



Effect of Naphthalene Acetic Acid (NAA) on Shelf Life and Berry Quality Parameters of Manjri Naveen Grapes (*Vitis vinifera* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at ICAR- National Research Centre of Grapes, Pune during 2020-2021. The experiment was designed in a randomized block design (RBD) having five treatments and four replications. Pre-harvest sprays of NAA (50 ppm, 100 ppm, 150 ppm and 200 ppm) were taken for application and applied at the 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 compared to untreated vines. The spraying of NAA @ 50, 100, 150, 200 ppm had a significant effect on berry weight, bunch weight, TSS/acidity ratio. The biochemical properties of berries were not influenced by the spraying of NAA at different concentrations. Therefore, the vines applied with a higher concentration of NAA (200 ppm) were found to be effective in increasing the shelf life and yield of Manjri Naveen grapes.

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1. 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 National Research Centre for Grapes, Pune, from Centennial Seedless. Normally the veraison starts after 90 days from pruning and requires 25 to 30 days for harvest. The fruit will be ready to harvest between 115 to 120 days after pruning being an early maturing variety. "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" [1].

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. Naphthalene acetic acid (NAA) is a synthetic form of auxin. "NAA is also used to prevent premature drops and thinning of fruits. It is useful after flowering. To get the best results of NAA, it should be applied in concentrations ranging from 20 to 100 mg/l" [2]. 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. [3] and Beerh et al. [4]. "Post-harvest quality of fruits can also be manipulated by pre harvest applications of different mineral elements, plant growth regulators, fungicides, or natural antagonists" [5-7]. Considering the importance of Manjri Naveen grapevines, the present research plan is reduce berry drop and increased shelf life with the 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.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at the research and developmental vineyards of ICAR- National Research Centre for 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 at 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 [8].

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

Table 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

2.2 Yield and Yield Components

The yield and berry quality of Manjri Naveen grapes were recorded at harvest. The average bunch weight (g) was calculated from the 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 millimeters.

2.3 Biochemical Analysis

Total soluble solids (TSS) were measured using a hand refractometer and expressed as degree Brix. Acidity was measured by titrating the sample with 0.1 N sodium hydroxide using a phenolphthalein indicator [9]. The total phenol and Tannins content of the berry was determined using the Folin- Ciocalteu method [10] using Catechol, as the standard. Total flavonoid content (TFC) was determined using the aluminium chloride assay described by Samatha et al. [11].

2.4 Physiological Loss in Weight (PLW)

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

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

2.5 Fallen and Rotten Berries (%)

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

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

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

2.6 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.)

3. RESULTS AND DISCUSSION

3.1 Yield and Quality Parameters

Applying the NAA at different concentrations 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. The result obtained from this study clearly showed that the yield significantly increased with the application of NAA at 150 ppm and 200 ppm (16.28 kg and 17.10 kg) respectively followed by the treatment NAA @ 50 ppm (13.48 kg). The results confirm the findings of Manish Prajapati and Devi Singh, [12], they reported that the NAA 200 ppm recorded maximum yield/plant (kg) in guava crop. The data recorded on T.S.S, Acidity was significantly influenced by all the treatments. The highest T.S.S. (18.40^o Brix) with least Acidity (0.66 %) was obtained with application NAA @ 200 ppm. While least T.S.S. (17.70^oBrix) with minimum T.S.S./Acidity ratio (25.66) were obtained with untreated vines. The lowest Acidity was obtained from NAA @ 100 ppm. This investigation might be due to the higher concentration of NAA @ 150 ppm and NAA @ 200 ppm. The study confirms the finding of Teotia et al. [13] found that pre-harvest spraying of NAA at different concentrations viz. 50, 100 and 250 ppm increased the TSS content of guava fruits. Also, Mahmud et al. [14] opinioned that the decrease in titratable acidity in papaya during storage was probably due to a 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 an increase in the storage period. The maximum TSS and acid ratio was observed in NAA @ 100 ppm followed by the NAA @ 50 ppm.

3.2 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 concentrations does not affect the phenolic properties of berries. 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 confirms the finding of Artes- Hernandez et al. [15] reported that white Superior Seedless table grapes stored for 7 days at 0^oC, followed by 4 days at 8^oC under modified atmosphere packaging, did not change their total phenolic content. Further slight decreases were seen during their subsequent shelf-life.

Table 2. Effect of NAA on bunch and berry quality parameters of Manjri Naveen grapes

Treatment	Bunch weight	Berry weight	Berry diameter	Berry length	Pedicle 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 @200ppm)	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 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 4. Effect of NAA on biochemical parameters of Manjri Naveen grapes

Treatment	Phenol (mg/g) fresh.wt.	Tannin (mg/g) fresh.wt.	Flavonoids (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 5. Correlation between different parameters of grapes cv. Manjri Naveen grapes

Treatment	Bunch weight (g)	Berry weight (g)	Berry diameter (mm)	Berry length (mm)	Yield /Vine (kg)	TSS (°Brix)	Acidity (%)	T/A Ratio (%)	Phenol (mg/g)	Tannin (mg/g)	Flavonoids (mg/g)	PLW (%)	Fallen berries (%)	Rotten berries (%)
Bunch 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

3.3 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 the reduced PLW %, fallen berries %, rotten berries % were observed with the application of NAA at 200 ppm, which was on par with its lower dose i.e. NAA at 150 ppm. Findings confirm the report of Ranjeet and Gupta [16], 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. [3] and Beerh et al. [4] 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 5 showing the positive and negative correlations between different parameters due to the use of different concentrations of Naphthalene acetic acid (NAA). The yield parameters showed bunch weight having a positive relationship with berry weight, berry diameter and yield per vine having negative correlation with berry length. TSS showed highly positive correlation with acidity, phenols, tannin, flavonoids and a negative correlation with TSS: Acidity ratio. Physiological loss in weight (PLW %) showed having a highly positive correlation between fallen berry, rotten berry.

4. 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 a higher concentration of NAA significantly reduced the berry drop and increases the shelf life of Manjri Naveen grapes.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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