.

Introduction

Aonla (*Emblica officinalis*) is native of tropical India and Southeast Asia, commonly named as 'Indian gooseberry'. Aonla fruits are fleshy, yellowish green in colour having six vague perpendicular furrows enclosing seeds. Nutritional, commercial and medicinal significance of aonla fruit makes it popular all over the world. India ranks first in area and production of aonla crop (Priya and Khatkar, 2013) in the world. In India, it occupied an area of 108 thousand hectare, production of 1266 thousand tonnes with 11722.20 kg/ha productivity (Anonymous, 2014) and (NHB, 2014). It is an important component of the famous Indian Ayurvedic medicines Chyavanprash and Trifla. It has played an important therapeutic role from time immemorial and is frequently recommended for its synergistic effects in both the ayurvedic and unani systems of medicine (Agarwal and Chopra, 2004).The major aonla growing states in India are Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Karnataka, Punjab and Himachal Pradesh. Uttar Pradesh, Gujarat and Tamil Nadu, contributing over 55 per cent to the total area and production of aonla in the country (Singh *et al.*, 2010). Its intensive plantation is in salt affected areas of Uttar Pradesh, including ravinous areas in Agra, Mathura, Eatwah, Fatehpur and semi-arid track of Bundelkhand. It can thrive well even under highly sodic soil and drought stress. Thus, it has been recognised as the King of arid fruits due to its in-built resistance to the most adverse soil and climatic conditions.

The fruit is highly nutritive for human consumption. It is the richest source of vitamin C (500-1500 mg/100g) (Pokharkar, 2005) and nutrients such as polyphenols, pectin, iron, calcium and phosphorus (Khopde *et al*., 2001) and (Yadav *et al*., 2012). The aonla fruit is a potent antioxidant, hypolipidemic and antibacterial, it also has antiviral and antacid properties. Aonla has been reported to be hepato-protective and possesses expectorant, purgative, spasmolytic, antibacterial, hypoglycemic and hypolipidemic activities (Mishra *et al*., 2010). Due to its highly acidic and astringent taste, low total soluble solids (TSS), poor flavor and colour, it is not popular as a table fruit (Jain and Khurdiya, 2004). Due to its astringent nature, consumers hesitant to eat it in raw form. Aonla becomes ready for harvesting from mid-November to first week of February. The produce remains in market for a very short span. Huge harvest of produce during peak harvesting season create glut and the growers are compelled to sell their produce at poor prices. Appropriate storage and processing methods can curtail the post-harvest losses to 30 per cent (Goyal *et al*., 2008) and make the fruit available for longer period. Plant growth regulators, certain chemicals and fungicides play a great role in increasing the storage life (Dhumal *et al*., 2008) of aonla fruits. Pre-harvest application of calcium is one of the most important practices of new strategies applied in the integrated fruit production systems, improving fruit characteristics and minimizing fungicides sprays towards the end of the harvest period.

Though some work has been done to standardize the cultural practices for different cultivars, yet no systematic research work has been done to standardize the various pre harvest application to prolong the storage life of fruits. Foliar application of calcium nitrate, fungicides, planofix, borax increases the yield and quality of aonla. Simultaneously, surface coating and proper packing of aonla increases the duration and quality of aonla. Keeping the above facts in the view, the present investigation was proposed to study suitable time for harvest and their different post harvest attributes.

*Corresponding Author Email: ankit.phm@gmail.com

Materials and Method

Present investigations was carries out on aonla orchard farm of College of Horticulture, Mandsaur, Madhya Pradesh during 2015-16 and 2016-17. The meteorological data like temperature, relative humidity, sunshine, wind velocity etc were taken from the College meteorological observatory. Various substances were applied 15-20 days before the expected date of harvesting of the crop and further fruits were store at ambient temperature for different post harvest observation. Effects of preharvest treatments on physic-chemical characteristics of fruit analyzed by Randomized Block Design (RBD) with sixteen treatments of foliar spray of Borax, Planofix, Bayleton, Calcium nitrate, Nimicidine and control were sprayed with normal tap water. The loss in weight during storage was expressed as per cent of initial weight on each sampling date. Moisture content was expressed in percentage. It was determined as per method described by Ranganna, 1986. Known amount of the aonla segments were taken in a petri dish and dried at a temperature of 60 ± 10C till the weight became constant and moisture was calculated and expressed in percentage.

$$\text{Moisture content (\%)} = \frac{\text{Initial weight-Final weight}}{\text{Initial weight}} \times 100$$

Fruit juice was extracted with the help of a juice extractor (B. San Barry and company, New Delhi). The fruits were first cut into segments/pieces to destone and weighed quantities of segments were fedded into the hopper on top of the juice extractor. The juice was collected in a jar and the volume was measured with the help of measuring cylinder and per cent juice recovered from a sample was calculated on the basis of initial weight of fruit segments. The collected data were analyzed through statistical procedure suggested by as described by Cochran and Cox (1967) and Gomez and Gomez (1984).

Results and Discussion

A series of metabolic changes occur in fruits after harvest which can be influenced by a number of preharvest treatments including those of nutrients, growth promoters and fungicides thereby, affecting fruit quality at harvest and hence their storability. Pre-harvest application of these substances can modify the place and direction of biochemical changes occurring within developing fruit and therefore have a potential to transform its quality at harvest which has a profound effect on the storage quality of fruits.

During the present course of investigations an increase in physiological weight loss (PLW) with an increase in storage duration was observed under all treatments consisting of chemicals, growth promoters and fungicides though the increase was significantly less than that observed in control fruits. It is a well known fact that with an increase in storage duration the respiratory and transpiratory losses keep on increasing which result in loss of metabolites and moisture, ultimately resulting in lower fruit weight (Garg, 2007). Such losses in term of moisture are higher if the difference between surrounding and internal vapour pressure of the commodity is greater. The mechanism of water loss from the fruit, which primarily accounts for its weight loss, is essentially the same as that of evaporation of water. The driving force for moisture loss in fruits is the vapour pressure of the moisture in fruit. All the weight loss is not due to water loss alone for respiration persists and heat of respiration may also account for part of it (Meena, 2015). Calcium is known to act as an antisenescent agent as it prevents cellular disintegration by maintaining protein and nucleic acid synthesis (Meena, 2015). It is clear from the table-1 that in the treatments treated with calcium nitrate @ 1.0 and 1.5 per cent have been observed to be most effective in reducing physiological weight loss (PLW) of fruit during storage, whereas the control fruits exhibited maximum loss. The increased weight loss in untreated fruits could be due to increased storage breakdown, which is associated with higher rate of respiration as compared to calcium treated fruits (Garg, 2007).

The reduction in physiological weight loss during storage of NA-7 aonla fruit with pre harvest treatments of 1.0 per cent $Ca(NO_3)_2$ has also been observed by Yadav and Singh (2002). They observed that calcium treatments either alone or in combination with fungicides increases the shelf life of fruits up to 20 days compared to only 10 days in control when the treatments were applied 10 to 20 days before harvest. The most effective treatment in reducing PLW in NA-7 aonla fruit was 1.5 per cent calcium nitrate in which only 11.30 per cent PLW was recorded which might be due to its ability to protect cell membranes from disorganization and other ant senescence properties (Garg, 2007). In response to $Ca(N0_3)_2$ treatments reduction in PLW of various commodities including aonla, have been amply demonstrated (Kumar *et al.,* 2005). Therefore, decrease in physio-logical weight loss with $Ca(N0_3)_2$ applications might be the net result of decrease in moisture loss and loss of storage reserves as respiratory substrate. Results in table-2 indicating that the pre-harvest sprays of $Ca(NO_3)_2$, Bayleton and Nimbecidine resulted in retention of higher moisture content in NA-7. Among the various treatments @ 1.5 per cent Ca(N03)2 resulted in the retention of maximum moisture content (81.42%) in NA – 7 during the 28 day of storage period with Bayleton and Nimbecidine treatments also proving to be quite useful. The role of calcium in preventing cellular disintegration is well known. Fungicidal treatments might have provided a barrier to moisture loss by blocking the anticells (Kaur *et al*., 2004; Yadav and Singh, 2002). Additionally, Bayleton treatment is reported to result in bio-synthesis of sterols of the fruit membrane and thus checks moisture loss. Retention of higher moisture content in Nimbecidine treated fruit might be due to the direct effect of azadirchtin, a principle active compound present in neem formulations. Which are believed to regulate the calcium and pectin contents, thereby lowering chances of cellular integrity during storage (Garg, 2007). Borax treatments might have helped in retaining moisture contents due to its role in lignification of the cell walls and thus prevents degradation of fruit tissue (Garg, 2007). Studies conducted by various workers on physic-chemical characters of different fruits suggest that juice contents of fruit in general can be influenced and increased by the application of different growth regulators including Planofix (Garg, 2007). Results from table-3 indicating thatthe juice yield of fruits decreased significantly during storage. Among the treatments 1.5 per cent $Ca(N0_3)_2$ proved to be most effective in retaining maximum juice content during storage. Higher juice recovery upon $Ca(N0_3)_2$ and some other treatments can be attributed to the lower moisture loss from such fruits as is evident from the data on PLW and moisture content. Studies conducted by various workers on physic-chemical characters of different fruits suggest that juice contents of fruit in general can be influenced and increased by the application of different growth regulators including Planofix (Garg, 2007).

Conclusion

The results of the present investigations calcium nitrate 1.0 and 1.5 per cent treatments have been observed to be most effective in reducing physiological weight loss (PLW) of fruit during storage, whereas the control fruits exhibited maximum loss. Whereas Pre-harvest sprays of $Ca(NO_3)_2$, Bayleton and Nimbecidine resulted in retention of higher moisture content in NA-7. Juice yield during storage of NA-7 fruit was better than that of control fruit when pre-harvest treatments of Planofix were applied.

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Table 1: Effect of various pre-harvest treatments on physiological weight loss (%) (Mean data of two years)

Treatment	NA – 7				
	Storage Duration in Days				
	7	14	21	28	Mean
T_1 Borax (0.25%)	1.48(1.21)	12.01(3.13)	16.83(4.05)	25.46(4.97)	13.943.21()
T_2 Borax (0.50%)	1.41(1.19)	11.97(3.12)	16.76(4.04)	25.42(4.98)	13.89(3.20)
T_3 Borax (0.75%)	1.41(1.27)	11.92(3.10)	16.71(4.04)	25.36(4.95)	13.85(3.19)
T_4 Planofix (20 ppm)	1.54(1.23)	11.58(4.06)	17.33(4.09)	25.85(5.01)	14.07(3.21)
T_5 Planofix (40 ppm)	1.51(1.22)	11.56(3.05)	17.13(4.09)	25.72(5.00)	13.98(3.21)
T_6 Planofix (60 ppm)	1.51(1.19)	11.54(3.05)	17.16(4.08)	25.67(5.00)	13.97(3.21)
T_7 Bayleton(0.05%)	1.64(1.27)	11.17(2.96)	15.96(3.95)	25.03(4.94)	13.45(3.15)
T_8 Bayleton(0.10%)	1.59(1.25)	11.09(2.93)	15.84(3.94)	24.64(4.92)	13.29(3.13)
T_9 Bayleton(0.15%)	1.54(1.23)	11.06(2.91)	15.90(3.93)	24.95(4.92)	13.36(3.13)
T10 $Ca(NO_3)_2$(0.5%)	1.63(1.26)	11.09(2.92)	15.90(3.93)	24.96(4.90)	13.40(3.12)
T11Ca (NO3)2 (1.0%)	1.51(1.22)	10.96(2.88)	15.79(3.91)	24.42(4.88)	13.17(3.10)
T12 Ca (NO3)2 (1.5%)	1.48(1.19)	10.84(2.85)	15.71(3.92)	24.24(4.85)	13.07(3.08)
T_{13} Nimbecidine(0.5%)	1.83(1.35)	11.71(3.09)	17.54(4.13)	25.86(5.01)	14.24(3.25)
T_{14} Nimbecidine(1.0%)	1.82(1.34)	11.66(3.08)	17.39(4.12)	25.78(5.00)	14.16(3.25)
T_{15} Nimbecidine(1.5%)	1.79(1.33)	11.62(3.07)	17.41(4.13)	25.77(5.00)	14.15(3.24)
T_{16} Control	1.93(1.49)	14.00(3.38)	21.85(4.83)	29.03(5.67)	16.70(4.04)
Mean	1.60(1.24)	11.61(3.0)	16.95(4.07)	25.51(5.00)	

CD (P=0.05) T = 0.39 I = 0.20 TxI = 0.78 Figures in parenthesis are the transformed value

Table 2: Effect of various pre-harvest treatments on moisture (%) (Mean data of two years)

Treatment	NA – 7					
	Storage Duration in Days					
	0	7	14	21	28	Mean
T_1 Borax (0.25%)	85.92	84.66	81.86	77.93	74.92	81.06
T_2 Borax (0.50%)	86.14	84.97	82.16	78.12	74.97	81.27
T_3 Borax (0.75%)	87.11	85.68	82.67	77.95	74.89	81.66
T_4 Planofix (20 ppm)	86.90	85.77	83.29	78.89	74.97	81.97
T_5 Planofix (40 ppm)	86.60	84.81	82.37	79.25	75.32	81.67
T_6 Planofix (60 ppm)	85.89	84.64	80.94	79.05	75.12	81.13
T_7 Bayleton (0.05%)	86.89	85.69	82.74	80.25	76.50	82.42
T_8 Bayleton (0.10%)	87.82	87.11	83.95	79.48	75.84	82.84
T_9 Bayleton (0.15%)	86.96	85.78	83.13	80.02	75.75	82.33
T_{10} $Ca(NO_3)_2$ (0.5%)	86.70	85.61	82.21	79.61	76.07	82.04
T_{11} $Ca(NO_3)_2$ (1.0%)	87.48	85.88	83.18	80.07	75.58	82.44
T_{12} $Ca(NO_3)_2$ (1.5%)	88.23	87.26	84.21	79.66	75.87	83.05
T_{13} Nimbecidine (0.5%)	87.17	85.94	82.31	76.86	72.10	80.88
T_{14} Nimbecidine (1.0%)	87.21	85.68	83.03	78.03	74.56	81.70
T_{15} Nimbecidine (1.5%)	87.87	86.80	83.59	78.08	74.92	82.25
T_{16} Control	85.95	84.35	79.76	75.34	72.37	79.55
Mean	86.93	85.66	82.59	78.66	74.98	

CD (P=0.05) T = 0.68 I = 0.38 TxI = 1.52

Table 3: Effect of various pre-harvest treatments on juice recovery (%) (Mean data of two years)

Treatment	NA – 7					
	Storage Duration in Days					
	0	7	14	21	28	Mean
T_1 Borax (0.25%)	42.70	40.09	36.96	33.46	30.89	36.82
T_2 Borax (0.50%)	43.86	41.72	37.03	34.48	31.72	37.76
T_3 Borax (0.75%)	42.84	40.90	38.15	33.82	31.61	37.46
T_4 Planofix (20 ppm)	44.88	42.28	38.86	36.52	31.85	38.88
T_5 Planofix (40 ppm)	44.88	42.94	40.55	37.18	33.66	39.84
T_6 Planofix (60 ppm)	44.88	42.94	39.27	35.14	32.99	39.04
T_7 Bayleton (0.05%)	48.96	47.43	42.02	39.37	37.21	43.00
T_8 Bayleton (0.10%)	48.96	46.82	44.88	40.80	37.23	43.74
T_9 Bayleton (0.15%)	47.94	46.41	41.82	38.91	35.76	42.17
T_{10} $Ca(NO_3)_2$ (0.5%)	46.92	44.68	41.00	37.23	34.39	40.84
T_{11} $Ca(NO_3)_2$ (1.0%)	48.96	47.43	44.06	40.29	37.21	43.59
T_{12} $Ca(NO_3)_2$ (1.5%)	51.00	49.73	43.35	40.29	38.38	44.55
T_{13} Nimbecidine (0.5%)	43.86	41.21	34.17	30.04	27.72	35.40
T_{14} Nimbecidine (1.0%)	42.89	40.80	36.03	30.97	28.04	35.74
T_{15} Nimbecidine (1.5%)	42.84	40.85	37.03	33.15	30.82	36.94
T_{16} Control	42.95	40.60	34.94	31.01	26.30	35.16
Mean	45.58	43.55	39.38	35.79	32.86	

CD (P=0.05) T = 0.69 I= 0.38 TxI= 1.52