Application of GA_3 and NAA as a Means for Improving Yield, Fruit Quality and Storability of Black Monukka Grape Cv.

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Abstract: This investigation was carried out for two successive seasons: 2009 & 2010 in a private vineyard located at El-Khatatba, Menoufiya governorate; to study the possibility of increasing yield, improving cluster quality, reducing berry shattering and enhancing storability of Black Monukka grapes through spraying with GA_3 and different doses of NAA either in the single or in the combined form. The chosen vines were ten-year-old, grown in a sandy loam soil, spaced at 2 X 3 meters apart, irrigated by the drip system, and cane-pruned and trellised by the Spanish Parron system. Eight treatments were applied as follows; spraying with tap water (control), spraying with 20 ppm GA_3, spraying with 25 ppm NAA, spraying with 50 ppm NAA, spraying with 75 ppm NAA, spraying with 20 ppm GA_3 + 25 ppm NAA, spraying with 20 ppm GA_3 + 50 ppm NAA and spraying with 20 ppm GA_3 + 75 ppm NAA. All treatments were applied after fruit set stage (at 2-3 mm berry diameter). Spraying with 20 ppm GA_3 + 75 ppm NAA gave the best results in comparison with control. This treatment resulted in the best yield and its components as well as the best physical properties of cluster and improved physical and chemical characteristics of the berries. Concerning the effect of GA_3 and/or NAA on clusters during cold storage for four weeks at 0°C, RH 90-95%, it was noticed that spraying with 20 ppm GA_3 + 75 ppm NAA was the best treatment on enhancing storability, since it reduced wastage resulting either from disease infection or physiological disorders and inhibited the rate of deterioration of physical and chemical properties of grapes during cold storage by reducing weight loss (%), decay (%), shattering (%), total spoilage (%) and the decrease in firmness, it also increased berry colour, TSS and TSS/acid ratio and decreased acidity compared to control. The economical study indicated that spraying clusters with 20 ppm GA_3 + 75 ppm NAA resulted in the highest net income of Black Monukka grape as compared to the control.

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1. Introduction:

Black Monukka is one of the table grape cultivars; ripens in mid July to late August. This cultivar holds a significant promise for commercial purpose due to its seedless, sweet, crisp, purplish-black colour and skin tenderness. However, the production of small to medium berries, loose clusters and high berry shattering are negatively reflected on productivity, cluster quality and storability (Harry *et al*., 1991).

The plant growth regulators (PGR) act as messengers and are needed in small quantities at low concentrations. Generally their site of action and biosynthesis are different. Most of the plant growth regulators exhibit a broad spectrum and thus a single PGR may influence several entirely different processes (Kassem *et al*., 2010). Berry size and cluster conformation of seedless grapes are customarily improved through the application of growth regulators (Reynolds *et al.*, 1992).

Gibberellic acid (GA_3) applied at fruit set is used extensively to increase berry size of Vitis vinifera seedless table grapes. Gibberellins primarily affect growth by controlling cell elongation and division, which is reflected on yield and its components and fruit quality of various grape cultivars (Pires *et al*., 2000; Omar and El-Morsy 2000; Rizk-Alla, 2000 and Omar and Girgis 2005).

NAA application affects fruit formation through cell division and elongation (Dutta and Banik 2007). Also, Iqbal *et al*. (2009) reported that NAA significantly reduced fruit drop, increased yield and improved fruit quality.

There are some reports indicating that the use of a combination of GA x NAA is more effective than the use of each compound alone in improving size of seedless grapes (Luckwill, 1959; El-Hammady & Abd El-Hamid, 1995 and El-Morsy, 2001).

Concerning the effect of preharvest treatments on storability, spraying GA_3 and/or NAA reduced weight loss (%), decay (%), shattering (%), total spoilage (%) and acidity (%) while it increased berry colour, TSS and TSS/acid ratio compared to control after 45 days of cold storage at 0°C, RH 90-95% (Ramteke *et al*., 2002 0n Tas-A-Ganesh' grapes; Fatma and Aisha, 2005 on Roumy Ahmer grapes; Rizk –Alla and Meshreki, 2006 and Mohamed *et al*., 2007 on Crimson Seedless grapes) working on GA_3 spraying. Also, El-Abbasy and El-Morsy, 2002 on Thompson Seedless grapes and Tecchio, et al., 2009 on 'Niagra Rosada' grapes who worked on NAA.

Therefore, the main objective of this study was to raise the yield/vine and its components, to improve cluster and berry characteristics and storability of “Black Monukka" grapes through the spraying of GA_3 and different doses of NAA either in the single or in the combined form.

2. Materials and Methods:

This investigation was conducted for two successive seasons (2009 & 2010) in a private vineyard located at El-Khatatba, Menoufiya governorate; on mature Black Monukka grapevines to study the effect of spraying with GA_3 and NAA on yield, fruit quality and storability of Black Monukka grapevines. The chosen vines were ten-year-old, grown in a sandy loam soil, spaced at 2 X 3 meters apart, irrigated by the drip system, and cane-pruned and trellised by the Spanish Parron system. The vines were pruned during the second week of January with bud load of 72 buds/vine. Ninety six uniform vines were chosen. Each four vines acted as a replicate and each three replicates were treated by one of the following treatments.

Clusters were sprayed as follows:

1. Spraying with tap water (control).
2. Spraying with 20 ppm GA_3.
3. Spraying with 25 ppm NAA.
4. Spraying with 50 ppm NAA.
5. Spraying with 75 ppm NAA.
6. Spraying with 20 ppm GA_3 + 25 ppm NAA.
7. Spraying with 20 ppm GA_3 + 50 ppm NAA.
8. Spraying with 20 ppm GA_3 + 75 ppm NAA.

The following parameters were adopted to evaluate the tested treatments:-

Representative random samples of 6 clusters/vine were harvested at maturity when TSS reached 16-17% according to Tourky *et al*., (1995).

1. Yield and physical characteristics of clusters:

Yield/vine (kg) was determined as number of clusters/vine X average cluster weight (g). Also, average cluster weight (g) and average cluster dimensions (cm) were determined.

2. Physical characteristics of berries:

These characteristics included the determination of the following:

Berry weight (g), berry size (cm^3), berry dimensions (length and diameter) (cm), berry pedicel diameter (mm), berry firmness (g/cm^2) (using 1fra texture analyzer instrument), berry adherence strength (g) (using Shatilons's instrument) and berry shattering (%), this estimate was calculated by dividing weight of the shattered berries by the initial cluster weight.

3. Chemical characteristics of berries:

Determination of total soluble solids in berry juice (T.S.S.) (%) by hand refractometer and total titratable acidity as tartaric acid (%) (A.O.A.C. 1985). Hence TSS /acid ratio was calculated and total anthocyanin of the berry skin (mg/100g fresh weight) according to Husia *et al*., (1965).

4. Storability

At maturity stage, when TSS reached 16-17% according to Tourky *et al*., (1995), clusters from treatment were harvested and picked in perforated bags, each bag contained 550 – 650 g, then packed in carton boxes and each box contained three bags.

All treatments were packed into 48 carton boxes (1.5 - 2 Kg/box), stored at ± 0°C and 90-95% RH for four weeks.

Each two carton boxes acted as a replicate and each three replicates were represented one treatment for following of the changes occurring in physical and chemical properties of the stored grapes.

4.1. Physical properties:

- Weight loss (%) per box was determined periodically according to the equation (weight loss X 100 / the initial weight of box).
- Decay (%) per box was calculated periodically according to the equation (weight of decayed X 100 / the initial weight of box).
- Shattering (%) per box was calculated periodically according to the equation (weight of the shattered berries X 100 / the initial weight of box).
- Total spoilage percentage (%) was calculated periodically as the sum of weight loss, decay and shattering per box.
- Berry firmness (g/cm^2) was estimated on ten berries through the use of texture analyzer instrument using a penetrating Cylinder of 1mm of diameter to a constant distance 1 mm inside the berry skin by a constant speed 2mm per sec. and the peak of resistance force of the skin was recorded periodically.
- Berry colour: Intensity of color was measured by Konick Minolta, Chroma Meter CR-400/410 for the estimation of Hue angle as described by Mcgire, (1992).

4.2. Chemical properties:

- Percentage of total soluble solids in berry juice (TSS) was recorded periodically using a hand refractometer.
- Total titratable acidity as tartaric acid (%) was also determined periodically (AOAC 1985).
- TSS/acid ratio was calculated periodically.

Statistical analysis:

The complete randomized block design was adopted for the experiment. The statistical analysis of the present data was carried out according to Snedecor and Chocran (1980). Averages were compared using the new L.S.D. values at 5% level.

3. Results and Discussion:

1. Yield and cluster physical characteristics:

Yield was significantly increased by the spraying with GA_3 and different doses of NAA either in the single or in the combined form (Table, 1). Spraying with 20 ppm GA_3 and the highest dose of NAA at 75 ppm after fruit set resulted in the highest values (15.90 and 15.06 Kg/vine) for both seasons respectively, whereas, the lowest values were obtained from control vines (14.11 and 13.36 Kg/vine) for both seasons respectively.

Cluster weight was appreciably increased due to spraying with 20 ppm GA_3 + 75 ppm NAA (662.4 and 627.5 g) compared with control which had the lowest values (587.9 and 556.7 g) for both seasons respectively.

Effect of spraying with 20 ppm GA_3 and different doses of NAA on cluster dimensions was statistically insignificant.

Yield produced as a result of spraying could be mainly attributed to the positive effect of GA_3 and NAA spray on cluster weight.

The enhancing effect of spraying with GA_3 and NAA on cluster weight can be interpreted in view of that role of GA_3 in stimulating both cell division and cell enlargement which by their turn are reflected on fruit weight increase and consequently yield (Moore 1979), in addition, Wasfy, (1995) reported that GA_3 intensifies an organ ability to function as a nutrient sink; it also increases the biosynthesis of IAA in plant tissues which delays the formation of the separation layer, thus, enhancing fruit retention, consequently fruit yield. Furthermore, the increase in cell size following NAA application possibly indicates its ability to mobilize carbohydrate uptake and thus enlarge the cells considerably. Another possibility is that NAA increases the elasticity of the cell wall, thereby enabling its enlargement due to increasing the rate of fruit growth, eventually leading to an increased yield of large fruit (Arteca, 1996). Application of NAA stimulate cell enlargement in the fruit mesocarp, which in turn, causes an improvement in fruit size and total yield (Stern *et al*., 2007).

The obtained results are similar to those achieved by Omar and El - Morsy (2000), Omar and Girgis (2005) and Omran *et al*., (2005) who found that GA_3 spraying after fruit set significantly increased the vine yield and cluster weight. As for the effect of NAA, Singh *et al*., (1986) on "Khalili" cv. and El-Hammady and Abd El-Hamid (1995) on "Ruby Seedless" found that NAA spraying at 50 ppm significantly increased cluster weight and yield /vine.

2. Physical characteristics of berries:

The positive effects attributed to spraying with GA_3 and different doses of NAA either in the single or in the combined form were obvious on physical characteristics of berries i.e. berry weight, size, length, diameter, pedicel diameter, firmness, adherence strength and shattering (Table, 2). The highest values of those parameters except shattering which had the lowest percentage were detected in case of clusters sprayed with 20 ppm GA_3 + 75 ppm NAA.

The increase in fruit size may be attributed to the increase in cell division and cell elongation caused by NAA and GA_3 (Cleland, 1995 and Ranjan *et al*., 2003). In addition, the role of GA_3 and NAA in increasing berry adherence strength and decreasing berry shattering percentage can be attributed to the beneficial effect of spraying GA_3 after fruit set on enhancing the number of epidermis and hypodermal layers in berry skin and increasing the diameter, thickness of bark and diameter of wood cylinder of the berry pedicel (Naosuke, 1986 and Rizk alla, 2000). In this respect, Zhang and Zhang (2009) reported that GA_3 and NAA can minimize berry shattering by inhibiting the generation of ABA, inactivating the activities of cellulase and polygalacturonase and delaying the development of abscission layer.

The obtained results are in agreement with those reported by Omar and El – Morsy (2000) and Abd El-Ghany (2001) who reported that GA_3 sprayed after fruit set significantly improved physical berry characteristics. As for the effect of NAA, Singh *et al*., (1986) on "Khalili" cv. and El-Hammady and Abd El-Hamid (1995) on Ruby Seedless found that NAA spraying at 50 ppm significantly improved berry physical properties.

Data illustrated in Figures (1 & 2) indicated the existence of a negative correlation between pedicel diameter (mm) and shattering (%) and between shattering (%) and yield (kg) in the both seasons.

3. Chemical characteristics of berries:

The results presented in (Table 3) revealed that spraying with GA_3 and different doses of NAA either

Table (1): Effect of different treatments on yield/vine and physical characteristics of clusters in 2009 and 2010 seasons

Treatment \ Characteristic	Yield/vine (kg)		Cluster weight (g)		Cluster length (cm)		Cluster width (cm)	
	2009	2010	2009	2010	2009	2010	2009	2010
Control	14.11	13.36	587.9	556.7	31.7	32.1	13.6	13.9
20ppm GA_3	15.44	14.62	643.3	609.4	32.7	32.5	14.1	14.3
25ppm NAA	14.94	14.15	622.3	589.4	32.2	32.7	13.8	14.2
50ppm NAA	15.07	14.27	627.8	594.6	32.4	32.5	14.0	14.4
75ppm NAA	15.17	14.37	632.2	598.8	32.5	32.6	13.7	14.2
20ppm GA_3+ 25ppm NAA	15.54	14.72	647.6	613.5	32.6	32.8	13.8	14.5
20ppm GA_3+ 50ppm NAA	15.70	14.88	654.3	619.8	32.7	32.6	13.7	14.2
20ppm GA_3+ 75ppm NAA	15.90	15.06	662.4	627.5	32.5	32.8	13.9	14.4
new L.S.D. at 0.05 =	**0.17**	**0.15**	**7.8**	**7.5**	**N.S**	**N.S**	**N.S**	**N.S**

Table (2): Effect of different treatments on physical characteristics of berries in 2009 and 2010 seasons

Treatment \ Characteristic	Berry weight (g)		Berry size (cm^3)		Berry length (cm)		Berry diameter (cm)		Pedicel diameter (mm)		Berry firmness (g/cm^2)		Berry adherence strength (g)		Berry shattering (%)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Control	2.77	2.61	2.65	2.52	2.13	2.01	1.59	1.51	1.64	1.57	34.09	32.40	186.90	173.42	5.63	6.47
20ppm GA_3	3.06	2.88	2.95	2.78	2.35	2.22	1.75	1.67	1.74	1.66	39.98	38.04	206.17	191.48	2.95	3.50
25ppm NAA	2.95	2.78	2.82	2.66	2.26	2.14	1.69	1.61	1.75	1.68	38.57	36.68	198.86	184.63	2.85	3.41
50ppm NAA	2.98	2.81	2.87	2.71	2.29	2.17	1.71	1.63	1.77	1.69	38.94	37.03	200.78	186.43	2.78	3.34
75ppm NAA	3.00	2.83	2.87	2.70	2.30	2.18	1.72	1.64	1.80	1.72	39.23	37.32	202.31	187.86	2.60	3.16
20ppm GA_3+25ppm NAA	3.08	2.91	2.96	2.79	2.36	2.24	1.77	1.68	1.81	1.73	40.27	38.32	207.67	192.88	2.52	3.09
20ppm GA_3+50ppm NAA	3.12	2.94	3.00	2.84	2.39	2.27	1.79	1.70	1.83	1.75	40.73	38.75	210.00	195.07	2.41	2.99
20ppm GA_3+75ppm NAA	3.16	2.98	3.05	2.87	2.42	2.30	1.81	1.72	1.85	1.77	41.27	39.28	212.82	197.71	2.28	2.86
new L.S.D. at 0.05 =	**0.04**	**0.03**	**0.05**	**0.03**	**0.03**	**0.02**	**0.02**	**0.01**	**0.03**	**0.02**	**0.63**	**0.56**	**2.43**	**2.11**	**0.13**	**0.11**

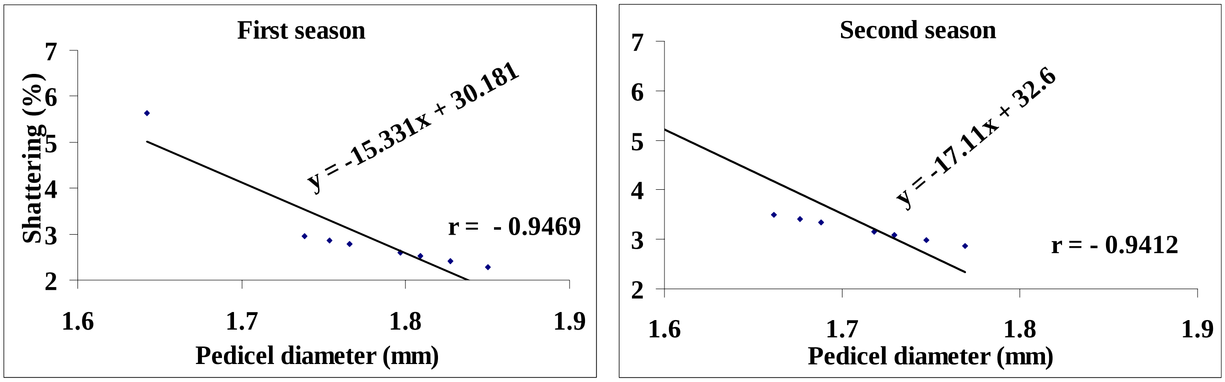

Fig (1): The relationship between the pedicel diameter (mm) and shattering (%) in both seasons

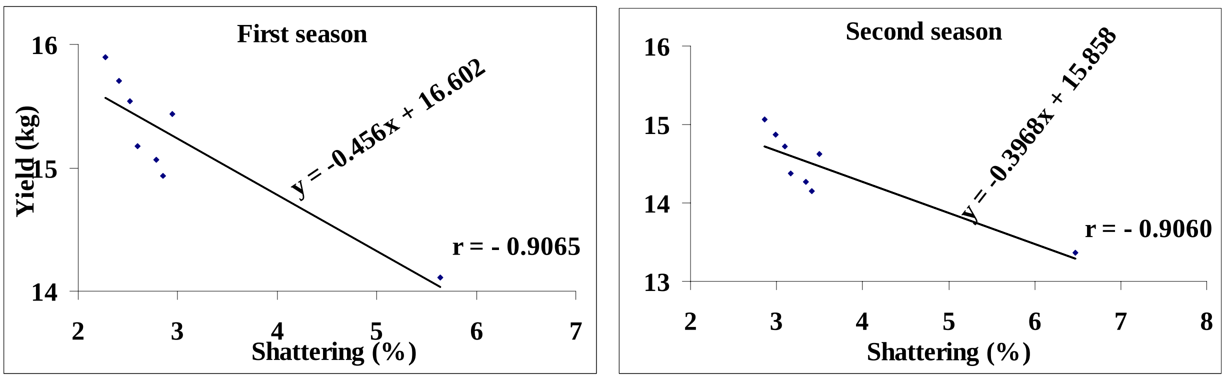

Fig (2): The relationship between the shattering (%) and yield (kg) in both seasons

Table (3): Effect of different treatments on chemical characteristics of berries in 2009 and 2010 seasons

Characteristic / Treatment	TSS (%)		Acidity (%)		TSS/acid ratio		Anthocyanin (mg/100g F.W.)	
	2009	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**
Control	16.41	16.78	0.57	0.54	28.79	31.07	43.7	41.1
20ppm GA_3	16.29	16.67	0.61	0.57	26.70	29.25	41.5	39.0
25ppm NAA	16.37	16.73	0.57	0.55	28.72	30.42	43.1	40.5
50ppm NAA	16.34	16.70	0.58	0.56	28.17	29.82	42.6	40.1
75ppm NAA	16.32	16.69	0.59	0.57	27.66	29.28	42.3	39.8
20ppm GA_3 + 25ppm NAA	16.27	16.63	0.61	0.57	26.67	29.18	41.2	38.7
20ppm GA_3 + 50ppm NAA	16.25	16.60	0.62	0.58	26.21	28.62	40.8	38.3
20ppm GA_3 + 75ppm NAA	16.24	16.58	0.63	0.58	25.78	28.59	40.6	38.1
new L.S.D. at 0.05 =	**0.07**	**0.08**	**0.01**	**0.02**	**1.30**	**1.10**	**1.2**	**0.9**

in the single or in the combined form delayed maturity stage represented by berry chemical characteristics; i.e. TSS, acidity, TSS/acid ratio and anthocyanin content of berry skin. Spraying with 20 ppm GA_3 + 75 ppm NAA generally resulted in the lowest values of TSS percentage, TSS/acid ratio and anthocyanin content in berry skin and the highest percentage of acidity in the juice as compared to control.

These results are in agreement with those found by Kataoka *et al*., (1984) and El-Hammady and Abd El-Hamid (1995) who found that GA_3 or NAA spraying decreased TSS percentage, TSS/acid ratio and anthocyanin content in berry skin and increased acidity percentage of the juice as compared to control.

4. Storability

4.1. Physical properties:

- Weight loss (%)

Data in Table (4) show that weight loss (%) increased gradually till the end of the cold storage period. This increase can be probably due to moisture loss from the grapes during cold storage. It can be observed that weight loss (%) was decreased by spraying with GA_3 and different doses of NAA either in the single or in the combined form. The highest weight loss percentage (6.09 & 7.01%) was recorded after four weeks of cold storage for clusters of the control in the two seasons respectively. On the other hand, fruits resulting from spraying with 20 ppm GA_3 + 75 ppm NAA showed the lowest weight loss percentage (5.63 & 6.57%) after four weeks of cold storage in both seasons respectively.

The obtained results are similar to those achieved by Fatma and Aisha, 2005 on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly reduced the increase in weight loss (%) compared to control during cold storage at 0°C, RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly reduced the increase in weight loss (%) in comparison with control during cold storage at 0°C, RH 90-95%.

- Decay (%)

As shown in (Table 5), a gradual significant increase in berry decay (%) was observed up to the end of cold storage period. Grapes of the control vines exhibited the highest significant decay percentage (0.57 and 0.62%) for the two seasons respectively. On the other hand, grapes resulting from spraying with 20 ppm GA_3 + 75 ppm NAA showed the lowest decay percentage (0.41 and 0.49%) in both seasons respectively.

These results are in line with those obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly reduced the increase in decay (%) compared to control during cold storage at 0°C, RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly reduced the increase in decay (%) compared to control during cold storage at 0°C, RH 90-95%.

- Shattering (%)

Data in Table (6) revealed that shattering (%) increased gradually till the end of cold storage. It can be observed that shattering (%) increase was decreased by GA_3 and NAA spraying either in the single or in the combined form. The highest shattering percentage (7.54 & 9.22%) was recorded after four weeks of cold storage for fruits of the control vines in the two seasons respectively. On the other hand, spraying with 20 ppm GA_3 + 75 ppm NAA showed the lowest shattering (3.74 & 4.12%) after four weeks of cold storage in both seasons respectively.

Similar results were obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly reduced the increase in shattering (%) compared to control during cold storage at 0°C, RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly reduced the increase in shattering (%) compared to control during cold storage.

- Total spoilage (%)

Data presented in (Table 7) clearly show that the total spoilage percentage for stored Black Monukka grapes increased gradually and significantly with the extension of the cold storage in both seasons. Clusters of the control had the highest total spoilage percentage (14.20 & 16.85%) recorded at the last sampling date, i.e. after four weeks of cold storage in both seasons respectively. On the other hand, spraying with 20 ppm GA_3 + 75 ppm NAA recorded the lowest total spoilage percentage (9.78 & 11.18%) at the end of storage period in both seasons respectively.

The obtained results are in agreement with those achieved by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly reduced the increase in total spoilage(%)

Table (4): Effect of different treatments on weight loss (%) during cold storage in 2009 and 2010 seasons

Treatment (T) / Date (D)	Days in cold storage					MEANS (T)
2009, season						
	0	**7**	**14**	**21**	**28**	
Control	0.00	1.03	1.41	2.34	6.09	**2.17**
20ppm GA_3	0.00	0.94	1.26	2.12	5.83	**2.03**
25ppm NAA	0.00	0.99	1.35	2.27	5.97	**2.12**
50ppm NAA	0.00	0.97	1.31	2.21	5.91	**2.08**
75ppm NAA	0.00	0.96	1.28	2.15	5.88	**2.05**
20ppm GA_3 + 25ppm NAA	0.00	0.91	1.22	2.07	5.77	**1.99**
20ppm GA_3 + 50ppm NAA	0.00	0.89	1.19	2.05	5.74	**1.97**
20ppm GA_3 + 75ppm NAA	0.00	0.86	1.16	1.99	5.63	**1.93**
MEANS (D)	**0.00**	**0.94**	**1.27**	**2.15**	**5.85**	
new L.S.D. at 0.05 (T) =	**0.04**					
new L.S.D. at 0.05 (D) =	**0.03**					
new L.S.D. at 0.05 (TXD) =	**0.09**					
2010, season						
Treatment (T) / Date (D)	**Days in cold storage**					
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	0.00	1.11	1.54	2.62	7.01	**2.46**
20ppm GA_3	0.00	0.97	1.33	2.32	6.71	**2.27**
25ppm NAA	0.00	1.06	1.45	2.51	6.89	**2.38**
50ppm NAA	0.00	1.03	1.40	2.44	6.83	**2.34**
75ppm NAA	0.00	1.01	1.37	2.38	6.78	**2.31**
20ppm GA_3 + 25ppm NAA	0.00	0.95	1.30	2.29	6.65	**2.24**
20ppm GA_3 + 50ppm NAA	0.00	0.91	1.26	2.25	6.60	**2.20**
20ppm GA_3 + 75ppm NAA	0.00	0.88	1.21	2.18	6.57	**2.17**
MEANS (D)	**0.00**	**0.99**	**1.36**	**2.37**	**6.76**	
new L.S.D. at 0.05 (T) =	**0.03**					
new L.S.D. at 0.05 (D) =	**0.02**					
new L.S.D. at 0.05 (TXD) =	**0.07**					

Table (5): Effect of different treatments on decay (%) during cold storage in 2009 and 2010 seasons

Treatment (T) / Date (D)	Days in cold storage					
2009, season						
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	0.00	0.08	0.13	0.22	0.57	**0.20**
20ppm GA_3	0.00	0.04	0.08	0.15	0.49	**0.15**
25ppm NAA	0.00	0.07	0.10	0.21	0.54	**0.18**
50ppm NAA	0.00	0.05	0.09	0.19	0.54	**0.17**
75ppm NAA	0.00	0.05	0.08	0.16	0.51	**0.16**
20ppm GA_3 + 25ppm NAA	0.00	0.03	0.07	0.13	0.46	**0.14**
20ppm GA_3 + 50ppm NAA	0.00	0.03	0.05	0.12	0.45	**0.13**
20ppm GA_3 + 75ppm NAA	0.00	0.01	0.04	0.09	0.41	**0.11**
MEANS (D)	**0.00**	**0.04**	**0.08**	**0.16**	**0.50**	
new L.S.D. at 0.05 (T) =	**0.05**					
new L.S.D. at 0.05 (D) =	**0.04**					
new L.S.D. at 0.05 (TXD) =	**0.11**					
2010, season						
Treatment (T) / Date (D)	**Days in cold storage**					
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	0.00	0.11	0.17	0.25	0.62	**0.23**
20ppm GA_3	0.00	0.06	0.12	0.18	0.55	**0.18**
25ppm NAA	0.00	0.09	0.15	0.22	0.60	**0.21**
50ppm NAA	0.00	0.08	0.13	0.22	0.57	**0.20**
75ppm NAA	0.00	0.06	0.13	0.19	0.57	**0.19**
20ppm GA_3 + 25ppm NAA	0.00	0.04	0.10	0.16	0.53	**0.17**
20ppm GA_3 + 50ppm NAA	0.00	0.03	0.07	0.13	0.50	**0.15**
20ppm GA_3 + 75ppm NAA	0.00	0.01	0.06	0.10	0.49	**0.13**
MEANS (D)	**0.00**	**0.06**	**0.12**	**0.18**	**0.55**	
new L.S.D. at 0.05 (T) =	**0.06**					
new L.S.D. at 0.05 (D) =	**0.05**					
new L.S.D. at 0.05 (TXD) =	**0.13**					

Table (6): Effect of different treatments on shattering (%) during cold storage in 2009 and 2010 seasons

Treatment (T) / Date (D)	Days in cold storage					
2009, season						
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	5.63	4.36	4.86	6.71	7.54	**5.82**
20ppm GA_3	2.95	2.28	2.87	3.51	4.45	**3.21**
25ppm NAA	2.85	2.21	2.81	3.40	4.36	**3.13**
50ppm NAA	2.78	2.15	2.77	3.31	4.29	**3.06**
75ppm NAA	2.60	2.01	2.69	3.09	4.17	**2.91**
20ppm GA_3 + 25ppm NAA	2.52	1.95	2.57	3.01	3.98	**2.81**
20ppm GA_3 + 50ppm NAA	2.41	1.86	2.54	2.87	3.94	**2.72**
20ppm GA_3 + 75ppm NAA	2.28	1.76	2.41	2.71	3.74	**2.58**
MEANS (D)	**3.00**	**2.32**	**2.94**	**3.58**	**4.56**	
new L.S.D. at 0.05 (T) =	**0.13**					
new L.S.D. at 0.05 (D) =	**0.10**					
new L.S.D. at 0.05 (TXD) =	**0.29**					
2010, season						
Treatment (T) / Date (D)	**Days in cold storage**					
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	6.47	5.91	6.36	7.64	9.22	**7.12**
20ppm GA_3	3.50	3.19	3.52	4.13	5.10	**3.89**
25ppm NAA	3.41	3.11	3.37	4.03	4.89	**3.76**
50ppm NAA	3.34	3.05	3.31	3.94	4.80	**3.69**
75ppm NAA	3.16	2.89	3.13	3.73	4.54	**3.49**
20ppm GA_3 + 25ppm NAA	3.09	2.82	3.05	3.65	4.42	**3.41**
20ppm GA_3 + 50ppm NAA	2.99	2.73	2.96	3.53	4.29	**3.30**
20ppm GA_3 + 75ppm NAA	2.86	2.61	2.84	3.38	4.12	**3.16**
MEANS (D)	**3.60**	**3.29**	**3.57**	**4.25**	**5.17**	
new L.S.D. at 0.05 (T) =	**0.16**					
new L.S.D. at 0.05 (D) =	**0.13**					
new L.S.D. at 0.05 (TXD) =	**0.36**					

Table (7): Effect of different treatments on total spoilage (%) during cold storage in 2009 and 2010 seasons

2009, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	5.63	5.46	6.41	9.27	14.20	**8.19**
20ppm GA_3	2.95	3.26	4.21	5.78	10.77	**5.39**
25ppm NAA	2.85	3.27	4.26	5.88	10.87	**5.43**
50ppm NAA	2.78	3.17	4.17	5.71	10.74	**5.32**
75ppm NAA	2.60	3.02	4.05	5.40	10.56	**5.12**
20ppm GA_3 + 25ppm NAA	2.52	2.89	3.86	5.21	10.21	**4.94**
20ppm GA_3 + 50ppm NAA	2.41	2.78	3.78	5.04	10.13	**4.83**
20ppm GA_3 + 75ppm NAA	2.28	2.63	3.61	4.79	9.78	**4.62**
MEANS (D)	**3.00**	**3.31**	**4.29**	**5.89**	**10.91**	
new L.S.D. at 0.05 (T) =	**0.23**					
new L.S.D. at 0.05 (D) =	**0.18**					
new L.S.D. at 0.05 (TXD) =	**0.51**					
2010, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	6.47	7.13	8.07	10.51	16.85	**9.81**
20ppm GA_3	3.50	4.22	4.97	6.63	12.36	**6.34**
25ppm NAA	3.41	4.26	4.97	6.76	12.38	**6.35**
50ppm NAA	3.34	4.15	4.84	6.60	12.20	**6.23**
75ppm NAA	3.16	3.96	4.63	6.30	11.89	**5.99**
20ppm GA_3 + 25ppm NAA	3.09	3.81	4.45	6.10	11.60	**5.81**
20ppm GA_3 + 50ppm NAA	2.99	3.67	4.29	5.91	11.39	**5.65**
20ppm GA_3 + 75ppm NAA	2.86	3.50	4.11	5.66	11.18	**5.46**
MEANS (D)	**3.60**	**4.34**	**5.04**	**6.81**	**12.48**	
new L.S.D. at 0.05 (T) =	**0.19**					
new L.S.D. at 0.05 (D) =	**0.15**					
new L.S.D. at 0.05 (TXD) =	**0.42**					

compared to control during cold storage at 0°C, RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly reduced the increase in total spoilage (%) compared to control during cold storage at 0°C, RH 90-95%.

- Berry firmness (g / cm^2)

As shown in (Table 8), it is obvious that berry firmness decreased gradually till the end of the cold storage period. Berry firmness decrease was reduced by spraying with GA_3 and different doses of NAA either in the single or in the combined form. The lowest berry firmness (19.7 & 18.7 g/cm^2) was recorded after four weeks of cold storage for fruits of the control vines in the two seasons respectively. On the other hand, spraying with 20 ppm GA_3 + 75 ppm NAA resulted in the highest berry firmness (29.1 & 27.7 g/cm^2) after four weeks of cold storage in both seasons respectively.

These results are in accordance with those obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly reduced the decrease in berry firmness compared to control during cold storage at 0°C, RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, *et al*., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly reduced the decrease in berry firmness compared to control during cold storage at 0°C, RH 90-95%.

- Berry colour

As shown in (Table 9), it is obvious that the improvement of berry colour increased gradually from purplish-black to deep-black up to the end of the cold storage period. Berry colour was enhanced by spraying with GA_3 and different doses of NAA either in the single or in the combined form. The lowest value of hue angle (322.68 & 313.89) was recorded by control grapes at the last sampling date, i.e. after four weeks of cold storage in the two seasons respectively. On the contrary, spraying with 20 ppm GA_3 + 75 ppm NAA resulted in the highest values of hue angle (352.84 & 344.72) in both seasons respectively.

The increase in berry colour during cold storage period may be attributed to the effect of water loss and endogenous sugars which considered being causal agents for synthesis of anthocyamns and other phenol compounds (Pirie and Mullins, 1977 and Ali and El-Oraby, 2004).

Similar results were obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly increased colour in the berry skin as compared to control during cold storage at 0°C, RH 90-95%.

4.2. Chemical properties:

- Percentage of total soluble solids (TSS)

Data in Table (10) revealed that, there was a gradual and significant increase in the berry juice TSS (%) till the end of the cold storage period. This increase is due to the moisture loss. Spraying with 20 ppm GA_3 + 75 ppm NAA recorded the highest TSS (%) at the last sampling date, i.e. after four weeks of cold storage (18.37 & 18.77%) in both seasons respectively. while, the control grapes had the lowest percentages (17.91 & 18.37%) after four weeks of cold storage in both seasons respectively.

Similar results were obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly increased in the juice TSS (%) compared to control during cold storage at 0°C& RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly increased the juice TSS (%) compared to control during cold storage at 0°C, RH 90-95%.

- Acidity (%)

As shown in (Table 11) it is obvious that berry juice acidity decreased gradually till the end of the cold storage period. Berry juice acidity decrease was reduced by spraying with GA_3 and different doses of NAA either in the single or in the combined form. The lowest berry juice acidity (0.40 & 0.31%) was recorded after four weeks of cold storage as a result of spraying with 20 ppm GA_3 + 75 ppm NAA in the two seasons respectively. On the other hand, berries of the control showed the highest berry juice acidity (0.53 & 0.43%) after four weeks of cold storage in both seasons respectively. The obtained results are similar to those achieved by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after fruit set significantly decreased in the juice acidity (%) compared to control during cold storage at 0°C, RH 90-95%. As for the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly decreased the juice acidity (%) compared to control during cold storage at 0°C, RH 90-95%.

- TSS/acid ratio

Results presented in (Table 12) indicate that TSS/acid ratio increased gradually and significantly

Table (8): Effect of different treatments on berry firmness (g/cm^2) during cold storage in 2009 and 2010 seasons

2009, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	34.1	31.7	27.3	24.9	19.7	27.5
20ppm GA_3	40.0	37.2	33.1	31.0	27.0	33.7
25ppm NAA	38.6	35.9	31.7	27.2	21.4	30.9
50ppm NAA	38.9	36.2	32.2	29.6	24.5	32.3
75ppm NAA	39.2	36.8	32.6	30.3	26.1	33.0
20ppm GA_3 + 25ppm NAA	40.3	37.9	33.7	31.4	27.7	34.2
20ppm GA_3 + 50ppm NAA	40.7	38.2	34.2	32.3	28.3	34.7
20ppm GA_3 + 75ppm NAA	41.3	38.7	34.5	32.8	29.1	35.3
MEANS (D)	39.1	36.6	32.4	29.9	25.5	
new L.S.D. at 0.05 (T) =	0.7					
new L.S.D. at 0.05 (D) =	0.6					
new L.S.D. at 0.05 (TXD) =	1.6					
2010, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	32.4	30.5	25.9	23.7	18.7	26.2
20ppm GA_3	38.0	35.4	31.5	29.5	25.7	32.0
25ppm NAA	36.7	34.1	30.1	25.9	23.8	30.1
50ppm NAA	37.0	35.2	30.6	28.2	23.3	30.9
75ppm NAA	37.3	35.0	31.3	28.8	24.8	31.5
20ppm GA_3 + 25ppm NAA	38.3	36.1	32.1	29.9	26.4	32.5
20ppm GA_3 + 50ppm NAA	38.8	36.0	32.9	30.7	26.9	33.1
20ppm GA_3 + 75ppm NAA	39.3	36.8	32.8	31.4	27.7	33.6
MEANS (D)	37.2	34.9	30.9	28.5	24.7	
new L.S.D. at 0.05 (T) =	0.6					
new L.S.D. at 0.05 (D) =	0.5					
new L.S.D. at 0.05 (TXD) =	1.3					

Table (9): Effect of different treatments on berry color (Hue angle) during cold storage in 2009 and 2010 seasons

Treatment (T) / Date (D)	Days in cold storage					
2009, season						
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	309.37	312.17	315.22	317.03	322.68	**315.29**
20ppm GA_3	317.27	323.82	328.87	332.31	337.44	**327.94**
25ppm NAA	311.76	316.23	319.56	322.22	327.32	**319.42**
50ppm NAA	313.69	319.25	323.02	326.33	331.05	**322.67**
75ppm NAA	315.99	322.07	326.29	329.68	334.80	**325.77**
20ppm GA_3 + 25ppm NAA	319.81	327.92	332.66	336.79	342.55	**331.94**
20ppm GA_3 + 50ppm NAA	322.53	331.83	337.06	341.09	347.28	**335.96**
20ppm GA_3 + 75ppm NAA	325.44	335.54	341.28	345.81	352.84	**340.18**
MEANS (D)	**316.98**	**323.60**	**327.99**	**331.41**	**336.99**	
new L.S.D. at 0.05 (T) =	**3.87**					
new L.S.D. at 0.05 (D) =	**3.06**					
new L.S.D. at 0.05 (TXD) =	**8.65**					
2010, season						
Treatment (T) / Date (D)	**Days in cold storage**					
	0	**7**	**14**	**21**	**28**	**MEANS (T)**
Control	302.37	304.14	305.44	307.67	313.89	**306.70**
20ppm GA_3	309.78	315.54	318.41	322.65	329.56	**319.19**
25ppm NAA	304.81	307.94	309.68	312.57	319.60	**310.92**
50ppm NAA	306.68	310.69	312.87	316.41	323.27	**313.99**
75ppm NAA	308.74	313.64	316.27	320.07	326.77	**317.10**
20ppm GA_3 + 25ppm NAA	312.64	319.36	322.51	327.24	334.59	**323.27**
20ppm GA_3 + 50ppm NAA	315.50	323.18	326.62	331.24	339.24	**327.15**
20ppm GA_3 + 75ppm NAA	318.54	326.81	330.53	335.46	344.72	**331.21**
MEANS (D)	**309.88**	**315.16**	**317.79**	**321.67**	**328.95**	
new L.S.D. at 0.05 (T) =	**3.51**					
new L.S.D. at 0.05 (D) =	**2.77**					
new L.S.D. at 0.05 (TXD) =	**7.85**					

Table (10): Effect of different treatments on TSS (%) during cold storage in 2009 and 2010 seasons

2009, season						
Treatment (T) / Date (D)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	16.41	17.03	17.36	17.74	17.91	**17.29**
20ppm GA_3	16.29	17.09	17.49	17.96	18.16	**17.40**
25ppm NAA	16.37	17.05	17.40	17.81	18.02	**17.33**
50ppm NAA	16.34	17.06	17.43	17.87	18.07	**17.35**
75ppm NAA	16.32	17.08	17.47	17.92	18.11	**17.38**
20ppm GA_3 + 25ppm NAA	16.27	17.11	17.52	18.01	18.23	**17.43**
20ppm GA_3 + 50ppm NAA	16.25	17.13	17.55	18.03	18.28	**17.45**
20ppm GA_3 + 75ppm NAA	16.24	17.14	17.57	18.06	18.37	**17.48**
MEANS (D)	**16.31**	**17.09**	**17.47**	**17.93**	**18.14**	
new L.S.D. at 0.05 (T) =	**0.09**					
new L.S.D. at 0.05 (D) =	**0.07**					
new L.S.D. at 0.05 (TXD) =	**0.20**					
2010, season						
Treatment (T) / Date (D)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	16.78	17.45	17.82	18.23	18.37	**17.73**
20ppm GA_3	16.67	17.51	17.97	18.45	18.56	**17.83**
25ppm NAA	16.73	17.48	17.86	18.31	18.42	**17.76**
50ppm NAA	16.70	17.50	17.90	18.38	18.47	**17.79**
75ppm NAA	16.69	17.51	17.93	18.41	18.52	**17.81**
20ppm GA_3 + 25ppm NAA	16.63	17.54	17.98	18.49	18.63	**17.85**
20ppm GA_3 + 50ppm NAA	16.60	17.56	18.02	18.52	18.68	**17.88**
20ppm GA_3 + 75ppm NAA	16.58	17.57	18.05	18.57	18.77	**17.91**
MEANS (D)	**16.67**	**17.52**	**17.94**	**18.42**	**18.55**	
new L.S.D. at 0.05 (T) =	**0.11**					
new L.S.D. at 0.05 (D) =	**0.09**					
new L.S.D. at 0.05 (TXD) =	**0.25**					

Table (11): Effect of different treatments on acidity (%) during cold storage in 2009 and 2010 seasons

2009, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	0.57	0.56	0.56	0.55	0.53	**0.55**
20ppm GA_3	0.61	0.57	0.51	0.48	0.45	**0.52**
25ppm NAA	0.57	0.55	0.52	0.50	0.49	**0.53**
50ppm NAA	0.58	0.55	0.51	0.50	0.48	**0.52**
75ppm NAA	0.59	0.56	0.51	0.49	0.46	**0.52**
20ppm GA_3 + 25ppm NAA	0.61	0.57	0.50	0.48	0.45	**0.52**
20ppm GA_3 + 50ppm NAA	0.62	0.57	0.49	0.48	0.43	**0.52**
20ppm GA_3 + 75ppm NAA	0.63	0.58	0.48	0.47	0.40	**0.51**
MEANS (D)	**0.60**	**0.56**	**0.51**	**0.49**	**0.46**	
new L.S.D. at 0.05 (T) =	**0.05**					
new L.S.D. at 0.05 (D) =	**0.04**					
new L.S.D. at 0.05 (TXD) =	**0.11**					
2010, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	0.54	0.52	0.49	0.47	0.43	**0.49**
20ppm GA_3	0.57	0.49	0.44	0.37	0.37	**0.45**
25ppm NAA	0.55	0.50	0.46	0.41	0.38	**0.46**
50ppm NAA	0.56	0.49	0.46	0.40	0.38	**0.46**
75ppm NAA	0.57	0.49	0.45	0.38	0.37	**0.45**
20ppm GA_3 + 25ppm NAA	0.57	0.51	0.44	0.37	0.36	**0.45**
20ppm GA_3 + 50ppm NAA	0.58	0.50	0.44	0.36	0.34	**0.44**
20ppm GA_3 + 75ppm NAA	0.58	0.51	0.41	0.34	0.31	**0.43**
MEANS (D)	**0.57**	**0.50**	**0.45**	**0.39**	**0.37**	
new L.S.D. at 0.05 (T) =	**0.07**					
new L.S.D. at 0.05 (D) =	**0.06**					
new L.S.D. at 0.05 (TXD) =	**0.16**					

Table (12): Effect of different treatments on TSS/acid ratio during cold storage in 2009 and 2010 seasons

2009, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	28.79	30.41	31.00	32.25	33.79	**31.25**
20ppm GA_3	26.70	29.98	34.29	37.42	40.36	**33.75**
25ppm NAA	28.72	31.00	33.46	35.62	36.78	**33.12**
50ppm NAA	28.17	31.02	34.18	35.74	37.65	**33.35**
75ppm NAA	27.66	30.50	34.25	36.57	39.37	**33.67**
20ppm GA_3 + 25ppm NAA	26.67	30.02	35.04	37.52	40.51	**33.95**
20ppm GA_3 + 50ppm NAA	26.21	30.05	35.82	37.56	42.51	**34.43**
20ppm GA_3 + 75ppm NAA	25.78	29.55	36.60	38.43	45.93	**35.26**
MEANS (D)	**27.34**	**30.32**	**34.33**	**36.39**	**39.61**	
new L.S.D. at 0.05 (T) =	**2.17**					
new L.S.D. at 0.05 (D) =	**1.72**					
new L.S.D. at 0.05 (TXD) =	**4.85**					
2010, season						
Date (D) / Treatment (T)	Days in cold storage					
	0	7	14	21	28	MEANS (T)
Control	31.07	33.56	36.37	38.79	42.72	**36.50**
20ppm GA_3	29.25	35.73	40.84	49.86	50.16	**41.17**
25ppm NAA	30.42	34.96	38.83	44.66	48.47	**39.47**
50ppm NAA	29.82	35.71	38.91	45.95	48.61	**39.80**
75ppm NAA	29.28	35.73	39.84	48.45	50.05	**40.67**
20ppm GA_3 + 25ppm NAA	29.18	34.39	40.86	49.97	51.75	**41.23**
20ppm GA_3 + 50ppm NAA	28.62	35.12	40.95	51.44	54.94	**42.22**
20ppm GA_3 + 75ppm NAA	28.59	34.45	44.02	54.62	60.55	**44.45**
MEANS (D)	**29.53**	**34.96**	**40.08**	**47.97**	**50.91**	
new L.S.D. at 0.05 (T) =	**1.93**					
new L.S.D. at 0.05 (D) =	**1.53**					
new L.S.D. at 0.05 (TXD) =	**4.32**					

with the extension of the cold storage period in both seasons. Spraying with 20 ppm GA_3 + 75 ppm NAA recorded the highest TSS/acid ratio (45.93 & 60.55) at the last sampling date, i.e. after four weeks of cold storage in both seasons respectively. On the other hand, grapes of the control had the lowest values of this parameter (33.79 & 42.72) at the end of storage period in both seasons respectively.

These results are in line with those obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed *et al*., (2007) on Crimson Seedless grapes who found that GA_3 spraying after berry set significantly increased in the juice TSS/acid ratio compared to control during cold storage at 0°C, RH 90-95%. As regards the effect of NAA, El-Abbasy and El-Morsy, (2002) on Thompson Seedless grapes and Tecchio, et al., (2009) on 'Niagra Rosada' grapes found that NAA spraying significantly increased the juice TSS/acid ratio compared to control during cold storage at 0°C, RH 90-95%.

5. Economical justification of the recommended treatment (spraying with 20 ppm GA_3 + 75 ppm NAA) compared with control.

It can be shown from the data presented in Table (13) that spraying with 20 ppm GA_3 + 75 ppm NAA gave the maximum net profit compared with the control in both seasons. The slight raise in the cost of production/Feddan over control for this treatment is economically justified in view of the higher price of the yield obtained from this treatment.

From the obtained results, it can be concluded that spraying grapes treated with spraying of GA_3 at 20 ppm + NAA at 75 ppm gave the highest yield, improved the physical and chemical characteristics of berries with increased storage life through reducing wastage resulting either from disease infection or physiological disorders and inhibited the rate of deterioration of physical and chemical properties of clusters during cold storage for Black Monukka grape cultivar.

Table (13): Cost and net profit/Feddan for the recommended treatment (spraying with 20 ppm GA_3 + 75 ppm NAA) compared with control

Per Feddan	2009, season		2010, season	
	20 ppm GA_3 + 75 ppm NAA	control	20 ppm GA_3 + 75 ppm NAA	control
*GA_3 (g)	4	---	4	---
*NAA (g)	15	---	15	---
*Price of GA_3 (g)	36.0	---	36.0	---
*Price of NAA (g)	45.0	---	45.0	---
Labour cost (L.E.)	100.0	---	120.0	---
Cost of cultural practices (L.E.)	2000	2000	2100	2100
Total cost (L.E.)	2181	2000	2301	2100
Increase of the total cost over control (L.E.)	181.0	---	201.0	---
Yield (Kg)	11128.3	9876.7	10542.4	9352.2
Increase of the yield over control (Kg)	1251.6	---	1190.3	---
Kg (L.E.)	2.00	1.90	2.50	2.40
Yield (L.E.)	22256.6	18765.8	26356.1	22445.2
Price of increase in yield over control (L.E.)	3490.9	---	3910.9	---
The net profit (L.E.)	20075.6	16765.8	24055.1	20345.2
The net profit (L.E.) over control (L.E.)	3309.9	---	3709.9	---

*GA_3 (g)	4g X 200 Litre		
*NAA (g)	15g X 200 Litre		
*Price of GA_3 (g)	4g X 9 L.E. = 36 L.E.		
*Price of NAA (g)	15g X 3 L.E. = 45 L.E.		

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