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Effect of pre-harvest treatments on storage quality of aonla cv. NA – 7 and Chakiya

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Abstract

An experiment was carried out in the aonla orchard farm K.N.K. college of Horticulture Mandsaur, Madhya Pradesh, during 2015 – 16 to 2016 – 17. The meteorological data revealed that the minimum temperature ranged from 8.7 0C to 26.6 0C and 9.6 0C to 28.4 0C and maximum temperature from 22.8 0C to 42.8 0C and 24.5 0C to 43.0 0C during 2015 – 16 and 2016 – 17, respectively. The highest and lowest relative humidity was recorded in the 44.1 % and 92.1 % and 43.0 % and 87.0 %, 2015 – 16 and 2016 – 17, respectively. Total rainfall 744.8 mm and 844.7 mm were recorded during 2015 – 16 and 2016 – 17, respectively. In randomized block design (RBD) with sixteen treatments consisting of foliar spray of Borax, Planofix, Bayleton, Calcium Nimicidine, and control trees were sprayed with water. Various substances, which were applied 15-20 days before the expected date of harvest. Fresh fruits of each cultivar from all sampling dates were stored under ambient conditions and following observations pertaining to changes in physico-chemical characteristics of the fruit were recorded at weekly were recored. most effective treatments in reducing PWL was 1.5 per cent calcium nitrate in which only 11.30 per cent PWL was recorded although it did not differ statistically from other concentrations of Ca(NO3)2 and Bayleton. However higher juice recovery upon Ca(N03)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.

Keywords: Pre-harvest sprays, Shelf life, Moisture content**,** Physical weight loss, Anola. To standardize the suitable time of harvest of aonla Cv.NA-7 & Chakiya Fruits

Introduction

Aonla {*Emblica officinalis* (L). Gaertn} is an important indigenous emerging fruit crop owing to its hardiness and ability to withstand adverse soil and climatic conditions and belongs to the family Euphorbiceae sub-family Phyllanthoideae (Arun *et al.*, 2009) [2]. India ranks first in area and production of aonla crop (Priya and Khatkar, 2013) [14] 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) [3] and (NHB, 2014). Among the fruits next to Barbados cherry and also useful for general improvement of health and medicinal purpose (Ram Kumar *et al.*, 2011) [16]. 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) [4]. 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) [18]. 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. Being a member of Euphorbiaceae, to which most of the xerophytes, the cacti and succulents belong; aonla is a hardy drought resistant fruit tree. A rare combination of character is its ability to withstand water stagnation too. The fruit is highly nutritive for human consumption. It is the richest source of vitamin C (500-1500 mg/100g) (Pokharkar, 2005) [15] and nutrients such as polyphenols, pectin, iron, calcium and phosphorus (Khopde *et al.*, 2001) [12] and (Yadav *et al.*, 2012) [20]. 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) [13]. However, owing 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) [10]. Due to its astringent nature, consumers are hesitant to eat it in raw form. Attempts are being made to produce value added products which are not only nutritious but also accepted by consumers (Goyal *et al*., 2008) [7]. 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 distress prices. Appropriate storage and processing methods can curtail the post-harvest losses to 30 per cent (Goyal *et al*., 2008) [7] 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) [6]. The excellent nutritive and therapeutic value as well as owing to restricted availability and high perishability of aonla fruit, value addition through processing would be the only effective tool for economic utilization of increased production of aonla in future. Pre-harvest calcium application 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. Bakshi *et al*. (2005) [5] reported that the role played by Ca in cell wall integrity is an established fact. Its application retains fruit firmness, which is an important quality parameter during storage.

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 handling techniques 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 inceases the duration and quality of aonla. Dehydation of aonla is the fruitful factor which also increases the quality and durability of the aonla. Several new varieties of aonla have been introduced in the Malwa region of Madhya Pradesh. 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 handling techniques to prolong the storage life of fruits. Keeping the above facts in view, the present study Suitable time for harvest of fruits of in relation to storage and quality is being proposed to be undertaken

Materials and Method

To examine the pre-harvest sprays of in the aonla orchard farm K.N.K. college of Horticulture Mandsaur, Madhya Pradesh, during 2015 – 16 to 2016 – 17. The meteorological data revealed that the minimum temperature ranged from 8.7 0C to 26.6 0C and 9.6 0C to 28.4 0C and maximum temperature from 22.8 0C to 42.8 0C and 24.5 0C to 43.0 0C during 2015 – 16 and 2016 – 17, respectively. The highest and lowest relative humidity were recorded in the 44.1 % and 92.1 % and 43.0 % and 87.0 %, 2015 – 16 and 2016 – 17, respectively. Total rainfall 744.8 mm and 844.7 mm were recorded during 2015 – 16 and 2016 – 17, respectively. Data were analyzed by completely randomized design (CRD) as per standard methods while effects of preharvest treatments on physico chemical characteristics of fruit analyzed by Randomized Block Design (RBD) with sixteen treatments consisting of foliar spray of Borax, Planofix, Bayleton, Calcium nitrate, Nimicidine, and control trees were sprayed with water. Various substances, which were applied 15-20 days before the expected date of harvest. After storing of 15 days fruits the following observations were recorded for physical w weight loss (PLW) Pre-weighed fruit samples were weighed on a physical balance after each storage interval. The loss in weight during storage was expressed as per cent of initial weight on each sampling date. Moisture content (%) Oven drying method was used to determine the moisture content from aonla (Ranganna, 1986) [17]. 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 (AOAC, 2000).

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

Juice (%) Fruit juice was extracted with the help of a juice extractor (B. San Barry and company, New Delhi) The fruit was first cut into segments/pieces to destone them and weighed quantities of segments were fed into the hopper on top of the juice extractor. The juice obtamed was collected in a beaker and 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) [17] and Gomez and Gomez (1984) [8].

Results & Discussion

It is depicted from table -1 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. 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) [9]. As in the present study, 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) [20]. They observed that calcium treatments either alone or in combination with fungicides prolonged 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) [9]. In response to Ca $(N0_3)_2$ treatments reduction in PLW of various commodities including aonla, have been amply demonstrated (Kumar *et al.* 2005) [11]. 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. From table-2 results shows that Pre-harvest sprays of Ca (N03)2, Bayleton and Nimbecidine resulted in retention of higher moisture content in NA – 7 and Chakiya aonla fruits. 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 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) [20]. 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) [9]. 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) [9]. Results from table-3 it has been observed that juice yield from 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) [9].

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

Treatment	NA – 7					Chakiya				
	Storage Duration in Days					Storage Duration in Days				
	7	14	21	28	Mean	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)	13.94 (3.21)	1.42 (1.19)	11.55 (3.11)	16.18 (4.02)	24.48 (4.95)	12.16 (3.18)
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)	1.36 (1.18)	11.51 (3.10)	16.12 (4.01)	24.44 (4.95)	12.11 (3.17)
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)	1.36 (1.16)	11.46 (3.08)	16.07 (4.01)	24.38 (4.93)	12.07 (3.16)
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)	1.48 (1.22)	11.13 (3.04)	16.66 (4.08)	24.86 (4.99)	12.28 (3.19)
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)	1.45 (1.20)	11.12 (3.04)	16.47 (4.07)	24.73 (4.97)	12.19 (3.18)
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)	1.45 (1.18)	11.10 (3.03)	16.50 (4.06)	24.68 (4.97)	12.18 (3.18)
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)	1.58 (1.26)	10.74 (2.94)	15.35 (3.92)	24.07 (4.91)	11.68 (3.12)
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)	1.53 (1.23)	10.66 (2.90)	15.23 (3.91)	23.69 (4.90)	11.53 (3.10)
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)	1.48 (1.21)	10.63 (2.89)	15.29 (3.91)	23.99 (4.89)	11.59 (3.10)
T_{10} $Ca (NO_3)_2$ (0.5%)	1.63 (1.26)	11.09 (2.92)	15.90 (3.93)	24.96 (4.90)	13.40 (3.12)	1.57 (1.24)	10.66 (2.90)	15.29 (3.90)	24.00 (4.87)	11.63 (3.10)
T_{11} $Ca (NO_3)_2$ (1.0%)	1.51 (1.22)	10.96 (2.88)	15.79 (3.91)	24.42 (4.88)	13.17 (3.10)	1.45 (1.20)	10.54 (2.86)	15.18 (3.89)	23.48 (4.85)	11.41 (3.07)
T_{12} $Ca (NO_3)_2$ (1.5%)	1.48 (1.19)	10.84 (2.85)	15.71 (3.92)	24.24 (4.85)	13.07 (3.08)	1.42 (1.17)	10.42 (2.82)	15.11 (3.89)	23.31 (4.83)	11.30 (3.05)
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)	1.76 (1.33)	11.26 (3.07)	16.87 (4.11)	24.87 (4.99)	12.44 (3.23)
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)	1.75 (1.32)	11.21 (3.06)	16.72 (4.09)	24.79 (4.98)	12.57 (3.22)
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)	1.72 (1.31)	11.17 (3.05)	16.74 (4.10)	24.78 (4.98)	12.35 (3.21)
T_{16} Control	1.93 (1.49)	14.00 (3.38)	21.85 (4.83)	29.03 (5.67)	16.70 (4.04)	1.86 (1.47)	13.46 (3.36)	21.01 (4.80)	27.91 (5.65)	16.06 (4.01)
Mean	1.60 (1.24)	11.61 (3.0)	16.95 (4.07)	25.51 (5.00)		1.53 (1.22)	11.24 (3.06)	16.30 (4.04)	24.53 (4.96)	

CD (P=0.05) T = 0.39 I = 0.20 TxI = 0.78 T = 0.38 I = 0.19 TxI = 0.76

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						Chakiya					
	Storage Duration in Days						Storage Duration in Days					
	0	7	14	21	28	Mean	0	7	14	21	28	Mean
T1 Borax (0.25%)	85.92	84.66	81.86	77.93	74.92	81.06	84.24	83.00	80.25	76.40	73.45	79.47
T2 Borax (0.50%)	86.14	84.97	82.16	78.12	74.97	81.27	84.45	83.30	80.55	76.59	73.50	79.68
T3 Borax (0.75%)	87.11	85.68	82.67	77.95	74.89	81.66	85.40	84.00	81.05	76.42	73.42	80.06
T4 Planofix (20 ppm)	86.90	85.77	83.29	78.89	74.97	81.97	85.20	84.09	81.66	77.34	73.50	80.42
T5 Planofix (40 ppm)	86.60	84.81	82.37	79.25	75.32	81.67	84.90	83.15	80.75	77.70	73.84	80.07
T6 Planofix (60 ppm)	85.89	84.64	80.94	79.05	75.12	81.13	84.21	82.98	79.35	77.50	73.65	79.54
T7 Bayleton (0.05%)	86.89	85.69	82.74	80.25	76.50	82.42	85.19	84.01	81.12	78.68	75.00	80.80
T8 Bayleton (0.10%)	87.82	87.11	83.95	79.48	75.84	82.84	86.10	85.40	82.30	77.92	74.35	81.21
T9 Bayleton (0.15%)	86.96	85.78	83.13	80.02	75.75	82.33	85.25	84.10	81.50	78.45	74.26	80.71

T10 Ca (NO3)2 (0.5%)	86.70	85.61	82.21	79.61	76.07	82.04	85.00	83.93	80.60	78.05	74.58	80.43
T11Ca (NO3)2 (1.0%)	87.48	85.88	83.18	80.07	75.58	82.44	85.76	84.20	81.55	78.50	74.10	80.82
T12 Ca (NO3)2 (1.5%)	88.23	87.26	84.21	79.66	75.87	83.05	86.50	85.55	82.56	78.10	74.38	81.42
T13 Nimbecidine (0.5%)	87.17	85.94	82.31	76.86	72.10	80.88	85.46	84.25	80.70	75.35	70.69	79.29
T14 Nimbecidine (1.0%)	87.21	85.68	83.03	78.03	74.56	81.70	85.50	84.00	81.40	76.50	73.10	80.10
T15 Nimbecidine (1.5%)	87.87	86.80	83.59	78.08	74.92	82.25	86.15	85.10	81.95	76.55	73.45	80.64
T16 Control	85.95	84.35	79.76	75.34	72.37	79.55	84.26	82.70	78.20	73.86	70.95	78.00
Mean	86.93	85.66	82.59	78.66	74.98		85.24	83.98	80.97	77.12	73.51	

CD (P=0.05) T = 0.68 I = 0.38 TxI = 1.52 T = 0.67 I = 0.37 TxI = 1.50

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

Treatment	NA – 7						Chakiya					
	Storage Duration in Days						Storage Duration in Days					
	0	7	14	21	28	Mean	0	7	14	21	28	Mean
T_1 Borax (0.25%)	42.70	40.09	36.96	33.46	30.89	36.82	41.86	39.30	36.24	32.80	30.28	36.10
T_2 Borax (0.50%)	43.86	41.72	37.03	34.48	31.72	37.76	43.00	40.90	36.30	33.80	31.10	37.02
T_3 Borax (0.75%)	42.84	40.90	38.15	33.82	31.61	37.46	42.00	40.10	37.40	33.16	30.99	36.73
T_4 Planofix (20 ppm)	44.88	42.28	38.86	36.52	31.85	38.88	44.00	41.45	38.10	35.80	31.23	38.12
T_5 Planofix (40 ppm)	44.88	42.94	40.55	37.18	33.66	39.84	44.00	42.10	39.75	36.45	33.00	39.06
T_6 Planofix (60 ppm)	44.88	42.94	39.27	35.14	32.99	39.04	44.00	42.10	38.50	34.45	32.34	38.25
T_7 Bayleton (0.05%)	48.96	47.43	42.02	39.37	37.21	43.00	48.00	46.50	41.20	38.60	36.48	42.16
T_8 Bayleton (0.10%)	48.96	46.82	44.88	40.80	37.23	43.74	48.00	45.90	44.00	40.00	36.50	42.88
T_9 Bayleton (0.15%)	47.94	46.41	41.82	38.91	35.76	42.17	47.00	45.50	41.00	38.15	35.06	41.34
T_{10} Ca $(NO_3)_2$ (0.5%)	46.92	44.68	41.00	37.23	34.39	40.84	46.00	43.80	40.20	36.50	33.72	40.04
T_{11}Ca $(NO_3)_2$ (1.0%)	48.96	47.43	44.06	40.29	37.21	43.59	48.00	46.50	43.20	39.50	36.48	42.71
T_{12} Ca $(NO_3)_2$ (1.5%)	51.00	49.73	43.35	40.29	38.38	44.55	50.00	48.75	42.50	39.50	37.63	43.68
T_{13} Nimbecidine (0.5%)	43.86	41.21	34.17	30.04	27.72	35.40	43.00	40.40	33.50	29.45	27.18	34.66
T_{14} Nimbecidine (1.0%)	42.89	40.80	36.03	30.97	28.04	35.74	42.05	40.00	35.32	30.36	27.49	35.04
T_{15} Nimbecidine (1.5%)	42.84	40.85	37.03	33.15	30.82	36.94	42.00	40.05	36.30	32.50	30.22	36.21
T_{16} Control	42.95	40.60	34.94	31.01	26.30	35.16	42.11	39.80	34.25	30.40	25.78	34.47
Mean	45.58	43.55	39.38	35.79	32.86		44.69	42.70	38.60	35.07	35.22	

CD (P=0.05) T = 0.69 I = 0.38 TxI = 1.52 T = 0.67 I = 0.37 TxI =1.5

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 (N03)2, Bayleton and Nimbecidine resulted in retention of higher moisture content in NA – 7 and Chakiya aonla fruits. Juice yield during storage of NA – 7 and Chakaiya aonla fruit was better than that of control fruit when pre-harvest treatments of Planofix were applied.

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