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Effect of Concentration and Application Date of Hydrogen Cyanamide (Dormex) on Bud Behaviour, Growth and Productivity of Early Sweet Grapevines

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Abstract: This investigation was conducted for two successive seasons (2017 & 2018) in a private vineyard located at Matay district, Minia Governorate; to study effect of concentration and application date of hydrogen cyanamide (Dormex) on bud behaviour, growth and productivity of Early Sweet grapevines. The chosen vines were ten-year-old, grown in a sandy soil, spaced at 2 X 3 meters apart and irrigated by the drip irrigation system. The vines were pruned during the third week of December in both seasons of the study so as to maintain a load of 72 buds/vine (6 canes X 12buds/cane) and trellised by the Gable system. Two concentrations of Dormex (4 or 5%) were sprayed at four dates: December 25th, January 1st, January 8th and January 15th. The results showed that the best effective concentration of Dormex was 5%. The early Dormex application date (December 25th) increased the buds content of gibberellic acid (GA_3) and indole-3-acetic acid (IAA) with a decrease in abscisic acid (ABA), which reflected on the early date of bud burst, but it caused irregularities and a decrease in percentage of bud burst and consequently decreasing number of bunches and yield. Moreover, the late Dormex application date (January 15th) greatly increased percentage of bud burst and coefficient of bud fertility as a result of which average number of bunches and yield per vine were obviously increased. Dormex application at 5% during first week of January (January 1st & 8th) was recommended to achieve an early, uniform and high percentage of bud burst, in addition to, realizing reliable vegetative growth and economic yield and berries with fairly good quality. From the economical point of view, Dormex costs which seemed to be considerably high are actually compensated by the gained benefits from improved yield earliness and fruit quality.

Key words: Early Sweet grapevines · Dormex · Bud behavior · Growth · Productivity

INTRODUCTION

Early Sweet is earliest white seedless table grape cultivar successfully grown under Egypt conditions. Warm winters in many regions often limit the productivity of grape because of insufficient winter chilling requirement [1]. 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 [2].

Bud dormancy in deciduous fruit trees 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 [3]. During dormancy, visible growth is suspended but developmental changes can still occur and buds are physiologically and biochemically active [4].

There are three successive phases of bud dormancy in grapevines; paradormancy that is regulated by physiological factors within the plant but outside the dormant structure, endodormancy that is regulated by physiological factors within the bud itself and ecodormancy that is imposed by environmental factors after endodormancy release ending when warm temperatures cause eco dormant buds to burst [5].

Many investigations have been conducted to artificially interrupt the dormancy in grapevines with synthetic chemicals [6]. Among such products, Dormex has been the most effective bud breaking agent for field use [1].

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Dormex (49%hydrogen cyanamide) is one of the most effective dormancy breaking agents for the grape and many deciduous fruit species which leads to earlier and more uniform bud burst, earlier fruit setting and early fruit ripening [6]. The effectiveness of this chemical depends on rate and time of application, stage of bud development post application temperatures and amount of chilling accumulated [7, 8].

The mechanism by which Dormex exerts its dormancy-breaking effect is not clear, but it has been shown to inactivate catalase enzyme in grape buds shortly after its application, leading to the accumulation of hydrogen peroxide and the development of oxidative stress [9, 10].

Variable results have been obtained with hydrogen cyanamide, depending on the plant variety, timing of treatment, application rate, stage of bud development, method of application, latitude and weather conditions and even on the same variety, it may have no effect on bud development or promote, delay bud break or kill buds, depending on the concentration and time of application [11].

Grapevines treated with hydrogen cyanamide have been reported to exhibit early and more uniform bud break, flowering, ripening and advancing maturity and had higher yield of the fruit than the control [12]. The timing of application of hydrogen cyanamide remains a problem; early application will result in frequently uneven bud break, while late applications can lead to bud damage [13]. On the other hand, early studies have pointed out the efficient role of Hydrogen Cyanamide (HC) as a plant growth regulator that supplements chilling and causes earlier and more uniform bud-break, improves yield and ameliorates growth uniformity [14-17]. To date, no research work was available in the literature concerning the effect of Dormex on Early Sweet grape cultivar.

The ultimate goal of this investigation is to find out the best concentration and time of Dormex spray to obtain an early, uniform and high percentage of bud burst. In addition, it's effect on vegetative growth, yield and bunch quality of Early Sweet grapevines.

MATERIALS AND METHODS

This investigation was conducted for two successive seasons (2017 & 2018) in a private vineyard located at Matay district, Minia Governorate; to study effect of concentration and application date of hydrogen cyanamide (Dormex) on bud behaviour, growth and productivity of Early Sweet grapevines. The chosen vines were ten-year-old, grown in a sandy soil, spaced at 2 X 3 meters apart and irrigated by the drip irrigation system. The vines were pruned during the third week of December in both seasons of the study so as to maintain a load of 72 buds/vine (6canes X 12buds/cane) and trellised by the Gable system. One hundred and eight uniform vines were chosen. Each four vines acted as a replicate and each three replicates were treated by one of the used treatments.

Nine treatments were sprayed as follows:

- Dormex at 4% on December 25th
- Dormex at 5% on December 25th
- Dormex at 4% on January 1st
- Dormex at 5% on January 1st
- Dormex at 4% on January 8th
- Dormex at 5% on January 8th
- Dormex at 4% on January 15th
- Dormex at 5% on January 15th
- Tap water (Control)

The following parameters were determined to evaluate the tested treatments:

Bud Behaviour: Number of bursted out buds/vine was recorded, then the percentage was calculated by dividing number of bud burst per vine by the total number of buds per vine left at pruning at weekly intervals along the bursting period. Moreover, coefficient of bud fertility was calculated by dividing average number of bunches per vine by the total number of buds/vine according to Huglin [18] and Bessis [19].

Yield and Physical Characteristics of Bunches: Samples of nine bunches/vine were harvested at maturity when TSS reached about 16-17% according to Tourky *et al*. [20]. The following characteristics were recorded:

Yield/vine (kg) was determined by multiplying average bunch weight (g) X number of bunches/vine. Average bunch weight (g) and average bunch dimensions (length and width) (cm).

Physical Characteristics of Berries: Average berry weight (g) and average berry dimensions (length and diameter) (cm) were measured.

Chemical Characteristics of Berries: Total soluble solids in berry juice (TSS) (%) by hand refractometer and total titratable acidity as tartaric acid (%) were determined according to A.O.A.C. [21].

Morphological Characteristics of Vegetative Growth: At growth cessation, the following morphological determinations were carried out on four fruitful shoots / the considered vine:

Average shoot length (cm), average number of leaves/shoot and average leaf area (cm^2) of the apical 5th and 6th leaves was taken at full bloom using a CI-203- Laser Area-meter made by CID, Inc., Vancouver, USA. Coefficient of wood ripening was calculated by dividing length of the ripened part by the total length of the shoot according to Bouard [22].

Chemical Characteristics of Vegetative Growth

Leaf Content of Total Chlorophyll: Sample of leaves were taken from the apical 5th and the 6th leaves on the main shoot/vine during the first week of July and determined by using nondestructive Minolta chlorophyll meter SPAD 502 [23].

Cane Content of Total Carbohydrates: Sample of canes were taken at winter pruning (during the third week of December) and were determined according to Smith *et al.* [24].

Bud Content of Hormones: Sample of buds were taken during the fourth week of January for determining bud content of gibberellic 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 [25].

Experimental Design and Statistical Analysis: The complete randomized block design was adopted for this experiment. The statistical analysis of the present data was carried out according to Snedecor and Cochran [26]. Averages were compared using new L.S.D. values at 5% level [27].

RESULTS AND DISCUSSION

Dynamics of Bud Burst: Data illustrated in Figure (1) show that all Dormex concentrations at 4% and 5% hastened the beginning of bud burst and reached to 50% bud break than the untreated vines. No differences were noticed between 4% and 5% of Dormex concentrations with regard to 50% bud break. Concerning the effect of Dormex application date, early Dormex application (December 25th) advanced both first and 50 % bud break as compared with the other dates, however, Dormex application on December 25th had an earliness in the beginning of bud burst by about one week than the medium Dormex applications (January 1st or January 8th); two weeks than the late Dormex applications on (January 15th) and three weeks compared with the control in both seasons. Conclusively, control vines (water spray) were the last to commence bud break, the earliest bud break was shown by the earliest Dormex application date and the high Dormex concentration.

Earliness of bud burst with Dormex (hydrogen cyanamide H_2CN_2) applications may be due to its role in increasing rate of respiration, measured as CO_2 evaluation and by reducing catalase activity as mentioned by Schulman *et al*. [28], similar effects were reported by El-Shazly [7] and El-Mogy *et al*. [8] they found that spraying grapevines with Dormex markedly accelerated bud break and eliminated its irregularities to a large extent.

Bud Behaviour: As shown in Table (1), it is obvious that bud behaviour measurements expressed as bud burst (%) and coefficient of bud fertility were significantly affected by concentration and application date of Dormex in both seasons.

Bud Burst Percentage: Concerning the effect of concentration of Dormex application on percentage of bud burst, data revealed that spraying with high concentration of Dormex (5%) resulted in the highest significant percentage of bud burst, whereas water spray (control) induced significantly the least percentage of this one in both seasons.

The most remarkable increment of bud burst was obtained by the last application date (January 15th), while the least percentage of this one was attained by early application date (December 25th) in both seasons. The preference of late Dormex application in promoting bud burst percentage in comparison with early application date might be attributed to coincidence of deep (winter) dormancy of the buds at time of early application as suggested by Smit and Burnett [29].

Coefficient of Bud Fertility: The effect of treatments in this respect was found to go parallel with bud burst (%) which was appreciably increased as a result of the increase of bud burst (%). Spraying with Dormex at 5% on January 15th had significantly the highest coefficient of bud fertility, whereas the least value of this one was obtained by control in both seasons.

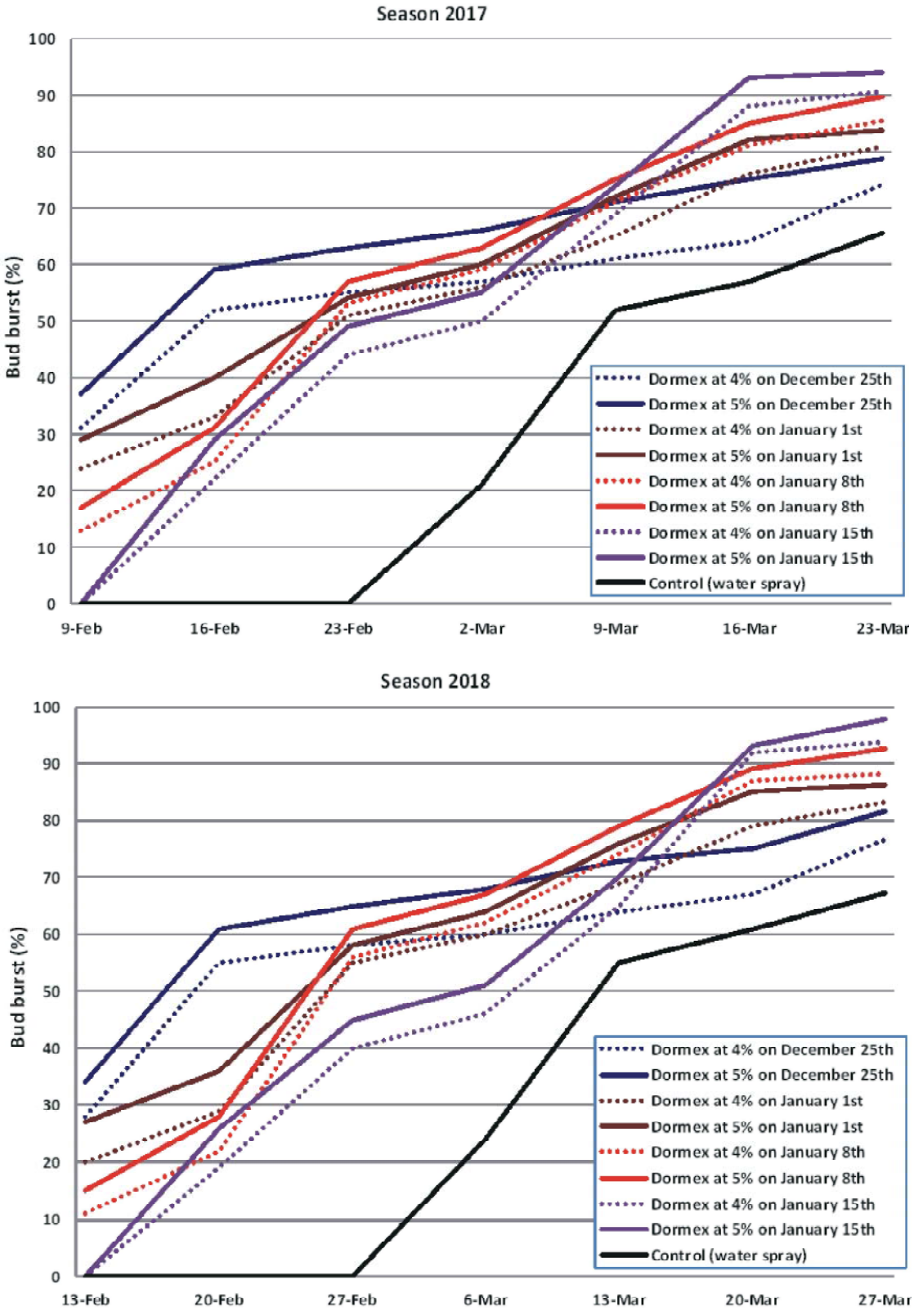

Fig. 1: Average weekly bud burst (%) as affected by different treatments

Table 1: Effect of concentration and application date of Dormex on bud burst (%) and Coefficient of bud fertility of Early Sweet grapevines in 2017 and 2018 seasons

	Bud burst (%)		Coefficient of bud fertility	
Treatments	2017	2018	2017	2018
Dormex at 4% on December 25th	74.2	76.7	0.38	0.41
Dormex at 5% on December 25th	78.7	81.6	0.39	0.42
Dormex at 4% on January 1st	80.9	83.3	0.41	0.44
Dormex at 5% on January 1st	83.6	86.3	0.42	0.45
Dormex at 4% on January 8th	85.4	88.2	0.44	0.47
Dormex at 5% on January 8th	89.8	92.7	0.45	0.48
Dormex at 4% on January 15th	90.7	93.9	0.46	0.50
Dormex at 5% on January 15th	94.1	97.7	0.47	0.51
Control (water spray)	65.6	67.2	0.36	0.39
New L.S.D. at (0.05)	3.3	3.7	0.01	0.02

Table 2: Effect of concentration and application date of Dormex on yield and bunch physical characteristics of Early Sweet grapevines in 2017 and 2018 seasons

	Yield/vine (kg)		No. of bunches		Average bunch weight (g)		Average bunch length (cm)		Average bunch width (cm)	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Dormex at 4% on December 25th	12.97	14.66	26.09	29.13	496.95	503.27	20.16	20.52	18.75	18.98
Dormex at 5% on December 25th	13.71	15.04	27.36	29.52	501.23	509.42	20.19	20.57	18.82	18.04
Dormex at 4% on January 1st	14.21	15.48	29.52	31.68	481.29	488.54	20.04	20.42	18.57	18.76
Dormex at 5% on January 1st	14.83	15.95	30.24	32.40	490.27	492.31	20.12	20.46	18.66	18.85
Dormex at 4% on January 8th	14.94	16.22	31.68	33.84	471.59	479.25	20.93	20.28	18.38	18.54
Dormex at 5% on January 8th	15.42	16.64	32.40	34.56	476.04	481.37	20.97	20.34	18.43	18.61
Dormex at 4% on January 15th	15.48	16.60	33.07	35.19	468.23	471.59	20.79	20.13	18.20	18.37
Dormex at 5% on January 15th	15.66	16.73	33.34	35.47	469.68	471.64	20.91	20.21	18.25	18.43
Control (water spray)	12.01	13.14	25.92	28.08	463.17	467.93	20.73	20.02	18.11	18.27
New L.S.D. at (0.05)	0.27	0.31	0.19	0.24	4.19	4.53	N.S.	N.S.	N.S.	N.S.

These results agree with those found by El-Shazly [7]; El-Mogy *et al.* [8]; Abo-ELwafa *et al.* [30] and Mohamed *et al.* [31]. They found that Dormex spray increased bud burst and bud fertility in many grape cultivars.

Yield and Physical Characteristics of Bunches: As shown in Table (2), it is obvious that yield and physical characteristics of bunch *i.e.* average of bunch weight, bunch length and bunch width were significantly affected by concentration and application date of Dormex in both seasons.

Data showed a significant increase in average number of bunches, yield per vine and average bunch weight with Dormex treatments as compared to control. It was found that Dormex application increased average number of bunches per vine (as a result of the increase in bud burst).

With regard to the effect of Dormex application date, it is clear that the yield increments were more pronounced with the late application date than the other application dates. Late application (January 15th) gave the highest number of bunches and yield followed in a descending order by medium application dates (January 1st & January 8th) and early application (December 25th). On the other hand, bunch weight showed a trend reverse to that of the number of bunches.

The effect of Dormex applications on bunch dimensions *i.e.* length and width was statistically insignificant.

From the previously mentioned results, it can be concluded that the effect of Dormex on increasing the yield per vine was gained as a result of its effect on increasing both number of bunches/vine and average bunch weight through increasing both bud burst (%) and bud fertility coefficient. The results in this connection are in agreement with those obtained by El-Shazly [7]; El-Mogy *et al*. [8]; Abo-ELwafa *et al.* [30] and Mohamed *et al.* [31]. They stated that Dormex application caused an obvious increase in the yield and improvement of bunch physical characteristics of some grape cultivars.

Now it is clear that, if early bud burst and consequently early harvesting is the aim of the grower, it is necessary to use early application date of Dormex. On the other hand, increasing the yield through increasing bud burst and fertility coefficient and consequently increasing number of bunches and yield could be achieved through late Dormex application date using a relatively high Dormex concentration (5%).

Table 3: Effect of concentration and application date of Dormex on physical properties of berries of Early Sweet grapevines in 2017 and 2018 seasons

	Average berry weight (g)		Average berry size (cm^3)		Average berry length (cm)		Average berry diameter (cm)	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018
Dormex at 4% on December 25th	4.49	4.58	4.39	4.51	2.34	2.37	1.98	2.01
Dormex at 5% on December 25th	4.53	4.61	4.43	4.54	2.37	2.39	2.01	2.03
Dormex at 4% on January 1st	4.37	4.45	4.25	4.38	2.30	2.34	1.93	1.97
Dormex at 5% on January 1st	4.43	4.54	4.32	4.45	2.31	2.35	1.94	1.98
Dormex at 4% on January 8th	4.27	4.38	4.17	4.29	2.28	2.31	1.91	1.95
Dormex at 5% on January 8th	4.32	4.43	4.21	4.35	2.29	2.33	1.93	1.96
Dormex at 4% on January 15th	4.12	4.19	4.01	4.13	2.21	2.24	1.87	1.91
Dormex at 5% on January 15th	4.23	4.32	4.13	4.22	2.25	2.29	1.90	1.92
Control (water spray)	4.09	4.17	3.98	4.09	2.19	2.23	1.86	1.89
New L.S.D. at (0.05)	0.03	0.02	0.02	0.01	0.03	0.02	0.02	0.01

Table 4: Effect of concentration and application date of Dormex on chemical properties of berries of Early Sweet grapevines in 2017 and 2018 seasons

	TSS (%)		Acidity (%)		TSS/acid ratio	
Treatments	2017	2018	2017	2018	2017	2018
Dormex at 4% on December 25th	16.89	16.85	0.38	0.36	44.45	46.80
Dormex at 5% on December 25th	16.94	16.89	0.35	0.34	48.40	49.68
Dormex at 4% on January 1st	16.75	16.57	0.43	0.39	38.95	42.50
Dormex at 5% on January 1st	16.81	16.70	0.41	0.38	41.01	43.96
Dormex at 4% on January 8th	16.49	16.48	0.45	0.41	36.92	40.19
Dormex at 5% on January 8th	16.68	16.57	0.44	0.40	37.92	41.44
Dormex at 4% on January 15th	16.22	16.27	0.47	0.44	34.51	36.98
Dormex at 5% on January 15th	16.38	16.40	0.46	0.43	35.60	37.91
Control (water spray)	16.09	16.13	0.49	0.46	32.83	35.06
New L.S.D. at (0.05)	0.04	0.03	0.02	0.01	2.91	2.87

Physical Characteristics of Berries: Positive effects attributed to Dormex applications were evident on berry weight, size, length and diameter (Table 3). Spraying with high concentration of Dormex (5%) resulted in significantly the highest significant value of these parameters, whereas water spray (control) induced significantly the least value of these ones in both seasons.

As for the application dates, it was found that early Dormex application (25th December) was more pronounced in increasing all studied physical characteristics of berries than the other dates in both seasons. Similar notations were mentioned by El-Mogy *et al*. [8]; Abo-ELwafa *et al.* [30] and Mohamed *et al.* [31], they pointed out that spraying grapevine with Dormex improved berry physical characteristics.

Chemical Characteristics of Berries: It is evident from the data in (Table 4) that, increasing Dormex concentrations markedly increased juice TSS and TSS/acid ratio and reduced acidity as compared with the control. The increment was more pronounced with Dormex at 5%.

Concerning the effect of spraying date, it can be noticed that early Dormex application (December 25th) significantly increased both TSS and TSS/acid ratio and reduced acidity as compared with the other dates.

The effects of Dormex 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 in this respect are in harmony with those obtained by El-Shazly [7]; El-Mogy *et al*. [8]; Abo-ELwafa *et al.* [30] and Mohamed *et al.*[31] working on different grape cultivars. They reported that Dormex spray improved fruit quality.

Morphological Characteristics of Vegetative Growth: As shown in Table (5), it is obvious that morphological characteristics of vegetative growth *i.e.* average of shoot length, number of leaves per shoot, leaf area and coefficient of wood ripening were significantly affected by concentration and application date of Dormex in both seasons.

Spraying with high concentration of Dormex (5%) resulted in significantly the highest significant value of these parameters, whereas water spray (control) induced significantly the least value of these ones in both seasons.

Table 5: Effect of concentration and application date of Dormex on morphological characteristics of vegetative growth of Early Sweet grapevines in 2017 and 2018 seasons

	Average shoot length (cm)		Average number of leaves/shoot		Average leaf area (cm^2)		Coefficient of wood ripening	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018
Dormex at 4% on December 25th	189.2	195.6	30.9	31.7	205.9	210.2	0.91	0.92
Dormex at 5% on December 25th	192.4	197.3	31.2	32.1	207.4	213.5	0.94	0.96
Dormex at 4% on January 1st	181.9	187.1	29.9	30.3	203.3	207.5	0.88	0.90
Dormex at 5% on January 1st	185.7	191.8	30.6	31.1	203.7	209.4	0.89	0.91
Dormex at 4% on January 8th	175.5	179.7	28.4	28.6	198.2	204.2	0.85	0.89
Dormex at 5% on January 8th	179.1	182.5	29.1	29.4	200.7	206.1	0.87	0.89
Dormex at 4% on January 15th	169.8	176.3	27.0	27.6	191.7	196.9	0.83	0.86
Dormex at 5% on January 15th	173.2	176.9	27.3	27.9	196.8	202.9	0.84	0.87
Control (water spray)	167.9	172.8	26.7	27.3	186.5	191.9	0.81	0.85
New L.S.D. at (0.05)	1.7	1.3	0.2	0.1	1.4	1.1	0.02	0.01

As for the application dates, it was found that Dormex application on either December 25th or January 1st significantly increased these parameters as compared with those sprayed on January 8th or 15th and this was true for both experimental seasons. Increments in leaf area with Dormex applications would be expected since the pathway of Dormex degradation in the plant is urea substrate. Generally, the results concerning the effect of Dormex spray on vegetative growth were in coincidence with those of bud burst percentage, where, increasing bud burst percentage dramatically decreased the vegetative growth of vines in both seasons.

The above mentioned results are in accordance with those reported, by El-Mogy *et al*. [8]; Abo-ELwafa *et al.* [30] and Mohamed *et al.* [31], they pointed out that Dormex spray increased the vegetative growth of the vines.

Chemical Characteristics of Vegetative Growth

Leaf Content of Total Chlorophyll and Cane Content of Total Carbohydrates: It is evident from the data in (Table, 6) that, increasing Dormex concentrations markedly increased leaf content of total chlorophyll and cane content of total carbohydrates as compared with the control. The increment was more pronounced with Dormex at 5%.

Concerning the effect of spraying date, it can be noticed that early Dormex application (December 25th) significantly increased both leaf content of total chlorophyll and cane content of total carbohydrates as compared with the other dates in both seasons of this investigation.

Similar results were obtained by Abd El-All [32] and Abo-ELwafa *et al.* [30] who pointed out that spraying grapevines with Dormex increased the leaf content of pigments and cane content of total carbohydrates.

Bud Content of Hormones: As shown in Table (7), it is obvious that bud content of hormones *i.e.* GA_3, IAA and ABA were significantly affected by concentration and application date of Dormex in both seasons.

Spraying with high concentration of Dormex (5%) resulted in significantly the highest significant value of GA_3 and IAA and the least value of ABA, whereas water spray (control) induced significantly the least value of GA_3 and IAA and the highest value of ABA in both seasons.

As for the application dates, it was found that Dormex application on either December 25th or January 1st significantly increased bud content of GA_3 and IAA and decreased ABA as compared with those sprayed on January 8th or 15th and this was true for both experimental seasons.

Many changes in some chemical components in 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 dormancy in buds [2, 33]. Endogenous hormones help plants to respond to the environmental signals [34]. Endogenous gibberellins (GA's) play a role in many developmental processes and have been proved to participate in the regulation of dormancy [35].

The present results showed that growth-promoting hormones (GA_3 and IAA) found to be increased, but growth-inhibiting hormones (ABA) decreased during bud break. This suggested that higher IAA and GA_3 contents and lower ABA content were needed for release of buds from dormancy.

The positive action of Dormex on breaking dormancy is mainly attributed to its effect in removing buds scales, reducing ABA, catalase, reduced and oxidized glutathione

Table 6: Effect of concentration and application date of Dormex on leaf content of total chlorophyll and cane content of total carbohydrates of Early Sweet grapevines in 2017 and 2018 seasons

	Total chlorophyll (SPAD)		Total carbohydrates (%)	
Treatments	2017	2018	2017	2018
Dormex at 4% on December 25th	36.18	39.27	26.91	28.29
Dormex at 5% on December 25th	36.94	39.83	27.48	28.73
Dormex at 4% on January 1st	35.01	37.68	25.84	26.99
Dormex at 5% on January 1st	35.76	38.49	26.13	27.58
Dormex at 4% on January 8th	34.18	35.87	24.57	25.82
Dormex at 5% on January 8th	34.82	36.43	25.06	26.41
Dormex at 4% on January 15th	32.47	34.36	23.53	24.75
Dormex at 5% on January 15th	33.16	35.71	24.18	25.72
Control (water spray)	30.91	32.72	23.11	24.46
New L.S.D. at (0.05)	0.57	0.51	0.43	0.39

Table 7: Effect of concentration and application date of Dormex on bud content of hormones of Early Sweet grapevines in 2017 and 2018 seasons

	GA3 (µg/g D.W.)		IAA (µg/g D.W.)		ABA (µg/g D.W.)	
Treatments	2017	2018	2017	2018	2017	2018
Dormex at 4% on December 25th	1.21	1.25	1.07	1.18	1.52	1.48
Dormex at 5% on December 25th	1.25	1.28	1.11	1.23	1.46	1.43
Dormex at 4% on January 1st	1.13	1.16	0.99	1.11	1.69	1.63
Dormex at 5% on January 1st	1.16	1.21	1.02	1.15	1.61	1.56
Dormex at 4% on January 8th	1.04	1.09	0.90	0.93	1.85	1.77
Dormex at 5% on January 8th	1.09	1.13	0.94	0.96	1.76	1.69
Dormex at 4% on January 15th	0.97	1.01	0.82	0.85	1.99	1.93
Dormex at 5% on January 15th	1.01	1.06	0.85	0.88	1.91	1.86
Control (water spray)	0.78	0.85	0.69	0.71	2.21	2.17
New L.S.D. at (0.05)	0.02	0.01	0.03	0.02	0.05	0.04

Table 8: Economical evaluation for Dormex treatments compared with control of Early Sweet grapevines in 2017 and 2018 seasons

Treatments	Bud burst date	Harvest date	Bud burst to harvest (Day)	Gained earliness at harvest (Day)	Yield/vine (kg)	Price kg (L.E.)	Total cost of Dormex	Net profit/Feddan (L.E.)
First season								
Dormex at 4% on December 25th	9-Feb	19-May	99	10	12.97	6.00	1070	53384.3
Dormex at 5% on December 25th	9-Feb	18-May	98	11	13.71	6.00	1300	56297.3
Dormex at 4% on January 1st	9-Feb	22-May	102	7	14.21	5.75	1070	56115.9
Dormex at 5% on January 1st	9-Feb	21-May	101	8	14.83	5.75	1300	58373.7
Dormex at 4% on January 8th	9-Feb	24-May	104	5	14.94	5.75	1070	59063.4
Dormex at 5% on January 8th	9-Feb	23-May	103	6	15.42	5.75	1300	60780.4
Dormex at 4% on January 15th	16-Feb	27-May	100	2	15.48	5.25	1070	55835.0
Dormex at 5% on January 15th	16-Feb	26-May	99	3	15.66	5.25	1300	56246.7
Control (water spray)	2-Mar	29-May	88	….	12.01	5.00	….	42018.8
Second season								
Dormex at 4% on December 25th	13-Feb	23-May	102	12	14.66	6.25	1080	63058.8
Dormex at 5% on December 25th	13-Feb	22-May	101	13	15.04	6.25	1310	64481.6
Dormex at 4% on January 1st	13-Feb	26-May	105	9	15.48	6.00	1080	63923.2
Dormex at 5% on January 1st	13-Feb	25-May	104	10	15.95	6.00	1310	65683.8
Dormex at 4% on January 8th	13-Feb	28-May	107	7	16.22	6.00	1080	67034.4
Dormex at 5% on January 8th	13-Feb	27-May	106	8	16.64	6.00	1310	68562.1
Dormex at 4% on January 15th	20-Feb	31-May	110	4	16.60	5.50	1080	62811.7
Dormex at 5% on January 15th	20-Feb	30-May	109	5	16.73	5.50	1310	63096.9
Control (water spray)	6-Mar	4-Jun	112	….	13.14	5.25	….	48287.6

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 [36].

It is clear from the foregoing results that the problem of insufficient chilling requirements for Early Sweet grapevines in Egypt can be successfully solved. Accordingly if the grower aims to obtain early and highly

paid yields without a big risk, he has to apply Dormex at 5% during first week of January. Such medium Dormex application dates (January 1st or January 8) thwould terminate winter dormancy and result in earlier and more uniform bud burst, good vegetative growth aspects and earlier fruit ripening.

Nevertheless, the grower must take into consideration that any exaggeration in advancing Dormex application date (December 25th) may cause too early bud burst in a very cool weather with low light intensity. This might cause frost injury and abscission of all or some flower bunches and yielding irregular and low percentage of bud break and consequently the yield is very low [29].

However, late Dormex application date (January 15th) could be used with Early Sweet grapevines for objectives other than advancing harvest. Thus, the late Dormex application date at high concentrations greatly enhanced percentage of bud burst and coefficient of bud fertility. Consequently, number of bunches and yield per vine were obviously increased.

Economical Evaluation for Dormex Treatments Compared with Control: Data in Table (8) disclosed obvious earliness in harvesting due to Dormex application as compared to the control. With regard to its effect on harvesting date, early application (December 25th) clearly enhanced it.

Accordingly, the increase in yield resulted in higher net profit in both seasons. Moreover, costs involved due to Dormex applications are far less than profits gained through earlier harvesting in addition to improving fruit quality.

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