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Effect of Dormex, Fructose and Methionine Spraying on Bud Dormancy Release of "Superior" Grapevines

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Abstract

This study was carried out during the two successive seasons 2015 and 2016 on 13 years old "Superior" grapevines to study the effect of spraying fructose (3, 5%), methionine (3, 5%) and hydrogen cyanamide 5% (Dormex) on bud dormancy release of "Superior" grapevines. Cyanamide is frequently used for grape bud dormancy release. However, those chemicals are potentially harmful to humans. In this study, we used substances that are less toxic to the environment and grape growers, such as fructose and methionine to determine their effects on "Superior" grape bud break. All treatments significantly improved the percentage of bud break, fruiting buds and yield, as well as the advancement of the harvest date and improving the berry quality compared to untreat ones (control). Also, all treatments induce gradually increased bud contents of IAA and GA_3 and a gradual decrease of ABA from treated date towards buds burst compared to untreated ones. Dormex spraying gave the highest values of studied traits compared to other treatments. No significant differences were found among 5% dormex and 3% fructose spraying. Hence, 3% fructose shows potential for use as a commercial bud break and improves superior grapes fruiting.

Keywords: *Dormancy, Grapevines, Fructose, Methionine, Dormex.*

Introduction

Grape is the most important fruit crop in the world. It is considered as one of the most popular fruit crop in Egypt. Warm winters in many regions often limit the productivity of grape because of insufficient winter chilling (George and Nissen, 1990 and El-Salhy, 2002). Under these conditions, lack of winter chilling may result in uneven and irregular bud burst as well as increment of dormant buds, reduction of flower buds, extended flowering and delayed fruit maturity (George and Nissen, 1990; El-Sese and Mohamed, 2003 and Mohamed and Omran, 2004).

Bud dormancy in woody perennials is a complex process that enables plants to survive long periods of adverse conditions, including the extremes of drought, cold and heat, and is characterized by growth cessation, arrest of cell division, and reduced metabolic and respiratory activity (Arora *et al*., 2003). During dormancy, visible growth is suspended but developmental changes can still occur (Saure, 1985) and buds are physiologically and biochemically active. Numerous physiological changes such as respiration rate, growth regulators, carbohydrate metabolism, water content and other compounds that thought to be involved in dormancy release were estimated to analyze the control of dormancy (Trejo-Martinez *et al*., 2009). Many investigations have been conducted to artificially interrupt the dormancy in grapevines with synthetic chemicals (Shulman *et al*., 1983; Lin and Wang, 1985; Nir *et al*., 1988; Zelleke and Kliewer, 1989; Dookoozlian and Williams, 1995). Among such products, hydrogen cyanamide (H_2CN_2) has been the most effective bud breaking agent for field use (Zelleke and Kliewer, 1989; El-Sabrout, 1998 and El-Salhy, 2002). It was very effective and leads to early and vigorous vegetative growth. Spraying dormex significantly increased the endogenous bud IAA and giberellic acid contents, and significantly reduced bud ABA contents compared to the control. Spraying with dormex (5%) gave the highest bud burst, yield and berry quality of grape cv. Flame Seedless (El-Sabrout, 1998). Those cyanamides are known to have a negative impact on grape growers' health and the environment. Nevertheless, these bud breaking inducing agents are not authorized for use in organic cultivation (Settimi *et al*., 2005). Hence, there is an urgent need to develop dormancy release agents that pose no health risks to humans and for organic farming products.

Sugar and methionine, may be utilized as bud break agents as they are safer than cyanamides. The sugar shows no toxic effects or mutagenicity and is a component of human food (Matsuo and Izumori, 2006). Methionine has been found to have no adverse effects on the human body (Garlick, 2006). The sugar improved the percentage of bud break when applied at 1% concentration. When the concentration was increased to 3%, percentage, bud break was increased. On the other hand, methionine induces bud break and slightly improved bud break at 3% concentration compared to control (Madhab *et al*., 2011).

The objective of this study was to examine the effect of environmentally friendly compounds, such as fructose sugar and methionine, on the bud dormancy release and fruiting of Superior grapevines growing under hot climates.

Materials and Methods

This study was carried out during 2015 and 2016 seasons on 54 uniforms in vigour 13-years old Superior grapevines soil grown in sandy soil at Assiut Agriculture Research Station, ARC, Assiut Governorate. All the selected vines are planted at 1.75x2.75 m apart. The vines were pruned during the 1st week of January for the two seasons of the study leaving 84 eyes on the basic of 6 fruiting canes x 12 eyes plus 6 renewal spurs x 2 eyes with the assistance of double T and irrigated by flooding irrigation system. All the selected vines received regular and horticultural practices that already applied in the vineyard except those dealing with using dormancy breakages. This study included the following six treatments, as follows:

1- Spraying with water (control).

2- Spraying with 5% hydrogen cyanamide (Dormex).

3- Spraying with 3% methionine.

4- Spraying with 5% methionine.

5- Spraying with 3% fructose.

6- Spraying with 5% fructose.

The experiment was designed as randomized complete block design (RCBD) with three replicates for each treatment, one vine per each.

Tap water was used for dilution and Triton B was applied at 1% to all spray solutions as a wetting agent. Foliar spray was carried out using a hand sprayer until drop point to dormant buds. All treatments were applied once at 2nd January.

During both seasons, the following measurements were determined:

1-Date of bud burst and its percentage: Date of bud burst was recorded and then the number of bursted out buds/vine was recorded, then the percentage was calculated by dividing the number of bud burst/vine by the total number of buds per vine which is left at pruning at weekly intervals along the bursting period.

2-Yield components and berry quality: All harvest dates, the yield per vine was recorded in terms of weight (kg) and number of cluster. Harvest date per treatment at least TSS reached 14% was recorded. Percentage of shot berries and weight of 25 berries and berry dimension were recorded. Berry chemical quality in terms of TSS, total acidity, TSS/acid ratio and reducing sugars were determined as outlined in A.O.A.C. (2000).

3-Bud hormonal content: Bud samples were collected, 15-days intervals, beginning from 7 January up to 18 February for determining the metabolic changes in the hormonal content in buds. Buds were randomly sampled and immediately transported to the laboratory. Bud samples were taken from each vine of each treatment and were analyzed for endogenous levels of gibberelic acid (GA_3), indole-3-acetic acid (IAA) and abscisic acid (ABA). The extraction and purification were made following the method of Kettner and Doerffling (1995).

Samples (1.0 g) were collected, from each treatment, and homogenized, at 4°C, in 80% methanol containing 0.1 g l^{-1} an antioxidant, butylated hydroxyl toluene (BHT). They were extracted at 4°C in dark for 72 h with subsequent change of solvent. The extracted samples were centrifuged and the supernatant was reduced to aqueous phase using rotary thin film evaporator (RFE). The pH of aqueous phase was adjusted to 2.5-3.0 and partitioned three times with $^{1}/_{3}$ volume of ethyl acetate. The ethyl acetate phase was dried down completely using RFE. The dried sample was re-dissolved in 1 ml of methanol (100%) and was analyzed on HPLC (Shimadzu, C-R4A Chromatopac; SCL-6B system controller) using UV detector and C_{18} column (39x300 mm). For identification of hormones, 100 µl samples filtered through 0.45 Millipore filters were injected into column. Pure IAA and GA_3 (Sigma, USA) were used as standards for identification and quantification of these hormones. The identification was made on the basis of retention time and peak area of the standards. Methanol, acetic acid and water (30:1:70, respectively) were used as a mobile phase. The flow rate was adjusted at 0.5 ml min^{-1} with an average time for 15 min $sample^{-1}$.

The wave length used for the detection of IAA was 280 nm, while for GA_3 was 254 nm. For ABA, samples were injected onto a C_{18} column and eluted with a linear gradient of methanol (30-70%), containing 0.01% acetic acid, at a flow rate of 0.8 ml min^{-1}. The retention time of ABA was determined by using authentic standards, monitoring the elution of standard at 254 nm.

Statistical analysis was done (Mead *et al.*, 1993) and treatments means were compared using new L.S.D.

Results

Environmental conditions:

Data of monthly temperatures and relative humidity as average during the two seasons of this study are presented in Table (1). During the two experimental seasons the mean monthly temperature ranged from 16.60 & 15.25°C in December to 18.50 & 19.80°C in Marsh, which is insufficient for winter chilling to overcome dormancy. In this regard, Weaver (1976) reported that grapes usually require a winter rest period of about 2 months, with an average daily mean temperature below 50°F (10°C), which mean insufficient cold. Thus, artificial means to compensate the lack of natural chilling becomes a dominant tool to produce economic grape yield in warm winter regions (Poni *et al.*, 1990).

Table 1. Monthly weather, maximum, minimum and mean of temperature and relative humidity of 2014/2015 and 2015/2016 seasons.

Month	2014/2015				2015/2016			
	Temperature (°C)			Relative humidity	Temperature (°C)			Relative humidity
	Max.	Min.	Mean		Max.	Min.	Mean	
Nov.	27.6	13.4	20.5	55.0	28.0	13.4	20.7	53.0
Dec.	22.4	10.8	16.6	64.0	23.1	7.4	15.25	62.0
Jan.	20.0	5.4	12.7	62.5	23.8	8.0	15.9	65.0
Feb.	23.2	10.2	16.7	66.0	26.2	7.0	16.6	67.0
Mar.	26.8	10.2	18.5	59.5	26.2	13.4	19.8	56.0
Apr.	25.8	10.0	17.9	55.5	33.4	12.4	22.9	52.5

After, Assiut Weather Station.

Behaviour of buds:

The effect of dormex, methionine and fructose spraying on bud burst and fruiting buds percentage and date of bud burst of Superior grapevines during 2015 and 2016 seasons are shown in Table (2). As a general view it can noticed that all treatments significantly increased the percentage of bud burst and fruiting buds, as well as the advancement of bud bust and blooming over the check treatment (control). Using dormex or fructose was significantly superior to use methionine in breaking dormancy and enhancing percentage of bud break and fruiting buds. The highest bud burst percentages (63.30 & 67.66%) were recorded on the vines that received dormex at 5%, followed by fructose at 3% spraying (58.00 & 61.33%). The fruiting buds percentage were 50.33 & 51.66% and 46.66 & 47.33% due to dormex at 5% and fructose at 3% spraying during the two studied seasons, respectively.

The corresponding date of bud burst was 20 & 19 Feb. and 19 & 20 Feb., respectively. On other hand, untreated vines had reduced percentages of bud burst (40.33 & 45.00%) fruiting buds (32.00 & 33.66%) and delayed bud burst (18 & 20 Mar.) during the two studied seasons, respectively.

The increment of bud burst percentage were 56.96 & 50.36% and 43.81 & 36.28%, fruiting bud percentage were 57.28 & 53.48% and 45.81 & 40.61% and bud burst was advanced by 26 & 30 days and 27 & 30 days due to dormex and fructose at 3% spraying compared to unsprayed vines during the two studied seasons, respectively.

Table 2. Effect of dormex, fructose and methionine spraying on bud behavior and date of bud burst of superior grapevines during 2015 and 2016 seasons.

Treatment	Bud burst %		Fruiting buds %		Date of bud	
	2015	2016	2015	2016	2015	2016
Control	40.33	45.00	32.00	33.66	18 Mar.	20 Mar.
Dormex 5%	63.30	67.66	50.33	51.66	20 Feb.	19 Feb.
Fructose 3%	58.00	61.33	46.66	47.33	19 Feb.	20 Feb.
Fructose 5%	53.33	58.33	43.66	40.00	24 Feb.	22 Feb.
Methionine 3%	52.66	59.33	41.00	38.33	23 Feb.	28 Feb.
Methionine 5%	45.33	51.33	40.00	44.66	20 Feb.	23 Feb.
LSD at 5%	2.89	2.74	2.69	2.40		

Yield components:

Data in Table (3) illustrated the effect of different breaking dormancy treatments on number of cluster, cluster weight and yield of superior grapevines during 2015 and 2016 seasons.

All breacking dormancy treatments significantly increased the number and weight of cluster, consequently significantly increased yield/vine compared to unspray ones (control) in both the two studied seasons. Dormex or fructose at 3% was most effective compared to other treatments. No significant promotion was detected among dormex and fructose at 3%. From economical point of view, the heaviest yield was on vines that sprayed with dormex (8.36 & 8.85 kg/vine) and fructose at 3% (8.43 & 8.38 kg/vine) during the two studied seasons, respectively. The untreated vines produced the lighest ones (5.78 & 6.16 kg/vine) in both seasons, respectively. Then, the increment percentage of yield/vine were 44.64 & 43.67% and 45.85 & 36.04% due to dormex and fructose at 3% spraying compared to unsprayed ones, during the two studied seasons, respectively.

In addition, date in the previous table indicated that spraying dormex, fructose or methionine cause advancing of harvesting date over unsprayed ones (control). The best advanced harvesting date was presented on vines that received dormex or fructose at 3% where, they were harvested about three weeks early compared to control. Other treatment advanced the harvest date about two weeks.

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Table 3. Effect of dormex, fructose and methionine spraying on number of cluster, cluster weight, yield and harvesting date of superior grapevines during 2015 and 2016 seasons.

Treatment	Number of cluster		Cluster weight (g)		Yield (kg/vine)		Harvesting date	
	2015	2016	2015	2016	2015	2016	2015	2016
Control	17.66	20.00	326.33	308.00	5.78	6.16	2 July	4 July
Dormex 5%	23.33	26.18	361.33	348.35	8.36	8.85	11 Jun.	10 Jun.
Fructose 3%	22.66	25.33	373.33	341.80	8.43	8.38	15 Jun.	12 Jun.
Fructose 5%	21.80	23.80	352.33	328.33	7.85	7.68	20 Jun.	17 Jun.
Methionine 3%	21.00	23.33	349.60	324.00	7.51	7.65	20 Jun.	20 Jun.
Methionine 5%	21.50	24.70	358.30	334.66	7.66	8.14	16 Jun.	18 Jun.
LSD at 5%	1.68	1.50	15.65	11.81	0.90	0.58		

Berry quality:

Data in Tables (4 & 5) clearly show that spraying any rest breakages significantly increased weight, length and width of berry, whereas, it was significantly reduced the shot berries percentage over the unsprayed ones (control). However, with regarding to the chemical characteristics of the berries, dormex, fructose and methionine they were significantly enhaned the TSS, TSS/acid ratio and reducing sugars percentage and decreased the total acidity over the control. The best improvement of berry quality was associated with dormex or fructose at 3% spraying. No significant improving was detected among dormex or fructose at 3% spraying. The heaviest twenty five berry weight were 82.75 & 81.20 and 84.25 & 80.44 g due to dormex and fructose at 3% spraying, respectively, against (73.60 & 71.85 g) on unsprayed ones, during the two studied seasons, respectively. Hence, the corresponding increment percentage of berry weight were (12.43 & 13.01%) and (14.47 & 11.19%) compared to control, respectively.

On other hand, the lowest shot berries % was (3.16 & 3.67) and (3.30 & 3.88%) due to dormex and fructose at 3% spraying, against (9.84 & 10.23%) on unsprayed ones during the two studied seasons, respectively. Thus, the corresponding reduction percentage reached (67.89 & 64.13%) and (66.46 & 62.07%), respectively.

Also, the highest values of TSS/acid ratio were 33.33 & 33.07 and 30.15 & 29.38 due to dormex and fructose at 3% spraying, against (22.66 & 22.49) on unsprayed ones, during the two studied seasons, respectively. The corresponding increment percentage of TSS/acid were (47.09 & 41.62) and (33.05 & 30.64) compared to control, respectively.

Table 4. Effect of dormex, fructose and methionine spraying on the weight of 25 berries, shot berries %, berry length and berry width of superior grapes during 2015 and 2016 seasons.

Treatment	25 berry weight (g)		Shot berries %		Berry length (cm)		Berry width (cm)	
	2015	2016	2015	2016	2015	2016	2015	2016
Control	73.60	71.85	9.84	10.23	1.74	1.39	1.70	1.35
Dormex 5%	82.75	81.20	3.16	3.67	1.91	1.55	1.87	1.50
Fructose 3%	84.25	80.42	3.30	3.88	1.95	1.53	1.90	1.49
Fructose 5%	80.22	77.78	4.10	4.82	1.86	1.48	1.85	1.46
Methionine 3%	80.50	78.00	3.89	4.88	1.86	1.48	1.88	1.46
Methionine 5%	81.55	79.30	3.66	4.34	1.88	1.51	1.84	1.48
LSD at 5%	3.68	2.92	0.61	0.86	0.09	0.07	0.10	0.10

Table 5. Effect of dormex, fructose and methionine spraying on some chemical properties of superior grapes during 2015 and 2016 seasons.

Treatment	TSS %		Total acidity %		TSS/acid		Reducing sugar %	
	2015	2016	2015	2016	2015	2016	2015	2016
Control	14.46	14.73	0.638	0.655	20.66	22.49	11.43	11.29
Dormex 5%	17.40	17.20	0.522	0.540	33.33	31.85	13.96	13.53
Fructose 3%	16.28	16.10	0.540	0.548	30.15	29.38	12.95	12.32
Fructose 5%	15.84	15.44	0.581	0.584	27.26	26.44	12.68	12.08
Methionine 3%	15.62	15.48	0.587	0.603	26.61	25.67	12.44	12.11
Methionine 5%	16.22	15.90	0.565	0.582	28.71	27.32	12.76	12.30
LSD at 5%	0.46	0.39	0.033	0.038	3.26	3.81	0.56	0.64

Bud hormonal content:

Data in Table (6) and Figure (1) showed the effect of dormex, methionine and fructose spraying on bud hormonal content. In a general view, it can be seen that all treatments induced a gradually significant increase in the contents of indole-3-acetic acid (IAA) and gibberellic acid (GA_3) and gradually significant decrease in abscisic acid (ABA) in buds of "Superior" grapevines from treated date towards to bud burst as compared with the vines that were sprayed with tap water (control). The obtained bud contents of IAA and GA_3 with dormex or fructose 3% surpassed their contents recorded with all other treatments in all the sampled dates. Maximum contents of IAA and GA_3 were obtained from buds treated with dormex, collected in 18 February, while minimum contents were recorded on untreated buds, sampled in 7 January. For ABA, the opposite situation was found. Maximum contents of IAA and GA_3 and minimum of ABA were obtained from buds treated with dormex, while minimum and maximum contents were obtained from unsprayed vines (control), respectively. No significant differences were detected among dormex and fructose at 3% effects.

Table 6. Effect of dormex, fructose and methionine spraying on hormonal content of buds of superior grapevines during 2015 and 2016 seasons.

Treatment	Sample date							
	2015	2016	2015	2016	2015	2016	2015	2016
	7 Jan.		21 Jan.		4 Feb.		18 Feb	
Indole acetic acid (IAA) (µg g^{-1} DW)								
Control	0.553	0.571	0.746	0.768	0.883	0.918	0.966	0.993
Dormex 5%	0.876	0.912	1.010	1.054	1.236	1.256	1.910	1.953
Fructose 3%	0.796	0.811	0.938	0.973	1.148	1.188	1.756	1.864
Fructose 5%	0.718	0.765	0.870	0.961	1.057	1.089	1.672	1.708
Methionine 3%	0.740	0.768	0.875	0.908	1.006	1.038	1.640	1.689
Methionine 5%	0.760	0.794	0.853	0.886	0.998	1.029	1.486	1.516
LSD at 5%	0.114	0.108	0.092	0.104	0.106	0.093	0.168	0.118
Gibberellic acid (GA) (µg^{-1} DW)								
Control	0.643	0.660	0.718	0.740	0.940	0.966	0.933	0.952
Dormex 5%	0.860	0.886	0.920	0.947	1.171	1.198	1.190	1.215
Fructose 3%	0.783	0.804	0.897	0.922	1.152	1.187	1.140	1.138
Fructose 5%	0.756	0.788	0.833	0.859	1.030	1.063	1.066	1.083
Methionine 3%	0.748	0.781	0.886	0.916	1.058	1.086	1.082	1.108
Methionine 5%	0.806	0.836	0.857	0.882	1.089	1.182	1.130	1.152
LSD at 5%	0.102	0.115	0.110	0.093	0.083	0.089	0.077	0.121
Abscisic acid (ABA) (µg g^{-1} DW)								
Control	2.033	1.998	3.100	3.025	2.200	2.181	1.333	1.312
Dormex 5%	1.716	1.689	2.500	2.450	1.733	1.698	0.966	0.948
Fructose 3%	1.600	1.582	2.533	2.480	1.503	1.476	0.979	0.966
Fructose 5%	1.766	1.726	2.566	2.486	1.900	1.873	1.066	1.049
Methionine 3%	1.603	1.575	1.963	1.925	1.883	1.859	1.001	0.984
Methionine 5%	1.620	1.598	2.510	2.478	1.850	1.824	0.992	0.968
LSD at 5%	0.253	0.262	0.384	0.352	0.277	0.264	0.308	0.234

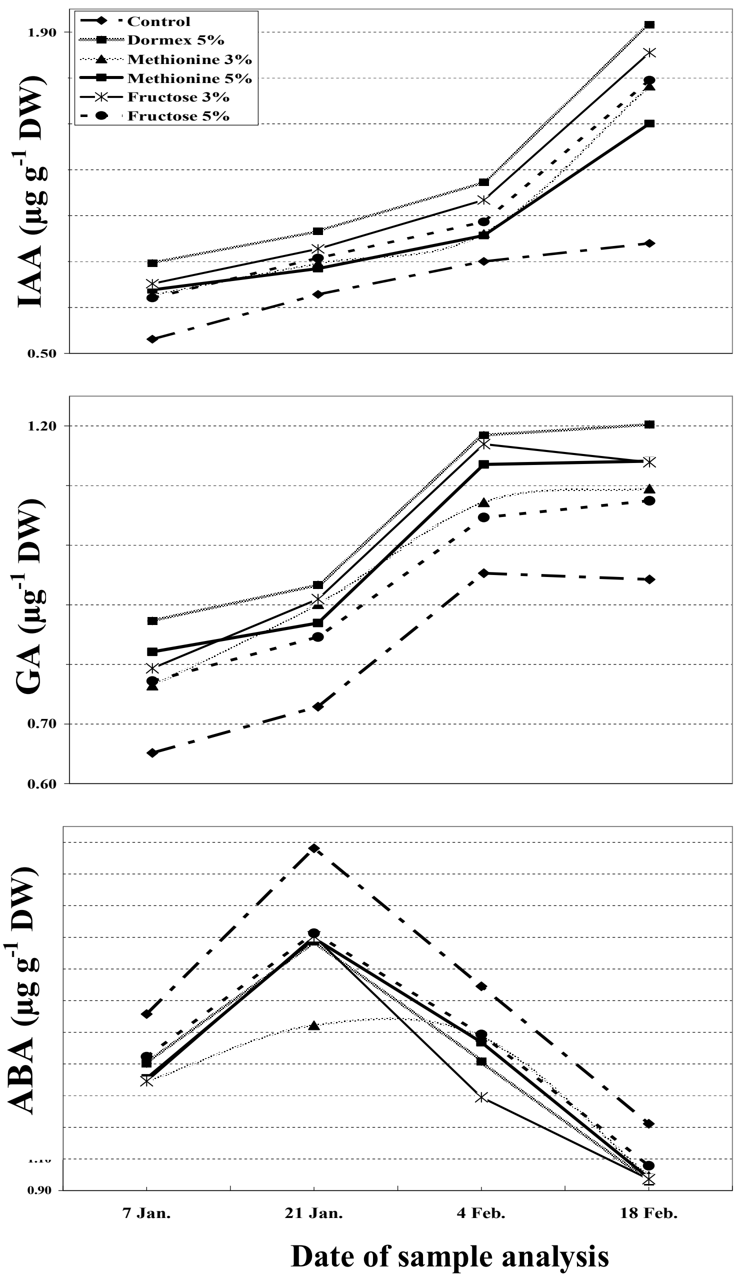

Fig. 1. Effect of dormex, fructose and methionine spraying on hormonal content of buds of superior grapevines, as mean of 2015 and 2016 seasons.

Discussion

Many changes in some chemical components in floral buds, particularly the contents of endogenous hormones (IAA, GA_3 and ABA) found to occur for playing a vital role in regulating dormancy and bud break. Several studies focused on the relationship between the endogenous hormones and/or amino acids and dormancy in buds (El-Sabrout, 1998; El-Sese and Mohamed, 2003 and Seif El-Yazal *et al*., 2012). Endogenous hormones help plants to respond to the environmental signals (Horvath *et al*., 2003). Endogenous gibberellins (GA's) play a role in many developmental processes and have been proved to participate in the regulation of dormancy (Wang *et al*., 2006). The present results showed that growth-promoting hormones (GA_3 and IAA) found to be gradually increased, but growth-inhibiting hormones (ABA) decreased during bud break (Table 6). This suggested that higher IAA and GA_3 contents and lower ABA content were needed for release of "Superior" grapevine buds from dormancy.

The positive action of dormex on breaking dormancy and fruiting is mainly attributed to its effect in removing buds scales, reducing ABA, catalase, reduced and oxidized glutathione and enhancing free water, IAA, GA_3, cytokinins, soluble sugars, amino acids, total indoles, oxidative stress, H_2O_2, total free polyamines and respiratory key enzymes activities (Wood, 1983 and Seif-El-Yazal and Rady, 2013). The decrease in ABA level as the chilling accumulation is increased in some grape cultivars. Hence, it is likely that the sugars might influence ABA metabolism, which subsequently affected the bud dormancy (Poudel, 2008). Also, methionine may induce bud break through the production of ethylene that is considered to affect dormancy release in plant species (Keegan *et al*., 1989).

In addition, the increasing of yield may be due to the effect of treatments in increasing the percentage of fruiting buds, Table (2) surely reflects the increasing of the number of cluster per treated vine which consequently increased the yield/vine. As well as, the effects of dormex and fructose on improving berry quality that could be mainly due to its effect on advancing bud burst and consequently all subsequent stages of early growth cycle and advancing maturity.

The results revealed that sugars may be used as bud break agents for breaking grape bud dormancy. Hence, 3% fructose solution showed a potential for use as a commercial bud break agent in the future.

The results in this connection were in agreement with those obtained by George and Nissen (1990), El-Sabrout (1998), El-Salhy (2002), Chaiwat *et al*. (2008), Sabry, Gehan *et al*. (2011), Madhab *et al*. (2011), Hatem *et al*. (2012), Seif El-Yazal and Rady (2013), Ahmed *et al*. (2014).

Conclusion

The best results with regard to breaking bud dormancy and improving yield and quality of "Superior" grapevines were obtained with spraying either dormex at 5% or fructose at 3%.

Such results revealed that sugar may be used as a bud break agent for breaking grape bud dormancy. Solution of fructose at 3% had the greatest bud break inducing ability. Hence, 3% fructose solution shows potential for use as a commercial bud break.

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تأثير رش الدورميكس والفركتوز والميثونين علي كسر سكون براعم شجيرات العنب السوبريور

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الملخص

أجريت هذه الدراسة خلال موسمي ٢٠١٥ ، ٢٠١٦ علي شجيرات العنب السوبريور عمر ١٣ سنة والمنزرعة بالمزرعة البحثية لمركز البحوث الزراعية – أسيوط. بهدف دراسة تأثير الرش بالدورميكس والفركتوز والمثيونين وذلك في بداية شهر يناير علي تفتح البراعم والمحصول وخصائص الحبات. أستخدم التركيز ٥% دورميكس ، ٣ ، ٥ % مثيونين ، ٣ ، ٥% فركتوز.

وأوضحت النتائج الآتي:

-أدت جميع المعاملات إلي زيادة نسبة تفتح البراعم وكذلك نسبة البراعم الزهرية مع تبكير موعد نضج الثمار مقارنة بالشجيرات الغير معاملة.

-سببت جميع المعاملات زيادة المحصول وتحسين خصائص العناقيد والحبات. وكانت أفضل المعاملات رش ٥% دورميكس. ولم تسجل فروق معنوية بين الرش بالدورميكس ٥% أو ٣% فركتوز.

-حدثت زيادة تدريجية في محتوي البراعم المعاملة لكل من أندول حمض الخليك وحمض الجبريليك. قابلها نقص تدريجي ومعنوي في حمض الأبسيسك.

من نتائج هذه التجربة يمكن التوصية بأهمية إستخدام محلول الفركتوز بتركيز ٣% ليكون بديلاً للمعاملة بالدورميكس وذلك لكسر سكون البراعم وتحسين تفتح البراعم وزيادة المحصول وتبكير النضج إضافة إلي المحافظة علي الشجيرات والبيئة.