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Enhancing the Yield and Quality of Red Roomy Grapevine by Using Bud Breaking Products

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Abstract: This study was conducted to evaluate the effectiveness of safe alternative to hydrogen cyanamide in breaking dormancy in Red Roomy' grapevines. The vines were treated with the following spray applications: control, dormex, Erger at a concentration of (3 ,5 %), calcium nitrate at a concentration of 3% and their combinations. The date of spray was carried out at 45 or 30 days before bud opening or in both of prementioned dates. All treatments included dormex, Erger and calcium nitrate and their combinations increased the berry set %. The results also showed improving in the quantity of the yield due to the increasement of the cluster weight and the number of clusters per vines by using the aforesaid treatments. Moreover, using dormex or Erger caused in enhancing cluster dimensions either berry dimensions. in the first season, the higher percentage of T.S.S and reducing sugars were obtained by vines sprayed either by dormex or by Erger at the highest level combined with calcium nitrate 3%. On contrary the acidity was decreased.

Key words: Red Roomy Dormex, Erger, calcium nitrate, dormancy, yield, quality.

1. Introduction

The grapevine (*Vitis vinifera*), belonging to the Vitaceae family, is considered one of the most important horticultural crops worldwide. In Iran, grapevine production and its related products hold significant economic and cultural value. With a rich history of cultivation dating back to ancient times, the area under grapevine cultivation has expanded rapidly over the past two decades. This growing interest in grapevine, both as fresh fruit and in processed forms, has encouraged comprehensive research aimed at improving farming practices, breeding, nutrition, and both the quantitative and qualitative aspects of production.

Grapevines are also highly valued for their medicinal properties, being rich in antioxidants and anti-cancer compounds. They are an excellent source of vitamins B1, B2, and C, as well as minerals such as iron, phosphorus, iodine, calcium, sulfur, and malic acid. Recent studies have revealed that grapevines possess antiviral properties, and due to their high content of polyphenols and tannins, they

also exhibit anti-tumor effects. In particular, grape berry and seed extracts are abundant in a potent antioxidant called proanthocyanin, which has been shown to strengthen the immune system and may offer protective benefits against skin cancer **(Marandi, 2007)**.

Dormex® is a plant growth regulator developed by Alzchem Group, primarily used in vineyards and orchards to stimulate uniform and earlier bud break in deciduous fruit crops. Its active ingredient, hydrogen cyanamide, is particularly effective in regions with mild winters where natural chilling is insufficient to break dormancy **(Sassine, 2019)**. Nowadays many countries banded it because of its high toxicity, for this Erger is tested in bud breaking dormancy. Erger® contains inorganic nitrogen, mono- and polysaccharides, calcium, and selected diterpenes. These components work synergistically to stimulate the plant's metabolic processes, leading to uniform bud development and flowering **(Wlasiuk *et al.*, 2018).**

Calcium nitrate, when used in combination with Erger®, has been shown to effectively induce bud break in deciduous fruit trees, such as apples, especially in regions with insufficient winter chilling. This combination serves as a safer alternative to traditional chemicals like hydrogen cyanamide **(Hawerroth *et al.*, 2007)** and **(Hawerroth *et al.*, 2009)**.

This study aimed to evaluate the effect of alternative chemical products, namely Erger and calcium nitrate, as potential substitutes for Dormex in breaking dormancy and the influence of them on the yield and it's quality of Red Roomy grapevines.

2. Materials and Methods

This study was carried out over two consecutive seasons (2022 and 2023) to assess the potential of Erger as an alternative to Dormex (hydrogen cyanamide) for breaking dormancy in Red Roomy grapevines. A total of 45 ten-year-old vines, spaced 2×2 meters apart, were selected from a vineyard in Tallah village, Minia Governorate. Soil analysis of the site was conducted according to the method of **Wilde *et al*. (1985)** and is presented in a corresponding table.

The vines were head-pruned in mid-January, leaving 72 buds per vine (20 fruiting spurs × 3 buds each, plus 6 replacement spurs × 2 buds each). All standard horticultural practices were followed, excluding those related to the treatments. The experiment followed a completely randomized block design (CRBD) with 15 treatments, each replicated three times (one vine per replicate). Triton B (0.1%) was used as a wetting agent in all spray applications.

The treatments included a water-only control, Dormex at 3%, and Erger at two concentrations (3% and 5%), either alone or combined with calcium nitrate at 3%."

Treatments were applied as follows:

1- Control: Water only.

2- Dormex: Sprayed at 3%, 45 days before bud break.

3- Erger (3%) – First Spray: Applied 45 days before bud break.

4- Erger (3%) – Second Spray: Applied 30 days before bud break.

5- Erger (3%) – Combined: Applied at both 45 and 30 days before bud break.

6- Erger (5%) – First Spray: Applied 45 days before bud break.

7- Erger (5%) – Second Spray: Applied 30 days before bud break.

8- Erger (5%) – Combined: Applied at both 45 and 30 days before bud break.

9- Calcium Nitrate ($CaNO_3$): Sprayed at 3%, at both 45 and 30 days before bud break.

10- Erger (3%) + $CaNO_3$ – First Spray: Applied 45 days before bud break.

11- Erger (3%) + $CaNO_3$ – Second Spray: Applied 30 days before bud break.

12- Erger (3%) + $CaNO_3$ – Combined: Applied at both 45 and 30 days before bud break.

13- Erger (5%) + $CaNO_3$ – First Spray: Applied 45 days before bud break.

14- Erger (5%) + $CaNO_3$ – Second Spray: Applied 30 days before bud break.

15- Erger (5%) + $CaNO_3$ – Combined: Applied at both 45 and 30 days before bud break.

For each vine, four clusters were weighed to determine average cluster weight and estimate total yield. Cluster length and width were measured, and berry dimensions (longitudinal and equatorial) were recorded using a vernier caliper. The average berry weight was calculated from a sample of 50 berries. Juice total soluble solids (TSS) were measured with a hand refractometer, and acidity was also assessed, following **A.O.A.C. (1990**) methods.

3. Results and Discussion

3.1. Yield and its components

The yield of the Red Roomy Cv. and its associated components including berry set percentage, number of clusters per vine, cluster weight and yield per vine were assessed over two growing seasons. As influenced by the application of dormex, Erger and calcium nitrate and their combinations. the results are presented in Tables 1 to 3."

Data declared that using dormex was effective in increasing the yield per vine due to enhancing the components of it (increasing the number of clusters per vine and the cluster weight) as well as spraying with Erger at any concentration had similar effect.

Data also showed that the date had no significant differences between the treatments. with a few exceptions.

In the second season, the data followed a similar trend. In conclusion, the highest yield per vine was achieved when the vines were sprayed with a combination of Erger at a 5% concentration and calcium nitrate at 3%, or when sprayed with Dormex at a 3% concentration.

These results are consistent with the findings of **El-Akkad (2004),** El-Agamy ***et al*. (2004), and Mekawy (2008)** on Roomy Red, as well as **Rosa *et al*. (2020)**, **Abd El-Wadoud (2010) and Aly *et al*. (2020)** on Flame Seedless and **Darde *et al*. (2019**) on Eva apple trees.

3.2. Berry set

Concerning the effect of spraying dormex, Erger and calcium nitrate and their combinations on berry set data presented in Table (1).

Based on the field data, spraying with Dormex, Erger, and calcium nitrate positively affected berry set in Roomy Red grapes compared to untreated vines. A significant increase in berry set was observed in both seasons, particularly with Dormex application, which proved to be the most effective treatment. However, spraying Erger at a 5% concentration combined with calcium nitrate at a 3% concentration (applied twice) showed no significant difference from Dormex alone. Both of these treatments had a statistically significant advantage over all other treatments, as documented in Table (1)

Furthermore, the combination of Erger at 5% (the highest level) and calcium nitrate was more effective than spraying Erger or calcium nitrate alone, as statistically confirmed in the same table. Additionally, the results indicated that the timing of application had no significant impact, with only a few exceptions. Similar trends were observed in the second season and were also statistically supported.

Table (1). Effect of spraying dormex, Erger and calcium nitrate on berry set percentage and number of clusters of Red Roomy grapevines during two successive seasons 2022/2023

Treatments	Percentage of berry set (%)		Number of clusters per vines	
	First season	Second season	First season	Second season
Control	5.73	5.73	30	31
Dormex 3%	10.93	11.03	35	36
Erger 3% (First Spray)	8.83	8.53	34	35
Erger 3% (Second Spray)	9.13	8.74	34	36
Erger 3% (First / Second Spray)	9.70	8.93	34	35
Erger 5% (First Spray)	9.40	9.35	34	35
Erger 5% (Second Spray)	8.87	8.87	33	35
Erger 5% (First / Second Spray)	9.64	8.9	34	35
Ca No33%	6.05	6.17	33	35
Erger 3% + Ca No3 (First Spray)	9.07	9.03	33	35
Erger 3% + Ca No3 (Second Spray)	9.17	9.15	33	35
Erger 3% + Ca No3 (First / Second Spray)	9.87	9.43	35	36
Erger 5% + Ca No3 (First Spray)	9.93	9.47	34	35
Erger 5% + Ca No3 (Second Spray)	10.13	9.66	34	36
Erger 5% + Ca No3 (First / Second Spray)	10.91	11	35	36
LSD at 5%	0.52	0.32	2.2	2.4

3.3. Berry physical characteristics

Tables (2-3) illustrate the effects of Dormex, Erger, calcium nitrate, and their combinations on the physical properties of Roomy Red grape berries. These properties include berry weight, longitudinal diameter (cm), and equatorial diameter (cm), as observed during the 2022 and 2023 growing seasons

Regarding the effect of dormex, Erger and calcium nitrate and their combinations on berry weight, the results shown in Table (2), data indicated that spraying with Dormex was the most effective treatment. Similarly, the combination of Erger at a 5% concentration and calcium nitrate at a 3% concentration on Roomy Red grapes also proved highly effective. There were no significant differences between these two treatments, but both showed a significant advantage over the other treatments in both seasons.

The results clearly indicate that the timing of spraying the aforementioned chemicals whether applied in the first or second spray did not lead to significant differences in their effects. However, the data showed that the combination of Erger and calcium nitrate was more effective than spraying either one alone. Additionally, applying calcium nitrate at a 3% concentration had a noticeable positive effect on increasing berry weight, including in comparison to untreated vines. The data from the second season followed a similar trend to that of the first season with respect to berry weight.

The results regarding the effects of Dormex, Erger, calcium nitrate, and their combinations on the longitudinal and equatorial diameters of Roomy Red grape berries are presented in Tables (3-4).

In the first season, the largest berry size was achieved either by spraying with Erger at 5% combined with calcium nitrate at 3%, or by spraying Dormex at 3%. The effects of these treatments were statistically significant compared to the other treatments, including the untreated control.

Table (2). Effect of spraying dormex, Erger and calcium nitrate on cluster weight and yield per vine of Red Roomy grapevines during two successive seasons 2022/2023

Treatments	Cluster weight (g)		Yield per vine (kg)	
	First season	Second season	First season	Second season
Control	343.3	348.7	10.3	10.8
Dormex 3%	389.7	395.0	13.6	14.2
Erger 3% (First Spray)	360.0	365.0	12.2	12.8
Erger 3% (Second Spray)	353.7	358.7	12.0	12.9
Erger 3% (First / Second Spray)	359.7	364.7	12.2	12.8
Erger 5% (First Spray)	372.0	376.3	12.6	13.2
Erger 5% (Second Spray)	369.3	374.0	12.2	13.1
Erger 5% (First / Second Spray)	373.3	377.7	12.7	13.2
Ca No33%	348.0	353.0	11.5	12.4
Erger 3% + Ca No3 (First Spray)	371.3	376.0	12.3	13.2
Erger 3% + Ca No3 (Second Spray)	369.3	373.3	12.2	13.1
Erger 3% + Ca No3 (First / Second Spray)	373.7	378.3	13.1	13.6
Erger 5% + Ca No3 (First Spray)	380.3	384.7	12.9	13.5
Erger 5% + Ca No3 (Second Spray)	376.0	380.7	12.8	13.7
Erger 5% + Ca No3 (First / Second Spray)	397	397.0	13.9	14.3
LSD at 5%	6.8	7.3	0.6	0.8

Table (3-4) further shows that spraying Erger at any concentration in combination with calcium nitrate at 3% was more effective than applying either Erger or calcium nitrate alone. However, there were no significant differences among the different concentrations of Erger when combined with calcium nitrate.

The data also revealed that the timing of the spray had no significant effect on improving berry longitudinal diameter. This finding was consistent in the second season as well.

Although spraying calcium nitrate at 3% improved berry size compared to the control, the difference was not statistically significant when compared to other treatments. Similar trends were observed in the second season.

Regarding berry equatorial diameter, the results presented in Table (4) indicated that spraying with Dormex had a positive effect compared to most other treatments. A similar improvement was observed with the combination of Erger at 5% and calcium nitrate at 3%, producing results comparable to Dormex at 3%. These two treatments significantly outperformed the other treatments in enhancing the berry equatorial diameter of Roomy Red grapes.

Furthermore, the timing of the spray had no significant influence on the equatorial diameter. Combinations of Erger (either 3% or 5%) with calcium nitrate at 3% were more effective than spraying either compound alone. These results were consistent across both growing seasons without exception.

The compound of dormex improve hormone balance (e.g., gibberellins and cytokinins) in the plant, which influences cell division and expansion—key processes in berry enlargement.

The current findings are in agreement with previous studies conducted by **Ahmed (1993)** on Zinfandel grapevines; **El-Ghany *et al.* (2001); Deieu and El Alem (2008)** on Thompson Seedless

grapevines; **Mohamed and Gouda (2017)** on Superior grapevines; **and Abdlhamid (2021)** on Flame Seedless grapevines.

Table (3). Effect of spraying dormex, Erger and calcium nitrate on berry weight and berry longitudinal of Red Roomy grapevines during two successive seasons 2022/2023

Treatments	Berry weight (g)		Berry longitudinal (g)	
	First season	Second season	First season	Second season
Control	59.3	55.7	2.3	2.4
Dormex 3%	58.3	67.3	2.6	2.7
Erger 3% (First Spray)	55.3	63.3	2.6	2.7
Erger 3% (Second Spray)	54.7	61.0	2.4	2.5
Erger 3% (First / Second Spray)	57.3	65.7	2.5	2.6
Erger 5% (First Spray)	56.7	61.3	2.4	2.4
Erger 5% (Second Spray)	55.0	61.3	2.4	2.5
Erger 5% (First / Second Spray)	57.7	63.7	2.4	2.5
Ca No33%	55.0	58.3	2.4	2.5
Erger 3% + Ca No3 (First Spray)	57.3	63.0	2.4	2.5
Erger 3% + Ca No3 (Second Spray)	56.7	62.0	2.5	2.5
Erger 3% + Ca No3 (First / Second Spray)	56.0	66.3	2.4	2.5
Erger 5% + Ca No3 (First Spray)	58.0	64.0	2.4	2.6
Erger 5% + Ca No3 (Second Spray)	56.3	65.3	2.3	2.5
Erger 5% + Ca No3 (First / Second Spray)	58.7	68.7	2.6	2.7
LSD at 5%	2.2	3.1	0.16	0.17

3.4. Berry chemical characteristics

Regarding the effect of Dormex, Erger, calcium nitrate, and their combinations on total soluble solids (TSS) and acidity. the results presented in Table (4) showed that all treatments had a positive impact compared to the untreated control. Furthermore, Dormex and Erger at a concentration of 5% produced similar results in this regard. Both treatments significantly enhanced the TSS content in Roomy Red grapes compared to the other treatments.

Based on the field data, the timing of the spray did not have a significant effect on improving TSS. However, the combination of Erger at 5% and calcium nitrate at 3% also positively influenced TSS, though there were no statistically significant differences between this combination and most other treatments except for the treatment involving two applications of Erger at 5% combined with calcium nitrate at 3%, which had a significant effect, similar to that of Dormex.

Regarding the effect of Dormex, Erger, calcium nitrate, and their combinations on the acidity of Roomy Red grapes during the 2022 and 2023 seasons, data presented in Table (5) illustrate that all treatments had a significant effect compared to the untreated control. Notably, spraying with either Dormex or Erger at a concentration of 5%, in combination with calcium nitrate at 3%, had a significantly positive impact on acidity levels compared to the other treatments.

The timing of the application was found to have no meaningful effect on acidity. Additionally, there were no significant differences between the various concentrations of Erger when combined with calcium nitrate at 3%, as confirmed statistically in Table 5.

Table (4). Effect of spraying dormex, Erger and calcium nitrate on berry equatorial and TSS of Red Roomy grapevines during two successive seasons 2022/2023

Treatments	Berry equatorial		TSS	
	First season	Second season	First season	Second season
Control	2.06	2.08	20.8	20
Dormex 3%	2.17	2.26	26.37	25.10
Erger 3% (First Spray)	2.05	2.16	24.33	22.90
Erger 3% (Second Spray)	2.04	2.14	22.90	22.30
Erger 3% (First / Second Spray)	2.12	2.22	23.63	22.33
Erger 5% (First Spray)	2.16	2.26	23.20	23.00
Erger 5% (Second Spray)	2.15	2.25	23.67	22.33
Erger 5% (First / Second Spray)	2.08	2.24	23.10	22.63
Ca No33%	2.10	2.20	23.27	22.67
Erger 3% + Ca No3 (First Spray)	2.03	2.16	23.30	22.33
Erger 3% + Ca No3 (Second Spray)	2.02	2.10	24.03	23.23
Erger 3% + Ca No3 (First / Second Spray)	2.04	2.20	23.50	23.00
Erger 5% + Ca No3 (First Spray)	2.21	2.30	23.77	22.87
Erger 5% + Ca No3 (Second Spray)	2.14	2.24	24.13	23.00
Erger 5% + Ca No3 (First / Second Spray)	2.28	2.36	26.47	25.33
LSD at 5%	0.12	0.12	2.11	1.97

However, spraying Erger at 3% showed a significant effect depending on the date of application, whereas the highest Erger concentration did not produce statistically significant differences in this regard.

The results also revealed that spraying Roomy Red grapevines with calcium nitrate alone had a positive effect on acidity levels. These findings were largely consistent in the second season, with only minor exceptions.

The present results are in agreement with those reported by **Swathi *et al*. (2019)** on the Paneer variety**, Mohamed and Mahfouze (2018), Aly *et al*. (2020)** on Flame Seedless, and **Popaska *et al*. (2023)** on Cardinal grapes also **El-Ghany *et al*. (2001)** of Thompson Seedless grapevines.

Regarding the effect of Dormex, Erger, calcium nitrate, and their combinations on reducing sugars, the results are presented in Table (5).

The findings indicated that all treatments significantly improved the reducing sugar content in Roomy Red grape berries, including the application of calcium nitrate at a concentration of 3%. Moreover, spraying with either Dormex or Erger at 5% combined with calcium nitrate at 3% had a greater positive effect compared to the other treatments.

Data in the same table showed no significant differences based on the timing of the application. Additionally, there were no significant differences between the highest and lowest concentrations of Erger when applied alone. However, combining Erger with calcium nitrate consistently showed a positive effect, though not always statistically significant—except in the case of spraying Roomy Red grapevines with Erger at 5% plus calcium nitrate at 3%, which did produce a statistically significant improvement.

A similar trend was observed in the second season, as shown in Table (5). Dormex enhancing the photosynthesis, more photosynthesis means **more carbohydrates**, which are ultimately stored as **sugars in the berries.** Also Erger gave More vigorous shoots and larger leaves and this enhances Photosynthetic activity, producing more sugars (glucose, fructose, sucrose) and decreasing acidity.

These results concerning the influence of Dormex, Erger, and calcium nitrate on the quality of Roomy Red grapes align with findings from previous studies by **Ahmed (1993**) on Zinfandel grapevines, **Mohamed and Gouda (2017)** on Superior grapes, **Swathi *et al*. (2019**) on the Paneer variety and **Jamshidian *et al*. (2023)** on Askari grapevines

As a conclusion, in light of these findings, increasing the yield and improving the quality of Roomy Red grapevines can be effectively achieved by spraying with Erger at 5% combined with calcium nitrate at 3%, applied twice during the season.

Table (5). Effect of spraying dormex, Erger and calcium nitrate on acidity and reducing sugars of Red Roomy grapevines during two successive seasons 2022/2023

Treatments	Acidity		Reducing sugars	
	First season	Second season	First season	Second season
Control	0.541	0.538	16.97	16.33
Dormex 3%	0.512	0.517	20.75	19.86
Erger 3% (First Spray)	0.519	0.536	19.30	18.33
Erger 3% (Second Spray)	0.536	0.530	18.35	17.92
Erger 3% (First / Second Spray)	0.524	0.530	18.82	17.92
Erger 5% (First Spray)	0.528	0.522	18.54	18.40
Erger 5% (Second Spray)	0.527	0.530	18.87	17.93
Erger 5% (First / Second Spray)	0.523	0.532	18.47	18.15
Ca No33%	0.523	0.532	18.59	18.17
Erger 3% + Ca No3 (First Spray)	0.522	0.530	18.62	17.95
Erger 3% + Ca No3 (Second Spray)	0.519	0.523	19.19	18.63
Erger 3% + Ca No3 (First / Second Spray)	0.523	0.522	18.75	18.40
Erger 5% + Ca No3 (First Spray)	0.526	0.536	18.94	18.31
Erger 5% + Ca No3 (Second Spray)	0.521	0.522	19.21	18.42
Erger 5% + Ca No3 (First / Second Spray)	0.511	0.520	20.83	20.00
LSD at 5%	0.06	0.04	1.34	1.16

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تحسين إنتاجية وجودة عنب "الرومي الأحمر" باستخدام مواد كاسرة السكون

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الملخص العربي

أُجريت هذه الدراسة لتقييم فعالية بدائل آمنة للهيدروجين سيانامید في كسر طور السكون في كروم العنب من صنف "رومي أحمر". أُجريت الدراسة خلال موسمين متتاليين (٢٠٢٢ /٢٠٢٣) لتقييم Erger كبديل آمن لـ Dormex لكسر السكون في عنب "رومي أحمر". تم اختيار ٤٥ كرمة عنب بعمر ١٠ سنوات، مزروعة بتباعد ٢×٢ م، في قرية تله بمحافظة المنيا تم تقليم الكروم في منتصف يناير، حيث تُرك ٧٢ برعماً: ٢٠ دوابر ثمرية × ٣ براعم + ٦ دوابر تجديدية × ٢ برعم . أظهرت جميع المعاملات التي شملت Dormex، Erger، ونترات الكالسيوم زيادة في نسبة عقد الثمار. كما لوحظ تحسن في كمية المحصول نتيجة زيادة وزن العناقيد وعددها في الكرمات المعاملة. إضافةً إلى ذلك، عزز كل من Dormex وErger أبعاد العناقيد وحجم الثمار. تم الحصول علي أعلي انتاجية مع أفضل جودة (زيادة نسبة المواد الصلبة الذائبة الكلية ونقص في الحموضه في الثمار) عند معاملة الكرمات بالارجر بتركيز ٥% مع نترات الكالسيوم بتركيز ٣% مرتين سنويا (٤٥ و٣٠ يوم قبل تفتح البراعم) وكانت النتائج مماثلة للرش بالدورميكس بتركيز ٣%. ويمكن تحقيق زيادة ملحوظة في الإنتاج وتحسين جودة عنب "الرومي الأحمر" من خلال استخدام Erger بتركيز ٥% مضافًا إليه نترات الكالسيوم ٣%، وتطبيقهما مرتين خلال فترة ما قبل التفتح، مما يجعله بديلاً فعّالًا وآمنًا لـ.Dormex .