The Beneficial Effects of Spraying Ethrel and Absicic Acid on Quality of Flame Seedless Grapes

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Abstract: During 2017 and 2018 seasons clusters of Flame seedless grapevines grown under Minia region conditions were subjected to Ethrel at 240 to 480 ppm and / or protone (10% ABA) at 200 to 400 ppm. The merit was examining the effect of these materials on advancing maturation of berries and enhancing colouration and quality of the berries. Treating the clusters with Ethrel and/ or protone (10% ABA) was very effective in advancing maturation of the berries and enhancing berries colouration and chemical quality of the berries relative to the control treatment. Using Ethrel at 480 ppm was superior than using protone at 200 and 300 ppm on advancing maturation and enhancing chemical quality of the berries. Moreover, using Ethrel at 240 to 360 ppm plus protone at 200 to 400 ppm was favourable than using each alone in this respect. The best treatment was exposing the clusters of Flame seedless grapevines to Ethr el at 360 ppm and protone at 300 ppm (10% ABA) once at veraison stage.
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1. Introduction

Many efforts were done for solving the problems of irregular colouration of coloured Flame seedless grapevines under hot climates nowadays, several trials were conducted to use Ethrel and protone, for advancing maturation date and promoting berries colouration grapevines cvs (**Davies, 1980**). The occurrence of this problem had negative effects on marketing of the fruits to local and foreign markets (**Orth *et al.,* 1993, Taiz and Zeiger, 2002, Zhang *et al.,* 2009 and Dal *et al.,* 2010)** were very effective in advancing maturation date, berries colouration and grapes quality in different grapes cvs. **(Abd El- Ghany- Eslam (2002); Ahmed and Zargar (2005) and Abd El- Mageed – Nermeen (2019)**.

The merit of this study was examining the effect of single and combined applications of Ethrel and protone as a source of ABA on maturation date, berries colouration and quality of berries in grapevines cvs Flame seedless grown under Minia region conditions.

2. Material and Method

This study was carried out during the two consecutive seasons of 2017 and 2018 on sixty six uniform in vigour own rooted 8 years old of grapevines cvs Flame seedless grown in a private vineyard located at west Abu Qorqas district, Minia governorate where the soil texture is sandy.

The selected vines are planted at 2x3 meters apart. The chosen vines were trained by spur pruning system leaving 72 eyes/ vine (12 fruiting spurs/ 5 eyes plus six replacement spurs x two eyes) using brawan supporting method.

Winter pruning was conducted on the first week of Jan. during both seasons.

Drip irrigation system was followed using well water containing 550 ppm salinity. Fertilizers were added with irrigation water (fertigation).

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil

Constituent	Values
Sand %	80.0
Silt %	11.0
Clay %	9.0
Texture	Sandy
O.M. %	0.1
pH (1: 2.5 extract)	8.0
EC (1: 2.5 extract) ppm	1.66
$CaCO_3$%	3.00
Total N%	0.009
Available P (olsen ppm)	101
Available K (ammonium acetate, ppm)	29.0

The selected vines (66 vines) received the same horticultural practiced that were already applied in the vineyard except application of Ethrel and protone these practices including the application of 10 tons F.Y.M. (0.3 % N), 250 kg ammonium nitrate (33.5% N), 150 kg calcium superphosphate (15.5 % P_2O_5) and 200 kg potassium sulphate (48% K_2O) per one feddan annually.

Soil is classified as sandy in texture with water label depth not less than to meters deep. The results of orchard soil analysis according to (**Piper, 1950**) and (**Black, 1965)** are given in Table (1).

This experiment included eleven treatments from single and combined applications of Ethrel at 240 to 480 ppm and protone at 200 to 400 ppm.

1- Control.
2- Spraying proton at 200 ppm (2 ml/ L).
3- Spraying proton at 300 ppm (3 ml/ L).
4- Spraying proton at 400 ppm (4 ml/ L).
5- Spraying ethrel at 480 ppm (1 ml/ L)
6- Spraying proton at 200 ppm +ethrel at 240 ppm (0.5 m/L).
7- Spraying proton at 200 ppm + ethrel at 360 ppm (0.75 m/L).
8- Spraying proton at 300 ppm + ethrel at 240 ppm (0.5 m/L).
9- Spraying proton at 300 ppm + ethrel at 360 ppm (0.75 m/L).
10- Spraying proton at 400 ppm + ethrel at 240 ppm (0.5 m/L).
11- Spraying proton at 400 ppm + ethrel at 360 ppm (0.75 m/L).

Each treatment was consisted of three replicates one vine per each. Ethrel (48%) and protone (10% ABA) were sprayed once at veraison stage when approximately 10% of the berries per cluster on 50% of the number of vine clusters had softened veraison stage.

Triton B as a wetting agent was added at 0.05% spraying was done till clusters run off.

Randomized complete block design (RCBD) was followed. Each treatment was replicated three times, one vines one each for realizing the objectives of this study, the following parameters were recorded in response to application of Ethrel and protone.

1-Maturaiton time:

It was calculated when T.S.S./ acid reached 25:1.

2- Yield per vine:

The yield of each vine was recorded in terms of weight (kg.) than the average weight of cluster (g.) was recorded. Five clusters per each vine were taken at random for determinations of the following.

Physical and chemical characteristics of the berries

1- Percentage of berries colouration by dividing number of red coloured berries by total number of berries per cluster and multiplying the product by 100.

2- Percentage of berries shattering by counting the number of dropped berries by the total number of berries per cluster and multiple the product by 100.

3- Average berry weight (g.) and dimensions (longitudinal and equatorial cm).

4- Percentage of total soluble solids in the juice by using handy refractometer.

5- Percentage of total acidity (as gram tartaric acid/ 100 ml juice) by titration against 0.1 N NaOH using phenolopthalein as indicator (**A.O.A.C., 2000**).

6- The ratio between T.S.S./ acid.

7- Percentage of reducing sugars in the juice by using **(Lane and Eynon, 1965)**. Volumetric method as described in (**A.O.A.C., (2000**).

8- Total phenols (**A.O.A.C. 2000**) and total anthocyanins in the berries by using ethrel alcohol and HCl method (mg/ 100 g. F.W.) (**Fulcki and Francis, 1968**).

The proper statistical analysis was done. Treatment means were compared using new L.S.D. test at 5% according to **Mead *et al.,* (1993)**.

3. Results

1-Maturation time:

Data in Table (2) show the effect of single and combined application of protone and Ethrel on maturation date of grapevine cv Flame seedless, during 2017 and 2018 seasons.

Maturation time was materially hastened with using protone at 200 to 400 ppm and ethrel at 240 to 480 ppm either applied alone or in combination compared to the control treatment.

Using protone at 400 ppm and ethrel at 360 ppm in ascending order effectively advanced maturation date. Combined applications of protone and ethrel was materially advanced maturation time than using each material alone. Combined application using two materials together gave an outstanding promotion on maturation time than using each material alone. The best double application treatment was application of protone at 400 ppm plus ethrel at 360 ppm gave a great advancement on maturation date. These results were truer during both seasons.

2- The yield / vine:

Data in Table (2) show the effect of single and combined applications of protone and ethrel on the yield/ vine of grapevines cv Flame seedless during 2017 and 2018 seasons. Single and combined applications of protone at 200 to 400 ppm and ethrel at 240 to 480 ppm caused unsignificant promotion on the yield/ vine relative to the control treatment. These results were true during both seasons.

3-The percentage of berries colouration.

Data in Table (3) show the effect of single and combined application of protone and ethrel on berries colouration % of grapevine cv Flame seedless during 2017 and 2018 seasons.

Single and combined applications of protone at 200 to 400 ppm and ethrel at 240 to 480 ppm significantly was followed by enhancing berries colouration compared to the check treatment treating the cluster of the grapevine cv Flame seedless with ethrel and protone. In descending was significantly responsible for advancing berries colouration % combined applications of the previous two materials were significantly favourable in enhancing berries colourations than application of each material alone. Using protone at 400 ppm and ethrel at 360 ppm gave the maximum values of berries colouration %. The untreated vines produced the lowest values. These results were true during seasons.

Table (2): Effect of spraying Ethrel and Absicic acid on maturation time, yield and average cluster weight of Flame seedless grapes during 2017 and 2018 seasons.

Treatment	Maturation time		Yield vine (kg.)		Av. Cluster weight (g.)	
	2017	2018	2017	2018	2017	2018
Control	28 June	26 June	11.6	11.8	360.0	350.0
Protone at 200 ppm	22 June	21 June	11.7	11.9	370.0	380.0
Protone at 300 ppm	20 June	20 June	12.0	12.2	370.0	380.0
Protone at 400 ppm	15 June	13 June	12.0	12.0	380.0	380.0
Ethrel at 480 ppm	18 June	17 June	12.2	12.1	390.0	390.0
Protone at 200 ppm + Ethrel 240 ppm	10 June	8 June	12.1	12.0	385.0	375.0
Protone at 200 ppm + Ethrel 360 ppm	7 June	6 June	12.2	12.2	385.0	370.0
Protone at 300 ppm + Ethrel 240 ppm	5 June	4 June	12.6	12.6	390.0	380.0
Protone at 300 ppm + Ethrel 360 ppm	3 June	2 June	12.8	12.8	390.0	390.0
Protone at 400 ppm + Ethrel 240 ppm	31 May	30 May	12.8	12.8	390.0	390.0
Protone at 400 ppm + Ethrel 360 ppm	28May	26 May	12.8	12.8	390.0	390.0
New L.S.D. at 5%	-	-	NS	NS	NS	NS

4- The percentage of berries shattering:

Data in Table (4) show the effect of single and combined application of protone and ethrel on the percentage of berries shattering of grapevine cv Flame seedless during 2017 and 2018 seasons.

Varying protone and ethrel treatments had no significant effect on the percentage of berry shattering. These results were true during both seasons.

5- The average cluster weight:

Data in Table (3) show the effect of single and combined application of protone and ethrel on the average cluster weight of grapevine cv Flame seedless during 2017 and 2018 seasons.

Average cluster weight was significantly unaffected by varying protone and ethrel treatment during both seasons.

Table (3): Effect of spraying Ethrel and Absicic acid on berries colouration, Av. Berry weight, Av. Berry longitudinal and Av. Berry equatorial of Flame seedless grapes during 2017 and 2018 seasons.

Treatment	Berries colouration %		Av. Berry weight (g.)		Av. Berry longitudinal (cm)		Av. Berry equatorial (cm)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	70.0	71.0	3.55	3.85	1.70	1.75	1.50	1.60
Protone at 200 ppm	75.0	76.0	3.95	4.00	1.80	1.80	1.55	1.60
Protone at 300 ppm	79.0	80.0	4.00	4.00	1.95	1.99	1.80	1.90
Protone at 400 ppm	81.5	82.0	4.22	4.20	2.00	2.05	1.95	1.95
Ethrel at 480 ppm	80.3	81.0	4.10	4.08	1.95	1.99	1.75	1.91
Protone at 200 ppm + Ethrel 240 ppm	85.0	85.0	4.00	4.05	2.01	2.00	1.98	1.90
Protone at 200 ppm + Ethrel 360 ppm	87.0	88.0	4.01	3.99	2.10	2.00	1.95	1.90
Protone at 300 ppm + Ethrel 240 ppm	88.0	89.0	3.88	4.00	2.10	2.05	1.90	1.90
Protone at 300 ppm + Ethrel 360 ppm	90.5	91.0	3.95	4.00	2.10	2.10	1.95	1.98
Protone at 400 ppm + Ethrel 240 ppm	91.0	91.0	4.05	4.00	2.05	2.10	1.90	1.95
Protone at 400 ppm + Ethrel 360 ppm	93.0	93.2	4.10	4.05	2.00	2.10	1.90	1.95
New L.S.D. at 5%	1.2	1.1	NS	NS	NS	NS	NS	NS

6- Physical and chemical characteristics of the berries:

Data in Table (3, 4, 5) show the effect of single and combined application of protone and ethrel on berry weight and dimensions, T.S.S., reducing sugars %, T.S.S./ acid, titratable acidity %, total phenols and total anthocyanins in the juice of grapevines cv Flame seedless during 2017 and 2018 seasons.

6-1 Berry weight and dimensions:

Average berry weight and dimensions were significantly unaffected by protone and ethrel treatments during seasons.

6-2 Total soluble solids, reducing sugars % and T.S.S./ acid

Single and combined applications of protone at 200 to 400 ppm and ethrel at 240 to 480 ppm. Significantly enhanced T.S.S. %, reducing sugars % and T.S.S. / acid relative to control.

Using protone and ethrel in descending order was significantly very effective in enhancing these chemical characteristics. These results were true during both seasons.

6-3 Titratable acidity%:

It was significantly reduced with single and combined applications of protone at 200 to 400 ppm and ethrel at 240 to 480 ppm relative to the control. Using ethrel at 480 ppm was significantly favourable than the other protone at 200 and 300 ppm in titratable acidity. Combined applications were significantly favourable than using each material alone in this connection. The lowest values were recorded on the vines treated with protone at 400 ppm and ethrel at 360 ppm.

6-4 Total phenols:

Total phenols was significantly declined with using protone at 200 to 400 ppm and ethrel at 240 to 480 ppm either application alone or in combination. The lowest values were recorded on the vine that received protone at 400 ppm and ethrel 360 ppm. The untreated vines produced the maximum values.

6-5 Total anthocyanins in the juice:

It is evident from the obtained data that subjecting the vines of the grapevines cv Flame seedless once with protone at 200 to 400 ppm and ethrel at 240 to 480 ppm either singly or in combinations significantly was very effective in enhancing the total anthocyanins relative to the control combined applications were preferable than using each material alone in enhancing total anthocyanins. The maximum values were detected on the vines that treated with protone at 400 ppm and ethrel at 360 ppm. The untreated vines produced the lowest values.

4. Discussion

Effect of Ethrel and protone

The acceleration on maturation of Flame seedless grapes due to application of Ethrel could be attributed to the break down of Ethrel to ethylene which results in activation the hydrolytic and oxidative enzymes involved in maturation increasing the degradation of chlorophylls and promoting the biosynthesis of plant pigments namely anthoyanins and carotenoids and hastening the compartmentation. In addition ethrel is effective in increasing mitochondrial oxidation of malic acid (**Dal *et al.*, 2010**).

Table (4): Effect of spraying Ethrel and Absicic acid on berries shattering, T.S.S., reducing sugars and total acidity of Flame seedless grapes during 2017 and 2018 seasons.

Treatment	Berries shattering %		T.S.S. %		Reducing sugars %		Total acidity %	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	6.36	6.42	18.0	17.8	16.5	16.4	0.660	0.655
Protone at 200 ppm	6.50	6.55	18.4	18.4	16.9	17.0	0.635	0.630
Protone at 300 ppm	6.60	6.65	18.7	18.9	17.2	17.4	0.631	0.626
Protone at 400 ppm	6.68	6.73	19.3	19.5	17.8	17.9	0.600	0.588
Ethrel at 480 ppm	6.66	6.71	19.1	19.3	17.6	18.0	0.605	0.600
Protone at 200 ppm + Ethrel 240 ppm	6.70	6.75	19.6	19.8	18.1	18.3	0.585	0.583
Protone at 200 ppm + Ethrel 360 ppm	6.81	6.82	19.8	20.0	18.3	18.5	0.578	0.570
Protone at 300 ppm + Ethrel 240 ppm	6.80	6.85	20.4	20.6	18.9	19.1	0.560	0.550
Protone at 300 ppm + Ethrel 360 ppm	6.86	6.90	20.8	20.9	19.2	19.4	0.538	0.530
Protone at 400 ppm + Ethrel 240 ppm	6.85	6.91	21.0	21.2	19.6	19.8	0.518	0.510
Protone at 400 ppm + Ethrel 360 ppm	6.88	6.95	21.4	21.6	19.9	20.1	0.500	0.490
New L.S.D. at 5%	1.90	1.88	0.4	0.3	0.4	0.3	0.030	0.025

Table (5): Effect of spraying Ethrel and Absicic acid on T.S.S./ acid, total phenols and total anthocyanins of Flame seedless grapes during 2017 and 2018 seasons.

Treatment	T.S.S. / acid		Total phenols (mg/ g F.W.)		Total anthocyanins (mg/ 100 g, F.W.)	
	2017	2018	2017	2018	2017	2018
Control	27.2	27.2	7.00	6.90	55.1	55.9
Protone at 200 ppm	29.0	29.2	6.40	6.30	60.6	61.0
Protone at 300 ppm	29.6	30.2	6.00	5.95	64.4	65.0
Protone at 400 ppm	31.9	32.8	5.00	4.80	69.9	70.0
Ethrel at 480 ppm	31.8	32.5	5.10	4.90	68.8	69.5
Protone at 200 ppm + Ethrel 240 ppm	33.5	34.0	4.10	4.00	70.0	71.8
Protone at 200 ppm + Ethrel 360 ppm	34.3	35.1	3.78	3.66	75.0	78.0
Protone at 300 ppm + Ethrel 240 ppm	36.4	37.5	3.70	3.55	79.9	80.8
Protone at 300 ppm + Ethrel 360 ppm	38.7	39.4	3.30	3.05	87.5	88.0
Protone at 400 ppm + Ethrel 240 ppm	40.5	41.6	3.25	3.00	88.1	88.5
Protone at 400 ppm + Ethrel 360 ppm	42.8	44.0	2.99	2.80	90.0	91.0
New L.S.D. at 5%	1.1	1.0	0.30	0.25	2.3	2.1

The effect of ABA in enhancing maturation of the berries be attributed to its effect as main single triggering the onset of the secondary metabolism in grape skine as well as enhancing the enzymes especially Upp- Glucose- Flavonic 3- O Glucose-T (**Zhang *et al.*, 2009**). The beneficial effects of ABA in reaching the plant tissues to senescence could give another explanation (**Taiz and Zeiger, 2002**). These results regarding the effect of ethrel are in concordance with (**Liu *et al.*, 2002**) on cabernet sauvignon grapes. (**Strydom 2014**) on Flame seedless grapes (**Ibrahiem, 2018**) on Crimson seedless grapes the results of (**Ferrara *et al.*, 2015**) on Crimson seedless grapes (**Lichter *et al.*, 2015**) on flame seedless grapevines (**Castellarin *et al.*, 2015**) on Thompson seedless grapes supported the present results.

Conclusion

For overcoming irregular colouration of clusters, advancing berries maturation and improving berries quality of the grapevine cv Flame seedless under Minia region conditions. It is preferable for treating clusters with ethrel at 360 ppm and protone at 300 ppm when approximately 10% of the berries on 50% of the clusters had softened (Veraison stage).

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