Original Research Article

Effect of Naphthalene Acetic Acid (NAA) on Shelf life and berry quality parameters of Manjri Naveen grapes (*Vitis vinifera L.*)

Abstract:

The experiment was conducted at ICAR- National Research Centre of Grapes, Pune during 2020-2021. The experiment was designed in randomized block design (RBD) having five treatments and four replication. Pre-harvest spray of NAA (50 ppm, 100 ppm, 150 ppm and 200 ppm) were taken for application and applied at veraison stage. The result obtained from this study showed that the higher concentration of NAA (200 ppm) reduces the berry drop, percentage of rotten berries and lowest PLW (%) as compare to untreated vines. The spraying of NAA @ 50, 100, 150, 200 ppm had significant effect on berry weight, bunch weight, TSS/acidity ratio. Biochemical properties of berry were not influenced by the spraying of NAA at different concentration. Therefore, the vines applied with higher concentration of NAA (200 ppm) were found to be effective for increasing the shelf life and yield of Manjri Naveen grapes.

Key Words: NAA, PLW, Shelf life, Yield

INTRODUCTION

Grape (*Vitis vinifera L.)* is the most important commercial crop grown in India, especially in Maharashtra. Grapes occupy far more land in the world than any other single fruit and account for nearly half of the total world production of all fruits. Manjri Naveen is the clonal selection made at N.R.C. for Grapes, Pune, from Centennial Seedless. Normally the veraison start after 90 days from pruning and require 25 to 30 days for harvest. The fruit will be ready to harvest between 115 to 120 days after pruning being early maturing variety. But the ripe berries are sensitive to hot climates and Keeping qualities (shelf life). To regulate the market supply and to reduce the losses, pre and post-harvest applications with plant growth regulators, chemicals and wrappers have been useful, in extending the shelf life of grapes during storage, enabling to reduce post-harvest losses. (Shanta Krishnamurthy, 1985)

Plant hormones are signal molecules produced within plants that occur in extremely low concentrations. Plant hormones control all aspects of growth and development from embryogenesis, the regulation of organ size, pathogen defense, stress tolerance and through to reproductive development. The naphthalene acetic acid (NAA) is a synthetic form of auxin. NAA is also used to prevent premature drop and thinning of fruits. It is useful after flowering. To get the best results of NAA, it should be applied in the concentrations ranging from 20 to 100 mg L-1 (Rosier et al. 2004). The use of growth regulators as pre-harvest sprays improves the quality of grapes and also the shelf life. Post-harvest berry shattering could be reduced by spraying NAA. In Cheema Sahebi, a pre-harvest spray of NAA 50 and 100 ppm significantly reduced the post-harvest berry shattering. (Dass et al., (1972) and Beerh et al. (1976). Postharvest quality of fruits can also be manipulated by pre harvest applications of different mineral elements, plant growth regulators, fungicides, or natural antagonists (Dominguez et al., 2012; Zhu et al., 2016a; Zoffoli et al., 2009). Considering the

Importance of Manjri Naveen grapevines, the present research plan to reduced berry drop and increased shelf life with application of agrochemicals in grapevines. The present study was conducted in order to investigate the effect of (NAA) on shelf life, yield and quality parameters at veraison stage of Manjri Naveen grapes.

MATERIALS AND METHODS

Experimental Site:

The experiment was conducted at research and developmental vineyards of ICAR- National research Centre of Grapes, Pune during 2020-2021. Pune is located in Midwest Maharashtra state (India) at an altitude of 559 m above the mean sea level. It lies in 18.32° N latitude and 73.51° E longitude. Twelve year-old Manjri Naveen grafted on 110-R rootstock were selected for the study. The vines were planted at a spacing of 2.5 m between rows and 1.2 m between vines within a row. The row orientation was in the direction of North – South. The vines were trained to double cordon Y system. The soil of this region is black having pH 7.75 and EC 0.46 dS/m. However, water used for irrigation had EC 1.8 and pH 8.3 (Sharma and Upadhyay, 2005).

The experiment was designed as randomized Block design (RBD) having five treatments and 4 replication. Application of NAA was done 10 days before harvest at version stage. Present study was conducted to know the effect of NAA on shelf life, yield and quality parameters of Manjri Naveen grapes.

Table No. 1: Treatment Details

T_1	NAA @ 50 ppm
T_2	NAA @ 100 ppm
T_3	NAA @ 150 ppm
T_4	NAA @ 200 ppm
T_5	Control

Yield and Yield Components

Yield and berry quality of Manjri Naveen grapes were recorded at harvest. The average bunch weight (g) was calculated from average weight of 15 bunches, while yield per vine (kg) was recorded at the time of harvest. Randomly selected berries from bunches were used for berry weight. To measure average berry length and berry diameter, 10 berries were selected randomly from different bunches from a given replication and measured using Digital Vernier Caliper (0–300 mm RSK™) and were expressed in millimeter.

Biochemical Analysis:

Total soluble solids (TSS) were measured using hand refractometer and expressed as degree Brix. Acidity was measured by titrating the sample with 0.1 N sodium hydroxide using phenolphthalein indicator (A.O.A.C, 1985). The total phenol and Tannins content of the berry were determined using the Folin- Ciocalteu method (Singleton and Rossi, 1965) using Catechol, as the standard. Total flavonoid content (TFC) was determined using the aluminum chloride assay described by Samatha et al. (2012).

Physiological loss in weight (PLW):

The PLW was calculated on initial weight basis. The physiological loss in weight of bunch was recorded on the basis of initial fresh weight of the fruit and subsequent loss in weight occurred during postharvest storage and expressed as percentage value.

$$\text{PLW (\%)} = \frac{\text{Initial weight of fruit} - \text{Finial weight of fruit}}{\text{Initial weight of fruit}} \times 100$$

Fallen and Rotten Berries (%):

Fallen and rotten berry percentage was recorded from each box by dividing the weight of fallen berries and total weight of packed bunch.

$$\text{Fallen berry (\%)} = \frac{\text{Weight of free berries inside each box}}{\text{Total bunch weight}} \times 100$$

$$\text{Rotten berries (\%)} = \frac{\text{Total weight of bunch - Bunch weight after removing defected berries}}{\text{Total weight of bunch}} \times 100$$

Statistical Analysis:

The experiment was conducted in randomized block design consisting of five treatments with four replications. All calculations were performed using the GLM procedure of SAS System software, (version 9.3.)

Result and discussion

Yield and quality parameters:

Applying the NAA at different concentration demonstrated a beneficial effect on bunch weight, yield and berry weight in Manjri Naveen grapes (Table 2). Bunch treated with NAA @150 and NAA @ 200 ppm had significantly higher bunch weight (391.17g and 395g) respectively than the untreated control. Application of NAA at pre veraison stage increases the yield per vine. Result obtained from this study clearly showed that the yield significantly increased by the application of NAA at 150 ppm and 200 ppm (16.28kg and 17.10kg) respectively followed by the treatment NAA @ 50 ppm (13.48 kg). The results confirm the finding of Manish Prajapati and Devi Singh, (2018) while working on Guava (*Psidium guajava* L.) they reported that combination of different plant growth regulators significantly affected the parameters such as plant height, fresh fruit weight(g), yield/plant (kg) found to be

Under the treatment (NAA 200 ppm). There were no significantly differences were recorded for berry length, berry diameter and pedicel diameter.

The data recorded on T.S.S, Acidity was significantly influenced by all the treatments. The highest T.S.S. (18.40^{0}Brix) with least Acidity (0.66 %) was obtained with application NAA @ 200 ppm. While, least T.S.S. (17.70 ^{0}Brix) with minimum T.S.S./Acidity ratio (25.66) were obtained with untreated vines. The lowest Acidity obtained from NAA @ 100 ppm. This investigation might be due to the higher concentration of NAA @ 150 ppm and NAA @ 200 ppm. The study confirm the finding of Teaotia *et al.* (1972) found that pre-harvest spraying of NAA at different concentration viz. 50, 100 and 250 ppm increased the TSS content of guava fruits. Also, Mahmud *et al. (*2008) opinioned that the decrease in titratable acidity in papaya during storage probably due to decrease in citric acid and calcium causing inhibition of enzymatic activity leading to delay in the use of organic acid in the enzymatic reaction of respiration. The mean TSS and acid ratio increased with increase in storage period. The maximum TSS and acid ratio was observed in NAA @ 100 ppm followed by the NAA @ 50 ppm.

Biochemical parameters:

The data recorded on biochemical changes of Manjri Naveen vines were presented in Table 4. The result obtained from the study revealed that the application of NAA at different concentration does not affect the phenolic properties of berry. This result might be just due to the time of application of NAA and its chemical properties. NAA is applied to increase the shelf life of grapes at pre veraison stage. The result in hand confirm the finding of Artes-Hernandez et al., (2006) reported that white Superior Seedless table grapes stored for 7 days at 0 ^{0}C, followed by 4 days at 8 ^{0}C under modified atmosphere packaging, did not change their total phenolic content. Further slight decreases were seen during their subsequent shelf-life.

Physiological loss in weight (PLW):

The data on physiological loss in weight (PLW) of grape bunches as influenced by the pre-harvest treatment with growth regulators are presented in Table 3. Among the treatments highest PLW was observed in control at (10.58 per cent). PLW was less in NAA @ 200 ppm at (7.56 percent). Data revealed that reduced PLW %, fallen berries %, rotten berries % were observed with application of NAA at 200 ppm, which was on par with its lower dose i.e. NAA at 150 ppm. Findings confirm with the report of Ranjeet and Gupta (1987) that pre harvest spray of NAA @ 150 reduced the physiological loss in weight in perlette grapes. The results obtained in this investigation might be due to the application of NAA at pre harvest reduces water loss in berries after post-harvest storage. These studies confirm the findings of Dass et al. (1972) and Beerh et al. (1976) reported that the use of growth regulators as pre-harvest sprays improves the quality of grapes and also the shelf life. In Cheema Sahebi, a pre-harvest spray of NAA @ 50 and @ 100 ppm significantly reduced the post-harvest berry shattering.

The correlations between different parameters studied are presented in Table No.5 showed the positive and negative correlations between different parameters due to use of different concentration of Naphthalene acetic acid (NAA). The yield parameters showed bunch weight having positive relationship with berry weight, berry diameter, yield per vine has negative correlation with berry length. TSS showed highly positive correlation with acidity, phenols, tannin, flavonoids and negative correlation with TSS: Acidity ratio. Physiological loss in weight (PLW %) showed having highly positive correlation with fallen berry, rotten berry.

CONCLUSION:

From this study it is concluded that the application of NAA @ 200 ppm increases berry weight, bunch weight and yield per vine. At pre veraison stage the application of higher concentration of NAA significantly reduced the berry drop and increases the shelf life of Manjri Naveen grapes.

Table No. 2. Effect of NAA on bunch and berry quality parameters of Manjri Naveen grapes.

Treatment	Bunch Weight	Berry Weight	Berry diameter	Berry length	Pedicel diameter	TSS	Acidity	TSS/ Acidity Ratio	Yield /Vine
	(g)	(g)	(mm)	(mm)	(mm)	(°Brix)	(%)		(kg)
T_1 (NAA @50ppm)	365.97	3.68	16.82	24.48	1.65	18.03	0.618	29.25	13.48
T_2(NAA @100ppm)	383.44	3.73	17.02	23.35	1.74	18.20	0.612	29.74	15.80
T_3(NAA @150ppm)	391.17	4.10	16.89	24.25	1.59	18.15	0.656	27.72	16.28
T_4(NAA @200 ppm)	395.49	4.17	16.73	23.33	1.60	18.40	0.661	27.87	17.10
T_5(Control)	319.30	3.98	16.43	24.43	1.81	17.70	0.614	25.66	13.90
SEm ±	**8.667**	**0.135**	**0.296**	**0.353**	**0.059**	**0.193**	**0.016**	**1.122**	**0.705**
C.D @ 0.5 %	**18.89**	**0.29**	**0.64**	**0.77**	**0.13**	**0.42**	**0.04**	**2.44**	**1.54**

Table No. 3. Effect of NAA on Shelf life of Manjri Naveen Grapes at 7th Day after storage

Treatment	PLW	Fallen Berry	Rotten Berry
	(%)	(%)	(%)
T_1(NAA @50ppm)	9.42	2.89	8.50
T_2 (NAA @100ppm)	8.41	2.25	5.18
T_3(NAA @150ppm)	8.10	2.10	3.84
T_4 (NAA @200ppm)	7.56	1.52	1.21
T_5 (Control)	10.58	4.75	10.13
SEm (±)	**0.59**	**0.84**	**1.41**
C.D @ 0.5 %	**1.50**	**1.84**	**3.08**

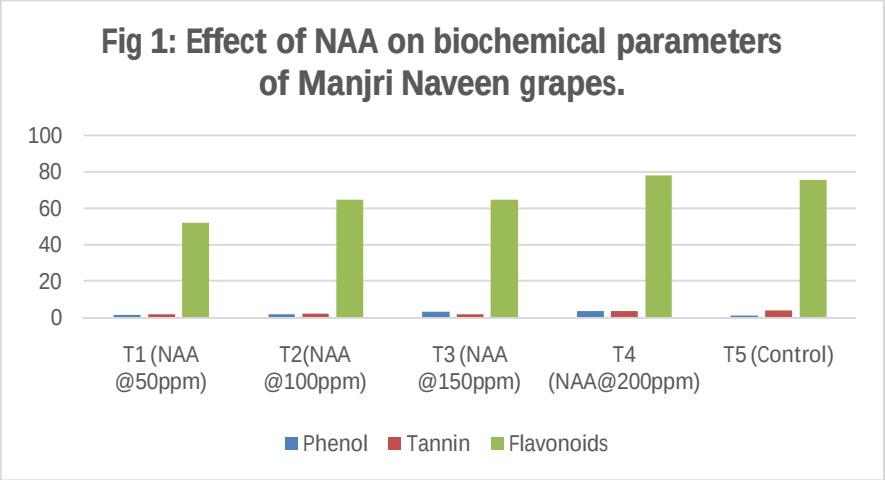
Table No.4: Effect of NAA on biochemical parameters of Manjri Naveen grapes

Treatment	Phenol	Tannin	Flavonoids
	(mg/g) fresh.wt.	(mg/g) fresh.wt.	(mg/g) fresh.wt.
T_1 (NAA @50ppm)	1.74	2.02	52.25
T_2(NAA @100ppm)	1.92	2.18	65.11
T_3 (NAA @150ppm)	3.44	2.02	64.97
T_4 (NAA@200ppm)	3.69	3.66	78.31
T_5 (Control)	1.47	4.05	75.97
SEm (±)	**0.363**	**0.458**	**6.908**
C.D @ 0.5 %	**0.79**	**1.00**	**15.05**

Table No. 5 Correlation between different parameters of grapes cv. Manjri Naveen grapes.

Treatment	Bunch Weight	Berry Weight	Berry diameter	Berry length	Yield /Vine	TSS	Acidity	T/A Ratio	Phenol	Tannin	Flavonoids	PLW	Fallen berries	Rotten berries
	(g)	(g)	(mm)	(mm)	(kg)	(°Brix)	(%)	(%)	(mg/g)	(mg/g)	(mg/g)	(%)	(%)	(%)
Cluster Weight(g)	1													
Berry Weight.(g)	0.209	1												
Berry diameter(mm)	0.793	-0.351	1											
Berry length(mm)	-0.610	-0.171	-0.428	1										
Yield /Vine(kg)	0.783	0.652	0.395	-0.761	1									
TSS(°Brix)	0.953	0.268	0.655	-0.769	0.827	1								
Acidity (%)	0.652	0.838	0.106	-0.269	0.778	0.649	1							
TSS/Acidity Ratio	0.645	-0.609	0.894	-0.411	0.138	0.586	-0.131	1						
Phenol(mg/g)	0.764	0.780	0.255	-0.416	0.871	0.761	0.982	0.007	1					
Tannin(mg/g)	-0.514	0.521	-0.860	-0.092	0.023	-0.279	0.070	-0.772	-0.012	1				
Flavonoids(mg/g)	-0.137	0.752	-0.549	-0.415	0.488	0.058	0.362	-0.658	0.343	0.857	1			
Reducing sugar	0.138	0.852	-0.372	0.265	0.335	0.110	0.818	-0.573	0.699	0.295	0.364	1		
PLW (%)	-0.971	-0.392	-0.662	0.711	-0.902	-0.972	-0.744	-0.488	-0.851	0.309	-0.102	0.229	1	
Fallen berries (%)	-0.993	-0.228	-0.745	0.660	-0.794	-0.981	-0.662	-0.633	-0.772	0.436	0.082	0.140	0.978	1
Rotten berries (%)	-0.892	-0.569	-0.480	0.738	-0.961	-0.936	-0.823	-0.294	-0.910	0.090	-0.320	0.351	0.973	0.913

Fig No.1: Effect of NAA on biochemical parameters of Manjri Naveen grapes



REFERENCES:-

1. A.O.A.C., 1985. Association of Official Analytical Chemists Edited by S. Williams, Association of Official, Analytical Chemists.
2. Artes- Hernandez, F., Tomas – Barberan, F.A.; Artes, F. 2006. Modified atmosphere packaging preserves quality of SO_2 – free "Superior seedless" table grapes. *Postharvest Biol. Technol.*2006, **39,** 146-154.
3. Beerh OP, Krishnamurthy CV, Narasimham P, Girdhar N and Raghuramai ah B, 1976. Effect of Pre-and post-harvest treatments control some corrmon disorders in Anab-e Shahi grapes. *Journal of Food Science and Technology* 1 3: 1 29 - 1 32.
4. Domínguez, I., Ferreres, F., Riquelme, F.P., Font, R., Gil, M.I., 2012. Influence of pre-harvest application of fungicides on the post harvest quality of tomato (*Solanum lycopersicum* L.). *Post harvest Biol. Technol*. 72, 1–10.
5. Dass H C, Randhawa G S and Negi S P 1974, Effect of growth regulators on post-harvest berry drop in Cheema Sahebi grape. *Indian Journal of Horticulture*31: 131-4.
6. Manish Prajapati and Devi Singh., 2018. Effect of Plant Growth Regulators on Flowering, Fruit Growth and Quality of Guava (*Psidium guajava* L.) cv. Allahabad Safeda. *Int. J. Curr. Micro biol. App. Sci* (2018) *Special Issue*-**7:** 3355-3361.
7. Mahumud, T.M.M., Eryani, R.A., Syed, O.S., Mohamed, A.R., Eryani, A.L and Abdul, R. (2008). Effect of different concentration and application of calcium on storage life and physic-chemical characteristics of papaya (*Carica papaya L.) Am. J. Agric. &Biol. Sci.*, **3(3):**526-533.
8. Rossetto, M, McNally J, Henry RJ. Evaluating the potential of SSR flanking regions for examining relationships in Vitaceae. Theo App Gen 2002; 104:61-66.
9. Rosier CL, Frampton J, Goldfarb B, Blazich FA, Wise FC. Growth Stages, Auxin type and concentration Influence Rooting of Stem Cuttings of Fraser Fir. *HortSci* 2004; 39:1397-1402.
10. Ranjit Kumar, Gupta O.P., and Kumar R. (1987). Effect of pre harvest application of fungicide growth regulators and calcium nitrate on storage behaviour perlette grapes at low temperature. *Haryana Agricultural University Journal of Research*, **17(1):** 30-38.

11. Samatha, T., R. Shyamsundarachary, P. Srinivas, and N. R. Swamy. 2012. Quantification of total phenolic and total flavonoid contents in extracts of OroxylumIndicum L. Kurz. *Asian J. Pharm. Clin. Res.* **5**:177–179.
12. Shanta Krishnamurthy. 1985. Factors affecting storage of grapes. *Proceeding of the National workshop on post-harvest management of grapes.* 129 -134.
13. Sharma, J., and A.K. Upadhyay. Effect of moisture stress on performance of own rooted and grafted vines of Tas-A-Ganesh (*Vitisvinifera L.*) VII international symposium on temperate zone fruits in the tropics and subtropics. *ISHS Acta. Hort.* 2005.662.
14. Singleton, V. L., and Joseph A. Rossi. 1965. "Colorimetry of Total Phenolics with Phosphomolybdic-Phosphotungstic Acid Reagents."*American Journal of Enology and Viticulture* 16(3).
15. Zhu Y., Yu, J., Brecht, J.K., Jiang, T., Zheng, X., 2016a. Pre-harvest application of oxalic acid increases quality and resistance to *Penicillium expansum* in kiwifruit during postharvest storage. *Food Chem.* 190, 537
16. Zoffoli J.P., Latorre, B.A., Naranjo, P., 2009. Pre harvest applications of growth regulators and their effect on Post-Harvest quality of table grapes during cold storage.*Post-harvest Biol. Technol.* 51, 183–192.