Assiut J. Agric. Sci., (48) No. (3) 2017 (150-159) *ISSN: 1110-0486*
Website: http://www.aun.edu.eg/faculty_agriculture *E-mail: ajas@aun.edu.eg*

Studies for Solving Late Maturation, Quality and Irregular Colouration Problem in Flame Seedless Grapes Grown Under Luxor Climatic Conditions

Abdealaal, A. H.M.[2]; F.F. Ahmed[1]; S.M.A. El-Masry[2] and Khaled, A.A. Mohamed[2]

[1]Hort. Dept. Fac. of Agric. Minia Univ., Egypt
[2]Hort. Dept. Fac. of Agric. Al-Azhar Univ. Assiut, Egypt
E.mail: fissalfadel@yahoo.com

Received on: 19/2 /2017 **Accepted for publication on:** 23/3 /2017

Abstract

During 2015 and 2016 seasons clusters of Flame seedless grapevines grown under Luxor region conditions were subjected to Ethrel and/or Proton (10% ABA) each at 250 to 500 ppm with or without the application of acetic acid and phosphoric acid each at 2000 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 Proton (10% ABA) each at 250 to 500 ppm with or without the application of acetic acid and phosphoric acid 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 was superior than using Proton on advancing maturation and enhancing chemical quality of the berries. Moreover, using Ethrel plus Proton was favourable than using each alone in this respect.

The best treatment was exposing the clusters of Flame seedless grapevines to Ethrel and Proton (10% ABA) each at 250 ppm plus application of phosphoric acid at 2000 ppm once at veraison stage.

Keywords: *Ethrel, Proton, ABA, maturation, colouration, quality, Flame seedless grapevines.*

Introduction

Irregular colouration of berries in the clusters of Flame seedless grapevines grown under Luxor region is considered a serious problem facing marketing of such grapevine cv. Many attempts were accomplished for solving such problem by using sources of ethylene and ABA. (Dal *et al*., 2010).

Amutha and Rajendra, (2001); Al-Maisary, (2002); Abd El- Ghany-Eslam, (2002); Fawzi and Abd El-Moniem, (2003); Lombard *et* al., (2004); Ahmed and Zarger, (2005); Omar and Gergis, (2005); EL-Halaby, (2006); Amiri *et al*., (2010); Mohamed –Ebtesam, (2012); Bahar *et al.,* (2012); Ferrara *et al*., (2015) and Castellarin, *et al* (2015) found that treating various grapevine cvs with Ethrel and ABA was followed by advancing maturation and enhancing berries colouration and quality of the berries.

The target of this study was elucidating the effect of using Ethrel and Proton (as a source of ABA) on maturation, berries colouration and quality of Flame seedless grapevines grown under Luxor region climatic conditions.

Material and Methods

This study was carried out during the two consecutive seasons 2015 and 2016 on fifty-seven uniform in vigour of own rooted 4 years- old of Flame seedless grapevines. The selected vines are grown in a private vineyard located at Esna district, Luxor Governorate where the texture of the soil is sandy.

The selected vines are planted at 2 x 3 meters apart. The chosen vines were trained by spur pruning system leaving 72 eyes/ vine (20 fruiting spurs x 3 eyes plus six replacement spurs x two eyes) using Gable supporting method. Winter pruning was conducted at the first week of Jan. during both seasons. Drip irrigation system was followed using well water containing 500 ppm salinity. The selected vines (57 vines) received the same horticultural practices that were already applied in the vineyard except application of Ethrel and Proton.

This experiment included the following nineteen treatments from Ethrel, Proton and acetic and phosphoric acids arranged as follows:

1-Control (spraying clusters with water).
2-Spraying Proton at 250 ppm.
3-Spraying Proton at 500 ppm.
4-Spraying Ethrel at 250 ppm.
5-Spraying Ethrel at 500 ppm.
6-Spraying Ethrel + Proton each at 250 ppm.
7-Spraying Ethrel + Proton each at 500 ppm.
8-Spraying Proton at 250 ppm + Acetic acid at 2000 ppm.
9-Spraying Proton at 500 ppm + Acetic acid at 2000 ppm.
10- Spraying Ethrel at 250 ppm + Acetic acid at 2000 ppm.
11- Spraying Ethrel at 500 ppm + Acetic acid at 2000 ppm.
12-Spraying Ethrel + Proton each at 250 ppm + Acetic acid at 2000 ppm.
13-Spraying Ethrel + Proton each at 500 ppm + Acetic acid at 2000 ppm.
14-Spraying Proton at 250 ppm+ Phosphoric acid at 2000 ppm.
15-Spraying Proton at 500 ppm+ Phosphoric acid at 2000 ppm.
16-Spraying Ethrel at 250 ppm+ Phosphoric acid at 2000 ppm.
17-Spraying Ethrel at 500 ppm+ Phosphoric acid at 2000 ppm.
18-Spraying Ethrel + Proton (each at 250 ppm) + Phosphoric acid at 2000 ppm.
19-Spraying Ethrel + Proton (each at 500 ppm) + Phosphoric acid at 2000 ppm.

Each treatment was replicated three times, one vine per each. Ethrel (48%) and Proton (10% ABA) were sprayed to the clusters alone once at veraison stage when approximately 10% of the berries on 50% of the clusters had softened. 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 where the experiment consisted from nineteen treatments and each treatment was replicated three times, one vine per each.

During both seasons, the following parameters were recorded:

1- Maturation date of berries.
2- Yield /vine/Kg
3- Percentage of berries colouration.
4- Berry weight (g), percentages of total soluble solids, reducing sugars, T.S.S./acid, total acidity (as g tartaric acid/100 ml juice)

(A.O.A.C, 2000) and total anthocyanins mg/100g fresh weight (Fulcki and Francies, 1968).

Statistical analysis was done using New L.S.D. at 5% parameter (Mead *et al.,* 1993).

Results and Discussion

1. Maturation date:

It is clear from the obtained data in Table (1) that single and combined application of Ethrel or Proton each at 250 to 500 ppm with or without the application of both acetic acid and phosphoric acid each at 2000 ppm materially advanced the maturation date of Flame seedless grapes. Wherease, concentrations of Ethrel and Proton from 250 to 500 ppm with or without the application of acetic acid and phosphoric acid caused a gradual advancement in dates of maturation. Using Ethrel was materially superior in advancing maturation dates than using Proton. Combined application of Ethrel and Proton was favourable than using each alone in this respect.

Using acetic acid besides Ethrel and/or Proton had no measurable effect on maturation date when combined with using Ethrel or Proton alone. Maturation date was 7 and 6 June in the vines treated with Ethrel and Proton each at 500 ppm plus phosphoric acid at 2000 ppm. Maturation date was 25 & 27 June in the vines untreated with Ethrel or Proton during both seasons, respectively. The earliness in the maturation date due to using the promised treatment over the control treatment reached 18 and 21 days during both seasons, respectively. This means that treating clusters of Flame seedless grapevines with Ethrel and Proton each at 500 ppm plus phosphoric acid at 2000 ppm advanced maturation date by 18 and 22 days during both seasons, respectively. The same trend was noticed during both seasons.

2. Yield:

It is clear from the obtained data in Table (1) that treating clusters of Flame seedless grapevines with Ethrel and/or Proton each at 250 to 500 ppm with or without the application of acetic acid and phosphoric acid (each at 2000 ppm) had no significant effect on the yield per vine during both seasons.

3. Percentage of berries colouration:

It is clear from the obtained data in Table (1) that single and combined applications of Ethrel and Proton (each at 250 to 500 ppm) were with or without the application of acetic and phosphoric acids each at 2000 ppm significantly superior than the control in improving berries colouration. Using Etherl plus proton was significantly favourable than using each material alone in this respect. A slight and unsignificant promotion on berries colouration was observed with increasing concentrations of Ethrel and Proton from 250 to 500 ppm. Using acetic acid with Ethrel or Proton had no significant effect on promoting colouration of the berries relative to using Ethrel and/or Proton. However, using phosphoric acid with Ethrel and/or Proton was accompanied with significant enhancing berries colourations comparing with using Ethrel and/or Proton. Exposing clusters to Ethrel and Proton (each at 500 ppm) along with the application of phosphoric acid gave the highest values of berries colouration (82 & 83%) during both seasons, respectively. The lowest values (65.3 & 66.0%) were recorded on the vines that received water alone (untreated vines) during 2015 and 2016 seasons, respectively. The percentage of increment on berries colouration % due to using the previous promised treatment over the control treatment reached (25.6 & 25.4%) during both seasons, respectively. Similar trend was observed during both seasons.

4. **Berry weight:**

It is clear from the obtained data in Table (2) that berry weight of Flame seedless grapevines was unaffected significantly with subjecting the clusters of Flame seedless grapevines to Ethrel and/or Proton (each at 250 to 500 ppm) with or without the application of acetic acid or phosphoric acid (each at 2000 ppm) relative to the control treatment during both seasons.

5. **Chemical characteristics of the berries:**

It is clear from the obtained data in Tables (2&3) that subjecting the clusters of Flame seedless grapevines with Ethrel and/or Proton (each at 250 to 500 ppm) with or without the application of acetic acid and phosphoric acid (each at 2000 ppm) significantly improved the chemical characteristics of the berries of Flame seedless grapevines in terms of increasing T.S.S.%, reducing sugars%, T.S.S./acid and total anthocyanins and reducing total acidity% over the control treatment. Using Ethrel at 250 to 500 ppm was significantly superior to using Proton at the same concentrations in improving the chemical characteristics of the berries. Combined application of Ethrel and Proton was significantly preferable than using each alone in this respect. Using phosphoric acid was significantly superior to using acetic acid in enhancing the chemical characteristics of the berries. Using acetic acid with Ethrel and/or Proton had no significant effect on promoting chemical characteristics of the berries relative to using Ethrel and/or Proton alone. Meaningful promotion on these chemical characteristics was observed with increasing concentrations of both Ethrel and Proton from 250 to 500 ppm. Therefore, the best results with regard to chemical quality characteristics were obtained due to subjecting the clusters to Ethrel and Proton each at 250 ppm with the application of phosphoric acid at 2000 ppm. Similar trend was noticed during 2015 and 2016 seasons.

The effect of ABA in enhancing maturation of the berries might be attributed to its effect as a main signal, triggering the onset of the secondary metabolism in grape skin. The beneficial effects of ABA in reaching the plant tissues to senescence could give another explanation (Taiz and Zeiger, 2002).

The effects of ABA on advancing maturity and enhancing quality of the berries in various grapevine cvs are in harmony with those obtained by Gagne *et al*., (2011) on Cabornet Sauvignon grapevines; Giribaldi *et al*., (2010) on the same grapevine cv and Bahar *et al*., (2012) on Crimson seedless grapevines. These authors agreed with the current study the meaningful effect of ABA on the yield and cluster weight.

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

These results concerning the effect of Ethrel on enhancing maturation of berries and quality of the grapes of Flame seedless grapevines were in accordance with the results of Leao and Assis, (1999) on Red Globe grapevines; Amutha and Rajendra, (2001) on Thompson seedless grapevines; Abd El-Ghany-Eslam, (2002) on Red Roomy grapevines; Al-Maisary, (2002) on Shadaa Soda and Yakooty grapevine cvs; Fawzi and Abd El-Moniem, (2003) on Black Monukka grapvines; Sharma and Singh, (2003) on Beauty grapevines; Nikolaou *et al.,* (2003) on Cardinal grapevines and Lombard *et al.*, (2004) on Flame seedless grapevines.

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Assiut J. Agric. Sci., (48) No. (3) 2017 (150-159) *ISSN: 1110-0486*
Website: http://www.aun.edu.eg/faculty_agriculture *E-mail: ajas@aun.edu.eg*

دراسات لعلاج مشكلة تأخر النضج وخصائص الثمرة وعدم انتظام التلوين فى حبات العنب الفليم سيدلس النامى تحت الظروف المناخية لمنطقة الأقصر

أحمد حسن محمود عبد العال[2]، فيصل فاضل أحمد[1]، صلاح الدين محمد علي المصرى[2] و خالد عبد العال أحمد محمد[2]

[1]قسم البساتين – كلية الزراعة – جامعة المنيا – مصر
[2]قسم البساتين – كلية الزراعة – جامعة الأزهر – فرع أسيوط

الملخص

خلال موسمى ٢٠١٥، ٢٠١٦ تم معاملة عناقيد كرمات العنب الفليم سيدلس النامية تحت ظروف منطقة الأقصر بالاثريل والبروتون مفردا او معا بتركيز ما بين ٢٥٠ إلى ٥٠٠ جزء فى المليون مع أو بدون استخدام حامض الخليك وحامض الفوسفوريك بتركيز ٢٠٠٠ جزء فى المليون وكان الهدف من هذه التجربة اختبار تأثير هذه المواد فى تبكير النضج وتحسين تلوين الحبات وخصائص الجودة.

كان معاملة العناقيد بالايثريل والبروتون (١٠% حامض الأبسيسك) منفردا او مشتركا بتركيز ما بين ٢٥٠ إلي ٥٠٠ جزء فى المليون مع أو بدون استخدام حامض الخليك أو حمض الفوسفوريك فعالا فى تحسين صفة تلوين الحبات وخصائص الجودة الكيميائية للحبات وذلك بالمقارنة بمعاملة الكونترول وقد تفوق استخدام الايثرل عن استخدام البروتون فى تبكير النضج وتحسين التلوين وخصائص الجودة الكيميائية للحبات وكان استخدام الاثنان أفضل من استخدام أى منهما بمفرده فى هذا الصدد.

كانت أفضل معاملة هى التى تضمنت رش عناقيد العنب الفليم سيدلس بالايثرل والبروتون (١٠%حامض الأبسيسك) بتركيز ٢٥٠ جزء فى المليون لكل منهما مع استخدام حامض الفوسفوريك بتركيز ٢٠٠٠ جزء فى المليون.

Table 1. Effect of single and combined applications of Ethrel, Proton and acetic and phosphoric acids on the maturation date, yield/vine/Kg and percentage of berries colouration of Flame seedless grapevines during 2015 and 2016 seasons

Treatment	Maturation date		Yield/vine/(Kg)		Berries colour-ation (%)	
	2015	2016	2015	2016	2015	2016
1. Control	June 25	June 27	8.5	8.8	65.3	66.0
2. Proton at 250 ppm	June 22	June 23	8.4	8.8	66.4	67.0
3. Proton at 500 ppm	June 20	June 20	8.4	8.9	67.0	67.7
4. Ethrel at 250 ppm	June 18	June 16	8.3	8.8	68.9	70.0
5. Ethrel at 500 ppm	June 16	June 14	8.3	8.8	69.0	70.3
6. Proton + Ethrel at 250 ppm	June 14	June 12	8.3	8.8	70.9	72.9
7. Proton + Ethrel at 500 ppm	June 12	June 10	8.2	8.7	71.0	73.0
8. Proton at 250 ppm + Acetic acid	June 22	June 23	8.2	8.7	66.4	67.1
9. Proton at 500 ppm + Acetic acid	June 20	June 20	8.2	8.7	67.1	67.8
10. Ethrel at 250 ppm+ Acetic acid	June 18	June 16	8.2	8.7	69.0	70.0
11. Ethrel at 500 ppm+ Acetic acid	June 16	June 14	8.2	8.7	69.0	70.4
12. Proton + Ethrel at 250 ppm+ Acetic acid	June 14	June 12	8.2	8.7	71.0	73.0
13. Proton + Ethrel at 500 ppm+ Acetic acid	June 12	June 10	8.2	8.7	71.0	73.0
14. Proton at 250 ppm + Phosphoric acid	June 20	June 18	8.1	8.7	72.9	74.1
15. Proton at 500 ppm + Phosphoric acid	June 18	June 16	8.1	8.7	73.0	74.2
16. Ethrel at 250 ppm+ Phosphoric acid	June 15	June 13	8.1	8.7	75.9	77.0
17. Ethrel at 500 ppm+ Phosphoric acid	June 13	June 11	8.1	8.7	76.0	77.3
18. Proton + Ethrel at 250 ppm+ Phosphoric acid	June 10	June 8	8.1	8.7	81.9	82.9
19. Proton + Ethrel at 500 ppm+ Phosphoric acid	June 7	June 6	8.1	8.7	82.0	83.0
New L.S.D at 5%	---------	---------	NS	NS	0.8	0.9

Assiut J. Agric. Sci., (48) No. (3) 2017 (150-159) ISSN: 1110-0486
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Table 2. Effect of single and combined applications of Ethrel, Proton and acetic and phosphoric acids on the berry weight and percentages of total soluble solids and reducing sugars in the berries of Flame seedless grapevines during 2015 and 2016 seasons

Treatment	Berry weight (g.)		T.S.S. %		Reducing sugars %	
	2015	**2016**	**2015**	**2016**	**2015**	**2016**
1. Control	2.99	3.04	17.1	16.9	15.2	14.9
2. Proton at 250 ppm	3.00	3.04	17.8	17.6	15.8	15.6
3. Proton at 500 ppm	3.00	3.04	18.0	17.7	15.9	15.7
4. Ethrel at 250 ppm	3.01	3.04	18.7	18.6	16.6	16.7
5. Ethrel at 500 ppm	3.02	3.04	18.8	18.7	16.7	16.8
6. Proton + Ethrel at 250 ppm	3.03	3.04	19.6	19.5	17.1	17.6
7. Proton + Ethrel at 500 ppm	3.03	3.04	19.7	19.6	17.1	17.6
8. Proton at 250 ppm + Acetic acid	3.03	3.03	17.9	17.6	15.9	15.6
9. Proton at 500 ppm + Acetic acid	3.03	3.03	18.1	17.7	16.0	15.7
10. Ethrel at 250 ppm+ Acetic acid	3.02	3.02	18.7	18.6	16.6	16.7
11. Ethrel at 500 ppm+ Acetic acid	3.02	3.02	18.8	18.7	16.7	16.8
12. Proton + Ethrel at 250 ppm+ Acetic acid	3.02	3.02	19.7	19.5	17.1	17.6
13. Proton + Ethrel at 500 ppm+ Acetic acid	3.02	3.02	19.8	19.6	17.1	17.7
14. Proton at 250 ppm + Phosphoric acid	3.02	3.02	20.0	20.5	17.7	18.4
15. Proton at 500 ppm + Phosphoric acid	3.02	3.02	20.3	20.6	17.8	18.5
16. Ethrel at 250 ppm+ Phosphoric acid	3.01	3.02	21.0	21.4	18.5	19.1
17. Ethrel at 500 ppm+ Phosphoric acid	3.01	3.02	21.3	21.5	18.6	19.1
18. Proton + Ethrel at 250 ppm+ Phosphoric acid	3.01	3.02	22.0	22.3	19.1	19.7
19. Proton + Ethrel at 500 ppm+ Phosphoric acid	3.01	3.02	22.1	22.3	19.2	19.8
New L.S.D at 5%	**NS**	**NS**	**0.6**	**0.7**	**0.5**	**0.6**

Table 3. Effect of single and combined applications of Ethrel, Proton and acetic and phosphoric acids on the percentage of total acidity, T.S.S./acid and total anthocyanins (mg/100g F.W) in the berries of Flame seedless grapevines during 2015 and 2016 seasons

Treatment	Total acidity %		T.S.S./acid		Total anthocyanins (mg/100 g F.W)	
	2015	2016	2015	2016	2015	2016
1. Control	0.684	0.676	25.0	25.0	17.1	17.0
2. Proton at 250 ppm	0.660	0.657	27.0	26.8	18.2	19.1
3. Proton at 500 ppm	0.658	0.655	27.4	27.0	18.3	19.2
4. Ethrel at 250 ppm	0.633	0.635	29.5	29.3	19.5	20.4
5. Ethrel at 500 ppm	0.631	0.634	29.8	29.5	19.6	20.5
6. Proton + Ethrel at 250 ppm	0.604	0.607	32.5	32.1	20.7	21.6
7. Proton + Ethrel at 500 ppm	0.603	0.606	32.7	32.3	20.8	21.7
8. Proton at 250 ppm + Acetic acid	0.659	0.657	27.2	26.8	18.2	19.2
9. Proton at 500 ppm + Acetic acid	0.657	0.655	27.5	27.0	18.3	19.3
10. Ethrel at 250 ppm+ Acetic acid	0.633	0.635	29.5	29.3	19.5	20.5
11. Ethrel at 500 ppm+ Acetic acid	0.631	0.634	29.8	29.5	19.7	20.6
12. Proton + Ethrel at 250 ppm+ Acetic acid	0.603	0.606	32.7	32.2	20.8	21.6
13. Proton + Ethrel at 500 ppm+ Acetic acid	0.602	0.605	32.9	32.4	20.9	21.7
14. Proton at 250 ppm + Phosphoric acid	0.580	0.589	34.5	34.8	22.0	23.0
15. Proton at 500 ppm + Phosphoric acid	0.579	0.588	35.1	35.0	22.1	23.1
16. Ethrel at 250 ppm+ Phosphoric acid	0.560	0.564	37.5	37.9	23.4	24.5
17. Ethrel at 500 ppm+ Phosphoric acid	0.559	0.563	38.1	38.2	23.5	24.6
18. Proton + Ethrel at 250 ppm+ Phosphoric acid	0.540	0.542	40.7	41.1	24.7	25.9
19. Proton + Ethrel at 500 ppm+ Phosphoric acid	0.539	0.540	41.0	41.3	25.0	26.0
New L.S.D at 5%	**0.014**	**0.013**	**1.1**	**1.4**	**0.9**	**1.0**