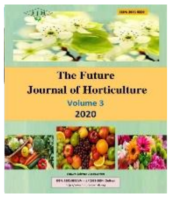
Available online free at www.futurejournals.org

The Future Journal of Horticulture

Print ISSN: 2692-5826 Online ISSN: 2692-5834

Future Science Association



Future J. Hort., 4 (2022) **28-35**

OPEN ACCES

DOI: 10.37229/fsa.fjh.2022.12.17

EFFECT OF NAPHTHALENE ACETIC ACID AND GIBBERELLIC ACID ON GROWTH, YIELD AND CLUSTER QUALITY OF BLACK MAGIC GRAPEVINES

Magda N. Mohamed, Shimaa M.M. El-Mogy and Haitham M.A. Mohamed*

Viticulture Res. Dept., Hort. Res. Instit., Agric. Res. Center, Giza, **Egypt.**

***Corresponding author:** hithamelkhateeb@yahoo.com **Received: 4** Nov. 2022 **; Accepted:** 17 Dec. 2022

ABSTRACT: This investigation was conducted for two consecutive seasons (2021 & 2022) in a private vineyard located at Matay center, Minia governorate to study the effect of naphthalene acetic acid (NAA) and gibberellic acid (GA_3) on yield and fruit quality of Black Magic grapevines. The chosen vines were five-year-old, grown in sandy soil, irrigated by drip system, planted at distance of 2 x 3 meters, cane-pruned and trellised by the Gable system. Eight treatments were performed as follows: three doses of NAA (25, 50 and 75 ppm) and GA_3 at 20 ppm were applied either solely or in combined with each other, in addition to the control treatment (spraying with water). All different doses of NAA were foliar sprayed twice: at the beginning of blooming stage and after fruit set stage when the berry diameter reaches 2-3 mm, while cluster dipping with GA_3 at 20 ppm was done after fruit set stage when the berry diameter reaches 8-10 mm.

The results revealed that all different doses of NAA either solely or in combined with GA_3 at 20 ppm significantly affected the growth, yield and physical and chemical properties of berries compared to control in both seasons. The combined application of NAA at 75 ppm plus GA_3 at 20 ppm was most effective for achieving the best results in terms of enhancing all vegetative growth traits, increasing yield and its attributes as well as improving berry physical and chemical properties of Black Magic grapes.

Key words: Naphthalene acetic acid, Gibberellic acid, Yield, Cluster Quality, Black Magic Grape

INTRODUCTION

Black Magic is one of the table grape cultivars; is an early-maturing ripens in June, which newly introduced to Egypt. Due to its seedless, sweet taste, low level of acidity, crispness, and dark purple to black colour, this cultivar shows tremendous promise for commercial use. Nevertheless, flower abscission and small to medium berry size which had an adverse effect on yield and fruit quality (**Nicolaescu** ***et al.*****, 2009, Abu-Zahra and Salameh, 2012, Dimovska** ***et al*****., 2013, Rolle** ***et al*****., 2013, Domingos** ***et al*****., 2015 and Kamiloglu** ***et al*****., 2019**)

In viticulture, quality enhancement is a crucial metric that can be achieved with the help of several plant growth regulators. Among the used plant growth regulators, gibberellic acid and naphthalene acetic acid play an important role in improving the grape yield and fruit quality attributes (**Senthilkumar** ***et al.*****, 2018**).

Naphthalene acetic acid (NAA) application influences fruit development by affecting cell division and enlargement (**Dutta and Banik,**

2007). Additionally, NAA dramatically decreased flower abscission, increased productivity and enhanced fruit quality **(Iqbal *et al.*, 2009**).

Gibberellic acid (GA_3) application after fruit set is widely used to increase the berry size of table grapes. GA_3 mainly affects growth by controlling cell division and hypertrophy, stimulating protein biosynthesis and producing new tissues that increase water and nutrient absorption, which positively affects the yield, its constituents and the quality of the fruits of different grape cultivars (**Pires *et al*., 2000, Omar and El-Morsy 2000, Dimovska *et al*., 2011**, **Abu-Zahra and Salameh, 2012**, **Dimovska *et al*., 2014**, **Abada *et al*., 2015** and **Belal, 2019**).

Previous studies demonstrated that using NAA and GA_3 together improved berry physical attributes, enhanced yield, and retarded berry maturation more than using either one alone (**El-Hammady & Abd El-Hamid, 1995** and **El-Morsy, 2001**).

The target of this investigation is to study the influence of exogenous application of NAA and GA_3 on the growth, yield and fruit quality attributes of Black Magic grape cultivar.

MATERIALS AND METHODS

This investigation was experiment for two consecutive seasons (2021 & 2022) in a private vineyard located at Matay center, Minia governorate to study the effect of naphthalene acetic acid (NAA) and gibberellic acid (GA_3) application on the yield and fruit quality of Black Magic grapevines. The selected vines were five years old, grown in sandy soil, irrigated by drip system, planted at distance of 2 x 3 meters, cane-pruned and trellised using the Gable system. With a bud load of 72 buds per vine (6 canes X 12 buds), the vines were pruned during the second week of January. A total of 96 uniform vines were selected. A replicate includes four vines, and each treatment constitutes of three replicates.

Eight treatments were performed as follows: three doses of NAA (25, 50 and 75 ppm) and GA_3 at 20 ppm were applied either solely or in combination with each other, in addition to the control treatment (spraying with water). All different doses of NAA were foliar sprayed twice: at the beginning of blooming stage and after fruit set stage when the berry diameter reaches 2-3 mm, while cluster dipping with GA_3 at 20 ppm after fruit set stage when the berry diameter reaches 8-10 mm.

The following criteria were used to assess the conducted treatments:

1. Vegetative growth characteristics

During the last week of June, four fruitful shoots were labeled to study vegetative growth characteristics as follows:

- Average shoots length (cm).

- Average number of leaves/shoot.

- Average leaf area (cm^2): leaves were taken from the apical fifth and sixth from the main shoot per vine and average leaf area measured using a CI-203- Laser Area-meter made by CID, Inc., Vancouver, USA.

- Leaf content of total chlorophyll: it was determined by using nondestructive Minolta chlorophyll meter SPAD 502 **(Wood et al., 1992).**

2. Yield and physical characteristics of clusters

According to **Tourky *et al.,* (1995)**, 6 clusters/vine representative random samples were collected at maturity when total soluble solids approached 16-17%.

- The yield per vine (kg) was calculated by multiplying the average cluster weight (g) and the number of clusters per vine.

- Average cluster weight (g)

- Average cluster dimensions (cm)

- Average number of berries per cluster

3. Physical properties of berries

- Average berry weight (g).

- Average berry size (cm^3)

- Average berry dimensions (cm)

- Average berry firmness (g/cm^2)

4. Chemical properties of berries

- Total soluble solids (TSS%) by using a hand refractometer

- Total titratable acidity (%) as tartaric acid (**A.O.A.C., 2000)**
- TSS /acid ratio
- Total anthocyanin (mg/100g fresh weight) in berry skin was determined according to **Husia *et al*. (1965)**

Experimental design and statistical Analysis

For this experiment, a completely randomized design was used. According to **Snedecor and Cochran (1980)**, the statistical analysis of the provided data was done. The new LSD values at the 5% level were used to compare averages (**Steel and Torrie, 1980**).

RESULTS AND DISCUSSION

1. Vegetative growth characteristics

Data presented in Table (1) showed that all different doses of NAA either solely or in combined with GA_3 at 20 ppm significantly enhanced all vegetative growth characteristics *i.e.* shoot length, number of leaves, leaf area and leaf content of total chlorophyll as compared to control in both seasons. NAA at high dose (75 ppm) had the best results of these traits than the use of other doses (50 or 25 ppm). Highest significant all vegetative growth characteristics were obtained by applying NAA at 75 ppm plus GA_3 at 20 ppm, whereas the least values of these ones was attributed to the control in both seasons.

The enhancing influence of NAA on vegetative growth can be attributed to the fact that it plays an important role in cell division and the elongation of cell wall (**Crosier *et al.,* 2000**).

The results obtained are consistent with those of **Hifny *et al.* (2017)**, which they reported that NAA application enhanced the vegetative growth of orange trees. Moreover, **El-Sayed (2021)** mentioned that leaf total chlorophyll content was increased by foliar spraying with NAA of Lime trees.

Table (1). Effect of NAA and GA_3 on vegetative growth characteristics of Black Magic grapevines during 2021 and 2022 seasons

Characteristic / Treatment	Average shoot length (cm)		Average number of leaves/shoot		Average leaf area (cm^2)		Total chlorophyll (SPAD)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	162.1	165.4	24.2	25.7	138.1	142.3	36.8	38.4
NAA at 25ppm	165.3	169.8	25.4	27.4	146.3	147.4	37.4	40.1
NAA at 50ppm	167.8	170.5	26.6	28.2	148.9	149.7	38.9	41.9
NAA at 75ppm	168.2	173.4	28.3	29.3	150.2	152.1	39.7	42.5
GA_3 at 20ppm	163.7	166.1	24.7	26.1	141.7	144.9	37.1	39.6
NAA at 25ppm + GA_3 at 20ppm	166.4	169.9	26.1	27.6	147.4	148.9	37.8	40.7
NAA at 50ppm + GA_3 at 20ppm	168.1	171.2	27.8	28.9	149.1	151.3	39.1	42.3
NAA at 75ppm + GA_3 at 20ppm	170.3	174.8	29.6	31.4	151.6	154.2	40.3	43.2
new L.S.D. at 0.05	1.7	1.3	1.2	1.5	1.1	1.4	0.5	0.6

2. Yield and cluster physical characteristics

As shown in Table (2), the yield per vine, cluster weight and cluster dimensions were significantly improved by the application of GA_3 at 20 ppm either alone or in combined with all different doses of NAA as compared to control in both seasons. With respect to number of berries per cluster, it was noticed that all different doses of NAA had significantly the highest values of this estimation. NAA at high dose (75 ppm) had the best results of berries number than the use of other doses (50 or 25 ppm). The combined application of NAA at 75 ppm plus GA_3 at 20 ppm significantly recorded the highest throughput values of yield and physical characteristics of cluster. On the other hand, control had the lowest values of these ones in both seasons.

Due to the positive role of GA_3 application in promoting cell division and enlargement, water absorption and protein biosynthesis, this explains the increase in yield and its attributes (**Dimovska *et al.,* 2011, Abu-Zahra and Salameh 2012 and Dimovska *et al.,* 2014**). As regard to NAA, the enhancement effect of NAA on yield and some fruit properties may be attributed that NAA makes the cell wall more flexible, allowing for its enlargement which led to the rate of fruit growth accelerates, ultimately resulting in an increase fruit yield (**Arteca, 1996**). In addition to, NAA application induces fruit mesocarp cells to expand, which improves fruit size and overall production (**Stern *et al.*, 2007**). Additionally, NAA dramatically decreased flower abscission, increased productivity and enhanced fruit quality **(Iqbal *et al.*, 2009**). Furthermore, NAA plays an important role in enhancing the movement of nutrients and minerals from other plant parts to the growing fruits and this reflected in increasing weight and volume (**Arora and Singh, 2014**).

These results are in accordance with those reported by **Omar and El-Morsy (2000)** and **Omran *et al.*, (2005)**; they mentioned that the vine yield and cluster weight were greatly increased by GA_3 spraying after fruit set. With respect to NAA, **El-Hammady and Abd El-Hamid (1995)** on Ruby Seedless grape cultivar and **Rizk-Alla *et al.,* (2011)** on Black Monukka grape cultivar showed that cluster weight and yield per vine were substantially increased by spraying with NAA.

Table (2). Effect of NAA and GA_3 on yield/vine and cluster physical characteristics of Black Magic grapevines during 2021 and 2022 seasons

Characteristic / Treatment	Yield/vine (kg)		Cluster weight (g)		Cluster length (cm)		Cluster width (cm)		Number of berries/cluster	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Control	12.36	12.96	456.2	464.6	32.1	32.5	13.7	13.9	103.1	104.2
NAA at 25ppm	13.14	13.35	481.4	485.6	32.3	32.8	13.8	14.1	107.7	108.3
NAA at 50ppm	13.41	14.31	493.2	512.7	32.4	32.9	13.8	14.2	109.8	113.5
NAA at 75ppm	13.82	14.85	504.3	536.0	32.4	33.1	13.9	14.2	111.3	118.0
GA_3 at 20ppm	14.58	15.05	532.1	545.3	32.7	33.4	14.1	14.4	103.9	104.8
NAA at 25ppm + GA_3 at 20ppm	15.26	15.92	563.1	572.8	32.8	33.4	14.2	14.5	108.8	109.6
NAA at 50ppm + GA_3 at 20ppm	15.76	16.66	577.2	603.7	32.9	33.5	14.3	14.5	110.7	115.0
NAA at 75ppm + GA_3 at 20ppm	16.25	17.51	597.4	627.5	33.4	33.8	14.5	14.7	114.0	119.2
new L.S.D. at 0.05	0.63	0.72	21.7	23.2	0.3	0.2	0.2	0.1	3.1	3.4

3. Physical properties of berries

Data presented in Table (3) showed that GA_3 at 20 ppm either solely or in combined with all different doses of NAA significantly enhanced all physical properties of berries as compared to control in both seasons. Highest significant berry weight, size, dimensions and firmness were obtained by applying NAA at 75 ppm plus GA_3 at 20 ppm, whereas the least values of these ones was attributed to the control in both seasons.

The efficacy of GA_3 to enhance berry weight, size, and dimensions could be ascribed to its influence to encouraging cell division and elongation, water uptake and protein synthesis (**Cleland, 1995**). Also, GA_3 promotes growth by improving the flexibility of cell walls and hydrolysis of starch into sugars that reduce the water potential of cells and encourage the entry of water, which leads to cell elongation and expansion (**Richard, 2006**).

These results are consistent with those stated by **Omar and El-Morsy (2000)**, **Rizk-Alla *et al.*, (2011), Dimovska *et al.* (2014) and Abada *et al.* (2015)**; they mentioned that the physical properties of berries were greatly improved by GA_3 spraying after fruit set. With respect to NAA, **El-Hammady and Abd El-Hamid (1995)** on Ruby Seedless grape cultivar and **Rizk-Alla *et al.*, (2011)** on Black Monukka grape cultivar showed that berry weight and size were substantially increased by spraying with NAA.

Table (3). Effect of NAA and GA_3 on berry physical properties of Black Magic grapevines during 2021 and 2022 seasons

Characteristic / Treatment	Average berry weight (g)		Average berry size (cm^3)		Average berry length (cm)		Average berry diameter (cm)		Average berry firmness (g/cm^2)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Control	4.26	4.29	4.08	4.16	2.32	2.37	1.69	1.76	39.26	41.53
NAA at 25ppm	4.31	4.32	4.12	4.19	2.38	2.44	1.74	1.79	43.74	45.81
NAA at 50ppm	4.33	4.36	4.13	4.21	2.41	2.48	1.75	1.81	44.13	46.16
NAA at 75ppm	4.37	4.39	4.16	4.25	2.42	2.48	1.77	1.82	44.39	46.45
GA_3 at 20ppm	4.95	5.03	4.75	4.88	2.47	2.55	1.82	1.86	45.17	47.19
NAA at 25ppm + GA_3 at 20ppm	5.01	5.06	4.79	4.93	2.49	2.57	1.83	1.87	45.51	47.45
NAA at 50ppm + GA_3 at 20ppm	5.05	5.09	4.85	4.94	2.52	2.59	1.85	1.91	45.93	47.88
NAA at 75ppm + GA_3 at 20ppm	5.08	5.11	4.87	4.97	2.57	2.63	1.88	1.93	46.58	48.51
new L.S.D. at 0.05	0.02	0.01	0.02	0.01	0.04	0.03	0.03	0.02	0.61	0.57

4. Chemical properties of berries

As shown in Table (4), data demonstrated that all chemical properties of berries including TSS, acidity, TSS/acid ratio and anthocyanin content of berry skin were significantly affected by all different doses of NAA either solely or in combined with GA_3 at 20 ppm as compared to control in both seasons. The combined application of NAA at 75 ppm plus GA_3 at 20 ppm significantly achieved the lowest values of TSS, TSS/acid ratio and anthocyanin content of berry skin and highest significant acidity of berry juice. Whereas, control had the highest values of TSS, TSS/acid ratio and anthocyanin content of berry skin and lowest values acidity of berry juice in both seasons.

The preservation of berry quality observed in the present study can be explained by the effective effect of GA_3 and NAA in delaying berry maturation by decreasing TSS, TSS/acid ratio and anthocyanin content of berry skin and increasing total acidity in berry juice (**El-Hammady and Abd El-Hamid, 1995, Omar and El-Morsy, 2000**, **Rizk-Alla *et al.*, 2011, Abada *et al.*, 2015 and Khalil, 2020**).

Table (4). Effect of NAA and GA_3 on berry chemical properties of Black Magic grapevines during 2021 and 2022 seasons

Treatment \ Characteristic	TSS (%)		Acidity (%)		TSS/acid ratio		Anthocyanin (mg/100g F.W.)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	15.9	16.2	0.52	0.49	30.6	33.1	47.9	49.3
NAA at 25ppm	15.8	16.1	0.53	0.51	29.8	31.6	47.1	48.6
NAA at 50ppm	15.6	15.9	0.53	0.52	29.4	30.6	46.8	48.4
NAA at 75ppm	15.5	15.8	0.55	0.54	28.2	29.3	46.3	47.9
GA_3 at 20ppm	15.3	15.5	0.57	0.55	26.8	28.2	45.4	46.8
NAA at 25ppm + GA_3 at 20ppm	15.2	15.4	0.58	0.57	26.2	27.0	45.1	46.4
NAA at 50ppm + GA_3 at 20ppm	15.1	15.2	0.59	0.57	25.6	26.7	44.7	45.9
NAA at 75ppm + GA_3 at 20ppm	14.9	15.1	0.61	0.58	24.4	26.0	44.3	45.6
new L.S.D. at 0.05	0.2	0.1	0.03	0.02	0.7	0.6	0.4	0.3

Economic feasibility of the recommended treatment (75 ppm NAA + 20 ppm GA_3) compared with control

As shown in Table (5), it is obvious that the combined application of NAA at 75 ppm + GA_3 at 20 ppm produced the greatest net profit compared with the control in both seasons. Economically, the minor increase in production costs/Feddan compared to control for this treatment is justified by the higher productivity that results from this treatment.

Table (5). Cost and net profit/ feddan for the recommended treatment (75 ppm NAA + 20 ppm GA_3) compared with control

Per Feddan	2021 season		2022 season	
	NAA at 75 ppm + GA_3 at 20 ppm	Control	NAA at 75 ppm + GA_3 at 20 ppm	Control
Price of NAA (L.E.)	170	---	175	---
Price of GA_3 (L.E.)	120	---	125	---
Labour cost (L.E.)	350	---	400	---
Cost of cultural practices (L.E.)	15000	15000	16000	16000
Total cost (L.E.)	15640	15000	16700	16000
Yield / Feddan (kg)	11375	8652	12257	9072
Yield / kg (L.E.)	9	9	9.5	9.5
Yield / feddan (L.E.)	102375	77868	116442	86184
The net profit (L.E.)	86735	62868	99742	70184

CONCLUSION

From the foregoing results, it can be concluded that the fruit quality attributes of Black Magic grapevines could be easily enhanced by the considered treatments. The combined application of NAA at 75 ppm plus GA_3 at 20 ppm achieved the best influence on the growth, yield and fruit quality attributes. However, this proposed protocol should be further investigated to minimize delay in berry. maturation.

REFERENCES

Abada, M.A.M.; Uwakiem, M.Kh. and Belal, B.E.A. (2015). Effect of spraying Gibberellic acid and Sitofex on improving yield and fruit quality of Early Sweet grapes grown at Minia region, Egypt. Alex. J. Agric. Res., 60(3): 111-117.

Abu-Zahra, T.R. and Salameh, N. (2012). Influence of Gibebrellic acid and cane girdling on berry size of Black Magic grape cultivar. Middle East Journal of Scientific Research, 11(6): 718-722.

Arora, R. and Singh, S. (2014). Effect of growth regulators on quality of Ber (*Zizyphus mauritiana* Lamk) Cv. 'Umran'. Agric. Sci. Digest., 34(2): 102–106.

Arteca, R.N. (1996). Plant Growth Substances: Principles and Applications. Chapman and Hall Press, NY, USA, 332p.

Association of Official Agricultural Chemists (A.O.A.C.) (2000). Official Methods of Analysis Published by (A.O.A.C), Benjamin Franklin Station, Washington D.C., U.S.A. 12th Ed., pp. 490-510.

Belal, B.E.A. (2019). Improvement of physical and chemical properties of Thompson Seedless grapes (H4 Strain) by application of Brassinolide and Gibberellic acid. Egypt. J. Hort. 46(2): 251-262.

Cleland, C.F. (1995). Plant Hormones Physiology, Biochemistry and Molecular Biology. P. J. Davies, (Ed). 2nd Edition, Kluwer Academic Publishers, the Netherlands.

Crosier, A.; Kamiya, Y.; Bishop, G. and Yokota, Y. (2000). Biosynthesis of hormones and Selicitor molecules. In: "Biochemistry and Molecular Biology of Plants", B.B. Buchanan, W. Gruissem and R.L. Jones (Ed.), pp. 850-901, Rockville, USA: American Society of Plant Physioloits.

Dimovska, V.; Beleski, K.; Boskov, K.; Ivanova, V. and Ilieva, F. (2013). The productive characteristics on black magic table grape variety, growing in the Tikves's vineyard, Republic of Macedonia. In IV International Symposium" pp. 141-146.

Dimovska, V.; Ivanova, V.; Ilieva, F. and Sofijanova, E. (2011). Influence of bioregulators and gibberellic acid on some technological characteristics of cluster and berry from some seedless grape varieties. J. Agric. Sci. Technology, BI, 1074-1058.

Dimovska, V.; Petropulos, V.I.; Salamovska, A. and Ilieva, F. (2014). Flame Seedless grape variety (*Vitis vinifera* L.) and different concentration of gibberellic acid (GA_3). Bulgarian J. Agric. Sci., 20(1): 137-142.

Domingos, S.; Scafidi, P.; Cardoso, V.; Leitao, A.E.; Di Lorenzo, R.; Oliveira, C.M. and Goulao, L.F. (2015). Flower abscission in *Vitis vinifera* L. triggered by gibberellic acid and shade discloses differences in the underlying metabolic pathways. Front. Plant Sci., 6:457.

Dutta, P. and Banik, A.K. (2007). Effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar guava grown in West Bengal. Acta Hort., 335 (6):407-411.

El-Hammady, A.M. and Abd El-Hamid, N. (1995). Effects of GA_3, NAA and cane girdling on yield and quality of 'Ruby Seedless' grapevines. Annals Agric. Sci., Ain Shams Univ., Cairo, 40(1): 293-305.

El-Morsy, A.A. (2001). Effect of CPPU, GA_3 and NAA on some quality parameters of Ruby Seedless grapes. Agric. Res. Tanta Univ., 27(3): 551-563.

El-Sayed, M. (2021). Effect of Naphthaleneacetic acid (NAA) on controlling of suckers growth on Lime trees grown in new reclaimed soil. J. of Plant Production, Mansoura Univ., 12 (5):553 – 558.

Hifny, H.A.; Khalifa, S.M.; Hamdy, A.E. and Abd El-Wahed, A.N. (2017). Effect of GA3 and NAA on growth, yield and fruit quality of Washington navel orange. Egypt. J. Hort., 44(1): 33- 43.

Husia, C.L.; Luh, B.S. and Chichester, C.D. (1965). Anthocyanin in free stone peach. J. Food Science, 30: 5-12.

Iqbal, M.; Khan, M.Q.; Jalal-Eddin, K.R. and Munir, M. (2009). Effect of foliar application of NAA on fruit drop, yield and physico-chemical characteristics of guava (*Psidium guajava* L.) Red flesh cultivar. J. Agric. Res., 47(3):259-269.

Kamiloglu, O.; Demirkeser, O. and Sakaroglu, N. (2019). The effects of paraffin and parafilm applications and different rootstocks on yield of grafted vine in 'Black Magic' grape cultivar. AGROFOR International Journal, Vol. 4, Issue No. 2, 51-57.

Khalil, H.A. (2020): Improved yield, fruit quality and shelf life in Flame Seedless grapevine with pre-harvest foliar applications of forchlorfenuron, gibberellic acid, and abscisic acid. Journal of Horticultural Research. 28(1): 77-86.

Nicolaescu, G.; Derendovskaia, A.; Perstniov, N.; Stirbu, A.; Tcaciuc, O.; Nicolaescu, A.; Ciobanu, T. and Josan, S. (2009). Gibberellin - as a determinant factor of grape's quality of Codreanca (Black Magic) variety. Lucrări ştiinţifice USAMVB, Seria B, Horticultural NO. 53 pp. 573-576.

Omar, A.H. and El-Morsy, F.M. (2000). Improving quality and marketing of Ruby Seedless Table grapes. J. Agric. Sci. Mansoura Univ., 25(7): 4425-4438.

Omran, Y.A.; Hashem, M.M. and El–Helw, H.A. (2005). Impact of application of gibberllic acid and *sacchromyces cerevisiae* on "Perlette Seedless" grapes productivity and fruit quality Assiut Univ. j. of botany 34 (1), p- p. 339-360.

Pires, E.J.P.; Terra, M. M.; Pommer, C.V. and Passos, I.R.S. (2000). Improvement of cluster and berry quality of Centennial Seedless grapes through gibberellic acid. Acta Horticulturae, No.526, pp.293-299.

Richard, M. (2006): How to grow big peaches. How to grow big peaches. USA, 8p. https://njaes.rutgers.edu/peach/orchard/pdf/How-to-Grow-Big-Peaches.pdf.

Rizk-Alla, M.S.; Abd El-Wahab, M.A. and Fkry, O.M. (2011). Application of GA_3 and NAA as a means for improving yield, fruit quality and storability of Black Monukka grape Cv. Nature and Science, 9(1):1-19.

Rolle, L.; Giacosa, S.; Gerbi, V.; Bertolino, M. and Novello, V. (2013). Varietal Comparison of the Chemical, Physical, and Mechanical Properties of Five Colored Table Grapes, International Journal of Food Properties, 16:3, 598-612.

Senthilkumar, S.; Vijayakumar, R.M. and Soorianathasundaram, K. (2018). Pre-Harvest Implications and Utility of Plant Bioregulators on Grape: A Review. Plant Archives, 18 (1): 19-27.

Snedecor, G.W. and Cochran, W.G. (1980). Statistical Methods. 7th ed., The Iowa State Univ. Press. Ames. , Iowa, U.S.A., pp. 593.

Steel, R.G. and Torrie, J.H. (1980). Reproduced from principles and procedures of statistics. Printed with the permission of C. I. Bliss, pp. 448-449.

Stern, R.A.; Flaishman, M. and Ben-Arie, R. (2007). Effect of synthetic auxins on fruit size of five cultivars of Japanese plum (*Prunus saliciana* Lindl.). Scientia Horticulturae, 112: 304-309.

Tourky, M.N.; El-Shahat, S.S. and Rizk, M.H. (1995). Effect of Dormex on fruit set, quality and storage life of Thompson Seedless grapes (Banati grapes) J. Agric. Sci., Mansoura Univ., 20(12): 5139-5151.

Wood, C.W.; Reeves, D.W. and Himelrick, D.G. (1992). Relationships between chlorophyll meter readings and leaf chlorophyll concentration. N status and crop yield. A review: Proc. Agro. Soc. N.Z., 23: 1-9.