Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 381-390

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.910.047

Effect of NAA (Napthaleneacetic acid) and 2, 4, 5-T (2, 4, 5-Trichlorophenoxyacetic acid) on Shelf Life of Apple cv. Red Delicious

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ABSTRACT

This explore was conducted to study the effect of NAA (Napthaleneacetic acid) and 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid) on shelf life of apple cv. Red Delicious under 30 days of ambient storage conditions. The growth regulator treatments showed significant effect on shelf life of apple under 30days of ambient storage. Maximum physiological loss in weight (CPLW) (7.53%) was recorded under NAA@ 20ppm and lowest physiological loss in weight (4.33%) was recorded under control. The TSS, total sugars was improved by growth regulators, while as malic acid percentage was lowered compared to untreated fruits. The sugars exhibited an increasing trend with the growth regulators. NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered a decreasing trend on the ascorbic acid content of treated fruits during the storage period. The effect of NAA on TSS and total sugars was observed more pronounced than 2,4,5-T under 30days of ambient storage. However, NAA promotes more ripening in apples, accelerated starch degradation, increased rot%, decreased fruit firmness and ultimately affected the storage life and fruit quality parameters.

Keywords

NAA, 2,4,5-T, Quality, Storage, CPLW

Article Info

Accepted:
04 September 2020
Available Online:
10 October 2020

Introduction

Apple (*Malus* × *domestica* Borkh.) is a typical temperate fruit belonging to family Rosaceae and sub-family Pomoidae.. In Jammu and Kashmir, Red Delicious cultivar of apple has been broadly acknowledged by the cultivators since of its engaging colour and financial picks up, contributing to more than 80% of generation and range beneath apple. From dietary point of see its significance in day by day eat less is obvious from an ancient saying “an apple a day keeps the doctor away”. Lurie (2010) found that application of 3,5,6 TPA and 2,4-D +NAA moved forward fruit quality of apricot at gather or after capacity, in any case, application of 2,4-DP –P caused serious inside browning after capacity. It has been reported that NAA when applied on early apple varieties stimulate ethylene production (Watkins and Nock, 2004). However, Curry (2006) observed that 1- Napthaleneacetic acid (NAA) when applied pre-harvest on late maturing varieties such as Delicious or Fuji apples suppresses ethylene production and delays loss of firmness after harvest. The study uncovered that that one application of NAA may delay apple fruit drop for 10-14 days after treatment and rehashed applications of NAA delay fruit abscission more than single applications. Be that as it may, fruit softening is more often than note expanded by two applications of NAA or warm climate after the primary application (Yuan and Carbaugh, 2007). Ashraf *et al.,* (2013) conducted a test to see the impact of 2,4-D in Kinnow and watched progressed natural product weight, more number of fruits per plant, juice percentage, Total soluble solids (TSS), ascorbic acid substance, acidity, TSS/acid ratio and decreased the fruit drop. Nawaz *et al.,* (2008) examined the impact of foliar showers of 2,4-D at 10, 20 and 30 ppm in Kin now mandarin and found most reduced fruit drop of 12.95 per cent, increased number of fruits/plant and fruit weight/plant. In this case most extreme TSS (12.03%) reducing sugars (3.44%) Non-reducing sugars (5.75) and total sugars (8.86%) were found in 30ppm 2, 4-D and least acidity (0.78%) was found in 10ppm 2, 4-D.

Materials and Methods

The present investigation entitled was carried out in a private orchard at village Mehmoodabad of Dooru, District Anantnag, during 2017-2018. The experiment was carried out on 80 trees which were 17 years old uniform and healthy apple trees of Cv. Red Delicious planted on sandy loam soil planted under 6×6 m spacing were used for the experimentation. Individual limbs were selected as experimental units. All cultural practices like hoeing, fertilization, weeding and sprays against pests and diseases were adopted as per the SKUAST-K recommended package of practice during the course of studies. Two growth regulators *viz*, α-napthalene acetic acid (10ppm and 20ppm) and 2, 4, 5-trichlorophenoxyacetic acid (15ppm and 30ppm) were sprayed four times. Accordingly four dates for four stages of spraying were fixed at 1st September, 8th September, 15th September and 23rd September, with the first October as the anticipated/expected date of harvest. The spraying of chemicals were thus designated as 4WBAH, 3WBAH, 2WBAH and 1WBAH (WBAH = Weeks Before date of Anticipated Harvest). Eighty trees (four limbs from each tree in every direction) of Red Delicious apple trees of uniform size and vigour were selected. The selected branches were carefully marked and tagged. The treatments were assigned to the selected limbs in a Randomized Complete Block Design (RCBD) with four replications. The fruit of each treatment were harvested at optimum maturity and were analyzed for different parameters. The fruit firmness was measured with the help of Effegi model penetrometer FT 3-27 with 11 mm probe, by removing a thin slice of skin with a stainless steel blade. Average of two measurements diagonal to each other were taken on each fruit and the results were expressed in lb per square inch.

The Soluble Solids Contents (SSC) was decided with the assistance of Erma make Japan hand refractometer (0-32% run) in °Brix by putting a drop of juice on the crystal and taking perusing at room temperature. A temperature redress was connected where the readings were made at temperature other than 20°C (Ranganna, 1986). Fruitacidity, Ascorbic acid, Total sugars, reducing non-reducing sugars were calculated as per the strategies laid out by Ranganna. Starch-iodine tests of cut fruits were carried out by utilizing the Cornell Generic Starch-Iodine Index

Chart, where 1 = 100% starch and 8 = 0% starch (Blanpied and Silsby, 1992). For deciding the CPLW from each treatment 10 fruits were taken independently. The initial weight of these fruits was recorded before long after gathering. The fruits were hence weighted at each organize of analysis. The CPLW was expressed on percentage basis as per equation:

$$\text{CPLW (\%)} = \frac{\text{Original weight} - \text{subsequent weight at analysis}}{\text{Original weight}} \times 100$$

Per cent soft rot in each replication of treatments was examined visually and counted during 30 days storage and their disease percentage of fruit were calculated by formula as under:

$$\text{Rot incidence (\%)} = \frac{\text{Number of diseased fruits}}{\text{Total number of fruits}} \times 100$$

Results and Discussion

Effect of different concentrations of NAA and 2, 4, 5-T on Total sugars, reducing sugars and non-reducing sugars of apple cv. Red Delicious after 30days under ambient storage

Observations pertaining to the effect on percent total sugars of Red Delicious apples in response to growth regulator treatments are presented in Table 1. Significant increase in total sugars has been observed due to growth regulator treatments compared to control (10.91%). NAA and 2,4,5-T also differed significantly in their effect former being more influential in increasing the sugar content (11.77%) than the latter (11.44%).

Observations on the effects of spraying at different stages on the total sugar percentage of fruits show significant difference due to timings. Spraying growth regulators 4WBAH, 3WBAH, 2WBAH and 1WBAH exhibited significant difference of 11.16%, 11.26%, 11.35% and 11.38% respectively. Interaction of treatment combinations of growth regulators and stages of spray indicate that there exhibited significant difference in their effect on the Total sugars of fruits during the storage period (Table 1). Data suggests that the total sugar content of NAA treated fruits varied more from check fruits (10.91%) through all stages (11.65 % to 11.83%) while as 2,4,5-T treated fruits registered a different range of (11.24% to 11.63%). Effect of growth regulator treatments on reducing sugars of Red Delicious apples are presented in Table 1. Observations in Table 4 indicate that growth regulator treatments have recorded a significant increase in reducing sugars of fruits over control (9.69%) during the storage period. Further data in Table 1 reveals that NAA and 2,4,5-T differed significantly between each other in effect. NAA (10.06%) being more effective than 2,4,5-T (9.97%).

The application of growth regulators at different stages shows significant difference in effect on the reducing sugars (Table 1). Spraying at 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvesting) recorded an average, a reducing sugar percent of 9.74%, 9.86%, 9.90% and 9.95% respectively.

Observations on interactions of growth regulators and stages of spray indicate that there existed a significant difference in their effect (Table 1). NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered an increasing trend in reducing sugars of treated fruits during the storage period. Effect of growth regulator treatments on reducing sugars of Red Delicious apples are presented in Table 4. Observations in Table 1 indicate that growth regulator treatments have recorded a significant decrease in non- reducing sugars of fruits over control (1.21%). Further data in

Table 1 reveals that NAA and 2,4,5-T differed slightly between each other in effect. NAA (1.72%) being more effective than 2,4,5-T (1.58%). The application of growth regulators at different stages shows significant difference in effect on the non-reducing sugars. Spraying at 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvesting) recorded an average, a non-reducing sugar percent of 1.42%, 1.40%, 1.44% and 1.43% respectively.

Observations on interactions of growth regulators and stages of spray indicate that there existed a significant difference in their effect. NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered a decreasing trend in non- reducing sugars of treated fruits. In general, the total sugars recorded an increase during storage which may be attributed to the hydrolysis of starch and other polysaccharides to soluble form of sugars by the growth regulators. Son *et al.,* (2004) also observed that NAA treatments in apricot had increased total soluble solids and sugars. Khunte *et al.,* (2014) established that total sugar of strawberry fruits treated with NAA were higher.

Effect of different concentrations of NAA and 2, 4, 5-T on Soluble solid content, Acidity and Ascorbic acid of apple cv. Red Delicious after 30days under ambient storage

Different observations made on SSC in terms of ˚Brix, in response to growth regulator treatments are given in Table 2. Observations on growth regulator treatments in different concentrations indicate that there existed a significant difference in effect (Table 2) on SSC of Red Delicious apples over control (12.49˚B). NAA and 2,4,5-T also exhibited a significant difference on SSC former recorded highest SSC (14.24˚B) as compared to latter (13.95˚B).Spraying at different timings exhibited a significant influence on the action of growth regulator treatments on the SSC of fruits (Table 5). Treatments given 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvesting) recorded a significant difference of 13.27˚B, 13.47˚B, 13.59˚B and 13.77˚B respectively.

Observations on the interaction of growth regulators and stages of spray indicate that there existed significant difference in their influence on SSC of Red Delicious apples. However maximum SSC (14.53˚B) was obtained with NAA at 1WBAH (weeks before anticipated harvesting) while the minimum SSC (13.25˚B) was recorded with 2,4,5-T at 4WBAH during the storage period. Rise in soluble solid content during storage may probably be due to hydrolysis of insoluble polysaccharides into simple sugars. Similar results with application of NAA were also observed by Ghosh *et al.,* (2016) and Khandaker *et al.,* (2015).

Data recorded on acidity of Red Delicious apples (malic acid content) as affected by various growth regulator treatments is given in Table 2. All the growth regulators significantly decreased the acidity percentage of fruits compared to control (0.197%) during the storage period as revealed on data in Table 5. NAA and 2,4,5-T exhibited a significant difference in effect in decreasing the acid content and the effect of NAA (0.172%) is shown more pronounced than 2,4,5-T (0.176%).

Different stages of spray reveal significant difference in their effect on acidity percentage of fruits. Spraying NAA and 2,4,5-T 1WBAH resulted in the maximum lowering of acid content (0.172%) at 1WBAH, while as the least reduction (0.190%) was shown by their use at 4WBAH (weeks before anticipated harvest).

Table.1 Effect of different concentrations of NAA and 2, 4, 5-T on Total sugars, reducing sugars and non-reducing sugars of apple cv. Red Delicious after 30days under ambient storage

Stage of application PGR'S	Total sugars (%)					Reducing sugars (%)					Non-Reducing sugars (%)				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
NAA @ 10ppm (T1)	10.82	10.91	10.95	10.96	**10.91**	9.53	9.74	9.83	9.86	**9.74**	1.29	1.17	1.12	1.09	**1.17**
NAA @ 20ppm (T2)	11.65	11.75	11.85	11.83	**11.77**	9.96	10.06	10.11	10.13	**10.06**	1.70	1.69	1.73	1.74	**1.72**
2,4,5-T @ 15ppm (T3)	11.26	11.36	11.45	11.55	**11.40**	9.84	9.85	9.86	9.86	**9.85**	1.41	1.50	1.69	1.74	**1.58**
2,4,5-T @ 30ppm (T4)	11.24	11.34	11.55	11.63	**11.44**	9.93	9.95	9.96	10.05	**9.97**	1.33	1.41	1.49	1.50	**1.43**
Control (T5)	10.83	10.94	10.90	10.92	**10.89**	9.44	9.70	9.77	9.86	**9.69**	1.39	1.24	1.15	1.08	**1.21**
Mean	**11.16**	**11.26**	**11.33**	**11.37**		**9.74**	**9.863**	**9.90**	**9.95**		**1.42**	**1.40**	**1.44**	**1.43**	
CD (p≤0.05)	Treatments = 0.018 stages = 0.016 Treatments × Stages= 0.036					Treatments = 0.017 Stages = 0.015 Treatments × Stages= 0.034					Treatments = 0.027 Stages = 0.024 Treatments × Stages = 0.054				

Table.2 Effect of different concentrations of NAA and 2, 4, 5-T on Soluble solid content, Acidity and Ascorbic acid of apple cv. Red Delicious after 30days under ambient storage

Stage of application PGR'S	SSC (˚B)					Acidity (%)					Ascorbic acid (mg/100g)				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
NAA @ 10ppm (T1)	13.46	13.45	13.47	13.76	**13.53**	0.197	0.185	0.175	0.167	**0.181**	3.83	3.66	3.73	3.64	**3.71**
NAA @ 20ppm (T2)	13.73	14.35	14.33	14.53	**14.24**	0.186	0.174	0.165	0.165	**0.172**	4.06	4.25	4.13	4.15	**4.15**
2,4,5-T @ 15ppm (T3)	13.25	13.35	13.57	13.49	**13.41**	0.196	0.177	0.166	0.168	**0.176**	4.33	4.45	4.33	4.43	**4.38**
2,4,5-T @ 30ppm (T4)	13.58	13.75	14.13	14.34	**13.95**	0.165	0.174	0.176	0.176	**0.173**	4.43	4.39	4.44	4.46	**4.43**
Control (T5)	12.33	12.43	12.46	12.76	**12.49**	0.206	0.202	0.195	0.186	**0.197**	3.74	3.63	3.64	3.55	**3.64**
Mean	**13.27**	**13.47**	**13.59**	**13.77**		**0.190**	**0.182**	**0.175**	**0.172**		**4.08**	**4.07**	**4.05**	**4.04**	
CD (p≤0.05)	Treatments = 0.029 Stages = 0.026 Treatments × Stages = 0.058					Treatments = 0.002 Stages = 0.001 Treatments × Stages = 0.003					Treatments = 0.015 Stages = 0.014 Treatments × Stages = 0.031				

Table.3 Effect of different concentrations of NAA and 2, 4, 5-T on Starch rating and firmness of apple cv. Red Delicious after 30days under ambient storage

Stage of application / PGR'S	Starch rating (1-8)					Firmness (lb/inch^2)				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
NAA @ 10ppm (T1)	7.37	7.53	7.67	7.75	**7.58**	11.84	11.63	11.45	11.26	**11.54**
NAA @ 20ppm (T2)	7.58	7.68	7.76	8.00	**7.77**	11.13	11.15	11.44	10.64	**11.09**
2,4,5-T @ 15ppm (T3)	7.34	7.51	7.65	7.73	**7.56**	12.27	12.14	12.25	11.94	**12.15**
2,4,5-T @ 30ppm (T4)	7.57	7.65	7.75	7.83	**7.70**	13.17	13.08	12.54	12.37	**12.79**
Control (T5)	7.18	7.39	7.63	7.71	**7.47**	13.15	13.07	12.52	12.45	**12.80**
Mean	**7.41**	**7.55**	**7.69**	**7.81**		**12.31**	**12.21**	**12.04**	**11.73**	
CD (p≤0.05)	Treatments = 0.018 stages = 0.016 Treatments × Stages = 0.036					Treatments = 0.051 Stages = 0.046 Treatments × Stages = 0.102				

Table.4 Effect of different concentrations of NAA and 2, 4, 5-T on CPLW (%) and Rot percentage of apple cv. Red Delicious after 30days under ambient storage

Stage of application / PGR'S	CPLW (%)					Rot percentage (%)				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
NAA @ 10ppm (T1)	7.43	7.45	7.54	7.59	7.50	18.30	18.62	19.34	20.50	**19.19**
NAA @ 20ppm (T2)	7.43	7.42	7.56	7.71	7.53	18.72	18.94	19.55	20.74	**19.49**
2,4,5-T @ 15ppm (T3)	5.41	5.43	5.23	5.26	5.33	18.24	18.55	19.24	20.44	**19.12**
2,4,5-T @ 30ppm (T4)	6.13	6.25	6.38	6.35	6.28	18.57	18.87	19.55	20.73	**19.43**
Control (T5)	4.17	4.45	4.33	4.36	4.33	16.92	17.50	18.63	19.59	**18.16**
Mean	6.11	6.20	6.21	6.25		**18.15**	**18.50**	**19.26**	**20.40**	
CD (p≤0.05)	Treatments = 0.026 stages = 0.023 Treatments × Stages =0.051					Treatments = 0.026 Stages = 0.023 Treatments × Stages = 0.052				

Treatment combinations of growth regulators and stages of spray indicate that there existed a significant difference in the effect of their interactions on the acidity of fruits. Maximum lowering of acidity (0.165%) was recorded with T_2S_4, while as least reduction in acidity (0.196%) was registered by T_3S_1. With the prolongation of storage interval, there was a decrease in acidity level irrespective of chemical treatments. This decrease in acidity level could be explained on the grounds that organic acids might be utilized rapidly in respiration for pre-climatric to post-climatric stage. Pawar *et al.,* (2005) acidity was lowered in pomegranate cv. Mridula after treatment with NAA. Mandal *et al.,* (2012) experienced a declining tendency in tritable acidity with the progression of storage period.

Observations in Table 2 indicate that growth regulator treatments have recorded a significant increase in Ascorbic acid content of fruits over control (3.64 mg/100g). Further data in Table 5 reveals that NAA and 2,4,5-T differed significantly between each other in effect. 2,4,5-T (4.38 mg/100g)) being more effective than NAA (4.15 mg/100g).

The application of growth regulators at different stages shows significant difference in effect on the Ascorbic acid content of fruits (Table 2). Spraying at 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvest) recorded an average, ascorbic acid content of 4.08mg/100g, 4.07 mg/100g, 4.05 mg/100g and 4.04 mg/100g respectively.

Observations on interactions of growth regulators and stages of spray indicate that there existed a significant difference in their effect (Table 2). NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered a decreasing trend on the ascorbic acid content of treated fruits during the storage period. This reduction may be due to conversion of glucose-6-phosphate into dehydro ascorbic acid by enzyme ascorbic acid oxidase. The storage periods at different intervals had a profound effect in decreasing of vitamin c contents. Similar results were also reported by Ahmad *et al.,* (1979).

Effect of different concentrations of NAA and 2, 4, 5-T on Starch rating and firmness of apple cv. Red Delicious after 30days under ambient storage

Data presented in Table 3 show that the fruit firmness was significantly affected due to growth regulator treatments over the control (12.80 lb/inch^2). NAA and 2,4,5-T, however differed with each other in effect, the former exhibited a tendency to reduce the fruit firmness more as compared to latter one during the storage period.

Different timings of use of growth regulators show significant difference in effect on fruit firmness (Table 3). Maximum fruit firmness was recorded at 4WBAH (13.17 lb/inch^2) with 2,4,5-T and lowest fruit firmness was recorded when growth regulators were sprayed 1WBAH (10.64 lb/inch^2) with NAA during the storage period of 30 days.

Data on interaction of growth regulators and stages of spray indicate that there existed a significant difference in the effect of various treatment combinations on the firmness of fruits, which ranged from 11.84 lb/inch^2 to 11.26 lb/inch^2 with NAA from 4WBAH to 1WBAH, while as the fruit firmness recorded with 2,4,5-T treatment combinations ranged from 13.17 lb/inch^2 to 12.37 lb inch^2 from S_1 to S_4. This might be due to the fact that the softening of fruit is caused either by breakdown of insoluble protopetin into soluble pectin or by hydrolysis of starch by NAA. Yuan *et al.,* (2007) revealed that NAA improved fruit ripening by reducing the flesh firmness in apples.

Observations on the table 6 indicate that there existed a significant difference of growth regulator treatments on the starch content of fruits over the control (7.47). NAA and 2,4, 5-T significantly differed with each other in lowering the starch content of fruits, however former(7.77) being more effective than the latter (7.70) in reducing the starch content of fruits. Application of treatments at different timings shows significant difference in effect on the starch content of fruits (Table 3). Spraying at 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvesting) recorded an average, starch content of 7.41, 7.55, 7.69 and 7.81 respectively.

Observations on interactions of growth regulators and stages of spray indicate that there existed a significant difference in their effect (Table 3). NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered a decreasing trend on the starch content of treated fruits during the storage period. This might be due to the fact that the starch degradation is accelerated during storage by the increase in rate of respiration and ripening. Starch is degraded and converted into sugar. Continuous hydrolysis of starch results in decreased starch content of fruits. Ozturk *et al.,* (2012) reported that the starch degradation of NAA treated fruits was faster than the control fruits.

Effect of different concentrations of NAA and 2, 4, 5-T on CPLW (%) and Rot percentage of apple cv. Red Delicious after 30days under ambient storage

Observations pertaining to the effect on physiological loss in weight after 30 days under ambiant storage of Red Delicious apples in response to growth regulator treatments are presented in Table 4. Observations on the table 4 indicate that there existed a significant difference of growth regulator treatments on the physiological loss of weight of fruits over the control (4.33%) during storage period. Both the growth regulators significantly differed with each other in increasing the physiological loss in weight of fruits. Maximum physiological loss in weight was recorded with NAA (7.53%).The application of growth regulators at different stages show significant difference in effect on the physiological loss in weight of fruits (Table 4). Spraying at 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvesting) recorded an average, a physiological loss in weight percent of 6.11%, 6.20%, 6.21% and 6.25% respectively.

Observations on interactions of growth regulators and stages of spray indicate that there existed a significant difference in their effect (Table 4). NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered an increasing trend in physiological loss in weight of treated fruits. This might be due to respiration and transpiration loss. Especially low atmospheric moisture and high temperature are the significant factors speeding up the water loss process. The results are in according with the findings of Mandal *et al.,* (2012) who reported that physiological loss in weight improved with NAA throughout storage period. Brackmann *et al.,* (2015) established that the fruits treated with amino vinyl glycine in the field showed an opposite response to the fruits with NAA in apple.

Observations on the table 4 indicate that there existed a significant difference of growth regulator treatments on the Rot (%) of fruits over the control (18.16%) during storage period. Both of the growth regulators significantly differed with each other in depressing the Rot (%) of fruits. Fruits treated with 2,4,5-T resulted in minimum Rot percentage of fruits (18.24%) when sprayed

4WBAH. Maximum Rot percentage was recorded with NAA (20.74%) sprayed 1WBAH. Applications of treatments at different timings show significant difference in effect on the Rot percentage of fruits (Table 4). Spraying at 4WBAH, 3WBAH, 2WBAH and 1WBAH (weeks before anticipated harvesting) recorded an average, rot percent of 18.15 %, 18.50%, 19.26% and 20.40% respectively.

Observations on interactions of growth regulators and stages of spray indicate that there existed a significant difference in their effect (Table 4). NAA and 2,4,5-T applied at any timing (4WBAH, 3WBAH, 2WBAH and 1WBAH) registered an increasing trend in the rot percentage of treated fruits during the storage period. This might be due to the fact that NAA speed up ripening and softening and thus shorten the post harvest life of apples (Ozturk *et al.,* 2012). Post harvest losses in the form of rottening result from several external and internal conditions. Fallahi (2007) observed that NAA promoted ethylene synthesis and also increase the respiration rate of fruit and ultimately has negative impacts on storage life and fruit quality.

References

Ahmad, M., Khalid, Z. M. and Farooqi, W. A. 1979. Effect of waxing and lining material on storage life of some citrus fruits. *Proceeding of Fla. State Horticulture Society* 92: 237-240.

Ashraf, M. Y., Asshraf, M., Akhtar, M., Mahmood, K. and Saleem, M. 2013. Improvement in yield, quality and reduction in fruit drop in Kinnow(*Citrus reticulate* Blanco.) by exogenous application of plant growth regulators, potassium and Zinc. *Pakistan Journal of Botany* 45(SI):433-440.

Blanpied, G. D. and Silsby, K. J. 1992. Prrediction of harvest date windows for apples. *Cornell coop. Exten. Bull* 2212: 1-12.

Brackmann, A., Thewes, F. R., Santos, L. F. D., Machado, E. P., Ludwig, V. and Artmann, L. D. S. 2015. Effect of growth regulator application on the quality maintanance of Brookfield apples. *Bragantia* 74(4):453-456.

Curry, E. A. 2006. NAA-induced ethylene and ACC in "Delicious" spur tissues: changes with temperature and time. *Journal of American Society for Horticultural Science* 116: 846-850.

Fallahi, E. 2007. Influence of 1-aminoethoxyvinylglycine hydrochloride and α-naphthalene acetic acid on fruit retention, quality, evolved ethylene and respiration in apples. *International Journal of Plant Production* 1(1): 53-61.

Ghosh, S. N., Bera, B., Roy, S. and Kundu, A. 2016. Effect of plant growth regulators on yield and fruit quality in pomegranate cv. Ruby. *Journal of Horticultural Science* 4(2): 158-160.

Khandaker, M. M., Hossain, A. S., Osman, N., Mat, N. and Boyce, A. N. 2015. Growth, yield and postharvest quality of wax apple as affected by NAA application. *Revista Brasileira de Fruticultura* 37(2): 410-422.

Khunte, S. D., Kumar, A., Kumar, V., Singh, S. and Saravanan, S. 2014. Effect of plant growth regulators and organic manure on physicochemical properties of strawberry cv. Chandler, *International Journal of Scientific Research and Education* 7(2):1424-1435.

Lurie, S. 2010. Plant growth regulators for improving post-harvest stone fruit quality. *Acta Horticulturae* 884: 21.

Mandal, G., Dhaliwal, H. S. and Mahajan, B. V. C. 2012. Effect of pre-harvest application of NAA and potassium nitrate on storage quality of winter

guava. *Indian Journal of Agricultural Sciences* 82(11): 985–989.
Nawaz, M. A., Ahmad, W., Ahmad, S. and Khan, M. M. 2008. Role of growth regulators on preharvest fruit drop, yield and quality in kinnow mandarin. *Pakistan Journal of Botany* 40(5): 1971-1981.
Ozturk, B. 2016. The effects of aminotheoxyvinylglycine (AVG) and naphthaleneacetic acid (NAA) on ethylene biosynthesis. *Pakistan Journal of Agricultural Science* 53(4): 893-900.
Pawar, P. S., Jagtap, D. D., Garad, B. V. and Shirsath, H. K. 2005. Effect of plant growth regulators on maturity, yield and fruit weight of pomegranate cv. Mridula. *Advanced Plant Science* 18: 167-170.
Rangana 1986. Handbook of Analysis and Quality Control for Fruits and Vegetable products.
Son L.2004. Effect of hand and chemical thinning on fruit size and quality of ‘ Priana and ‘Beliana’ apricot (*Prunus arminiaca*) cultivars. *New Zealand Journal of Crop and Horticultural Science* 32(3):331-335.
Wargo, J. M., Merwin, I. A. and Watkins, C. B. 2004. Nitrogen fertilization, midsummer trunk girdling and AVG treatments affect maturity and quality of ‘Jonagold’ apples. *Hortscience* 39: 493-500.
Yuan, R. and Carbaugh, D. H. 2007. Effects of NAA, AVG and 1-MCP on ethylene biosynthesis, pre-harvest fruit drop, fruit maturity and quality of “Golden Supreme” and “Golden Delicious” apples. *HortScience* 42: 101-105.

How to cite this article:

Shemoo Nisar, Ishtiyaq A. Khan, M. A. Mir, Nageena Nazir, F. A. Khan, Shaila Din, Rihana Rahman, Insha Javeed and Tajamul Farooq wani. 2020. Effect of NAA (Napthaleneacetic acid) and 2, 4, 5-T (2, 4, 5-Trichlorophenoxyacetic acid) on Shelf Life of Apple cv. Red Delicious. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 381-390. doi: https://doi.org/10.20546/ijcmas.2020.910.047