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Response of some Vegetative Traits of Red Roomy Grapevines to Paclobutrazol Treatments

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ABSTRACT

The present study was carried out over two consecutive growing seasons, namely 2021/2022 and 2022/2023, to investigate the impact of paclobutrazol application at concentrations of (500, 750, and 1000 ppm) on the growth development of Red Roomy grapevines. For this purpose, a vineyard located in Tow village, within the Minya district of the Minia Governorate Egypt, was chosen as the research site. The application of all paclobutrazol concentrations to Red Roomy vines resulted in a notable reduction in vine spread, as evidenced by decreased shoot length (cm), leaf area (cm²), and pruning wood weight (kg/vine) when compared to untreated vines. Conversely, the use of paclobutrazol (PMZ) led to a significant increase in the wood ripening coefficient, the number of leaves per vine, and cane thickness (cm) across both experimental seasons when compared to the control treatment. Additionally, the levels of leaf photosynthetic pigments and nutrients were found to rise in tandem with increasing concentrations of PBZ during both seasons. The most notable values were observed in vines treated with PBZ at a concentration of 1000 ppm which applied two weeks prior to flowering yielded the most favorable results, closely followed by the PBZ at 750-ppm concentration applied at the same time, with no significant differences observed between these two effective treatments. Based on present findings, it is advisable to apply paclobutrazol at a concentration of 750 ppm to Red Roomy grapevines two weeks prior to flowering to achieve regulated vegetative growth, particularly under the conditions present in Minia Governorate, Egypt.

Keywords: Red Roomy – grapevines – Retardants - Paclobutrazol – Plant development.

INTRODUCTION

Grapes (*Vitis vinifera* L.), a member of the Vitaceae family, represent one of the most significant fruit crops in temperate regions, having adapted successfully to subtropical and tropical agricultural climates. They are rich in essential minerals such as calcium, phosphorus, and iron, as well as vitamins including B1, B2, and C. Grape juice is known for its mild laxative properties and stimulating effects (Basak, 2001). The cultivation of grapes is thought to have originated in Armenia, located near the Caspian Sea in Russia. In Egypt, the total area dedicated to grape cultivation has reached 186,404 feddans, yielding approximately 1,790,734 tons, which averages to about 10,033 tons per feddan (MALR, 2022).

The Roomy grape cultivar is highly regarded as one of the leading seeded grape varieties grown in Egypt. Nevertheless, growers of the Red Roomy grape in the Middle Egypt governorates face a significant obstacle related to the inconsistent timing and delay of bud break. This problem of delayed and irregular bud break leads to a fruit set that falls short of expectations, largely due to elevated temperatures experienced in May. Such climatic conditions negatively impact both the yield and quality of the grape harvest in this area (El-Sese and Mohamed, 2003).

Rational fertilization is a win-win strategy for agricultural income and environmental preservation in ecologically sensitive places. When organic and natural sources were combined with inorganic sources for grapevine variety fertilization, there was an increase in vegetative development, leaf mineral content, yield, and quality compared to when inorganic sources were used alone (Shaheen, *et al.* 2013 and Hegazi *et al.* 2014).

The chemical designation of Paclobutrazol, also known as PP333, is (*2RS, 3RS*) -1- (4-chlorophenyl) - 4,4-dimethyl-2-(1H-1,2,4-triazol-1-yl) pentan-3-ol. It is marketed under various commercial names, including Clipper, Cultar, Parlay and Bonzi. As a plant growth regulator, it is classified within the triazole group of fungicides, functioning by inhibiting the biosynthesis of gibberellins. This action subsequently slows down the conversion of *Kaurene*-19-ol to GA3, which is why it is commonly referred to as an 'antigibberellin'. Paclobutrazol (PBZ) has been shown to effectively inhibit shoot growth in various perennial fruit trees by decreasing the number of shoots, thereby promoting a more favorable spur-type growth pattern and reducing the vegetative sink. This compound not only stimulates early and vigorous flowering but also curtails vegetative growth and restricts bud extension, facilitating the ripening process and the initiation of inflorescence in apical buds. Furthermore, paclobutrazol is noted for its environmental stability in soil and water, exhibiting a long half-life under both aerobic and anaerobic conditions. Its efficacy is attributed to its inhibition of gibberellin biosynthesis at the kaurene stage, which has been shown to reduce vegetative growth (Gollagi *et al*., 2019 and Gul *et al*., 2024).

Not only the concentration of the used material is effective, but also the timing of application. Many authors

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attempted to control the vegetative and development through various concentrations and application time such as Shaltout *et al*. (1988) on Roumi Red grape (1 week before full blooming), Reynolds (1988) on Rieslin grape 4 weeks after berry set, Hunter and Proctor (1992) on grape leaves (17 days after blooming), Agüero *et al*. (1995) on Emperatriz and Malvinas grapevines (2, 3 and 4 weeks before bloom), Todić *et al*. (2012) on the Cabernet Sauvignon grapevine (two times: once 10 to 15 days before flowering and again 10 to 15 days after full bloom), and Wassel *et al*. (2023) on Superior seedless grapevines (at the time of bud emergence).

The response of the vegetative growth performance of Red Roomy grapevines to paclobutrazol treatments under Minia Governorate was the target of this research.

MATERIALS AND METHODS

In a private vineyard orchard located in Tow village, Minya District, Minya Governorate, Egypt, throughout two growing seasons of 2021/2022 and 2022/2023, this study was conducted to investigate the response of growth characteristics of Red Roomy grapevines to paclobutrazol treatments. Thirty uniform 9-year-old grapevines were selected for this study. The distances within vines were 2 x 2 meters, leading to a total of one thousand and fifty vines per feddan. The winter pruning was performed in the first week of January for both growing seasons, employing Gable systems for trellising and cane-pruning techniques. Each vine was designed to support a load of 72 buds, which comprised six fruiting canes with ten eyes each, along with six renewal spurs containing two eyes each. At the onset of the trials, the soil was subjected to mechanical, physical, and chemical analyses to a depth of 0.0 to 90 cm, following the procedures outlined by Wilde *et al*. (1985), with the results presented in Table (a). The experimental design included ten treatments, which featured three distinct concentrations of paclobutrazol (500, 750 and 1000 ppm) along with a control group. Each concentration was applied at three different times, and the treatments were organized in a complete randomized block design with three replicates. A total number of thirty vines represented 10 treatments X 3 replications were utilized.

Table a. Physical and chemical analysis of the used soil in the study.

Character			Values
Particle size distribution			
Sand: 5.89%	Silt: 25.60%	Clay: 68.51%	Texture: Clay
Chemical analysis			
pH	7.9	Total N (%)	0.06
EC (dS/m)	0.81	P ppm (Olsen)	9.4
Total $CaCO_3$ (%)	1.37	K (ppm)	637.0
O.M. (%)	0.69	Mg (ppm)	58.0
Available micronutrients (EDTA)			
Fe (ppm)	4.1	Mn (ppm)	4.5
Zn (ppm)	3.4	Cu (ppm)	1.6

Our study treatments could be listed as follows:

1. Control (without PBZ addition).
2. PBZ 500 ppm 3 weeks.
3. PBZ 500 ppm 2 weeks.
4. PBZ 500 ppm 1 week.
5. PBZ 750 ppm 3 weeks.
6. PBZ 750 ppm 2 weeks.
7. PBZ 750 ppm 1 week.
8. PBZ 1000 ppm 3 weeks.
9. PBZ 1000 ppm 2 weeks.
10. PBZ 1000 ppm 1 week.

Paclobutrazol was applied to Red Roomy grapevines at various concentrations on three distinct occasions: one week prior to flowering, two weeks prior to flowering, and three weeks prior to flowering. All other agricultural practices for the Red Roomy grapevines were conducted in accordance with standard procedures.

Data registered and measurements:

Vegetative growth traits:

1. The measurement of main shoot length (in centimeters) was conducted during the final week of December across both seasons, where the average length was determined by assessing ten main shoots from each vine.
2. The assessment of leaf area (cm^2) involved the selection of twenty mature leaves located opposite the basal clusters, utilizing the equation established by Ahmed and Morsy (1999). Leaf area (cm^2) = 0.45 (0.79 x maximum diameter^2) + 17.77 then average leaf area was registered.
3. Number of leaves per shoot.
4. Cane thickness (cm): in the last week of January, prior to the winter pruning, the thickness of the canes (measured in centimeters) was assessed by taking measurements from ten canes of each vine using a vernier caliper.
5. The mass of pruned wood, quantified in kilograms, was documented after the winter pruning procedure, which entailed the extraction of one-year-old pruning wood from each vine, with the results presented as kilograms per vine.
6. The coefficient for wood ripening was established by calculating the proportion of the length of the brownish segment of each cane in relation to the total length of the cane, in accordance with the equation proposed by Bouard (1966):

$$\textbf{Wood ripening coefficient} = \frac{\textbf{Length of brownish part of each cane}}{\textbf{Total length of the cane}}$$

Pigments determination:

The investigation into plant pigments, focusing on chlorophyll a, chlorophyll b, total chlorophylls, and total carotenoids, was performed and quantified in mg/g of fresh weight. To enable the assessment of leaf area, ten fresh leaves were gathered and subsequently divided into smaller pieces. A 0.5 g sample of these leaf fragments was homogenized and extracted using 25% acetone, with the assistance of a small amount of Na_2CO_3. The mixture was then filtered, and the residue was washed several times with acetone until the filtrate was devoid of color. Acetone was utilized as the blank in this analysis. The optical density of the resultant filtrate was assessed with a spectrophotometer at wavelengths of 662, 644, and 440 nm. The equations employed for the quantification of the three photosynthetic pigments were based on the methodologies established Von Wetstein (1957) and Hiscox and Isralstam (1979):

$$\textbf{Chl. a} = (9.784 - E662) - (0.99 - E644) = \textbf{mg.}$$

$$\textbf{Chl. b} = (21.426 - E644) - (4.65 - E662) = \textbf{mg.}$$

$$\textbf{Total chlorophylls} = \textbf{Chl. a} + \textbf{Chl. b.}$$

$$\textbf{Total carotenoids} = (4.965 - E440) - 0.268\,(\textbf{Chl. a} + \textbf{Chl. b.}) = \textbf{mg.}$$

Where: **E = optical density at a given wavelength. The concentrations of pigments were then expressed in mg/g fresh weight of leaves according to the following formula:**

$$\textbf{Concentration of pigments in mg/g FW} = \frac{\textbf{mg/l X dilution}}{\textbf{weight}} \textbf{X 100}$$

Determination of leaf content of N, P, K, Zn, Fe and Mn

To evaluate the levels of nitrogen (N), phosphorus (P), and potassium (K) in the dried leaves of the vines, ten leaves were collected from the primary branches located opposite the basal clusters of each vine. After being dried in an oven at 70 degrees Celsius, the petioles of these leaves were ground into a fine powder. A 0.5-gram portion of this crude dried powder from each treatment underwent wet digestion with a mixture of concentrated sulfuric acid (H_2SO_4) and perchloric acid ($HClPO_4$) in a 10:4 volume ratio, which was then heated until a clear solution was achieved. The resulting solution was carefully transferred into a 100 ml volumetric flask for further analysis.

- Nitrogen (%) was assessed utilizing a modified Micro-Kjeldahl apparatus, as outlined by Chapman and Bratt (1961).
- Phosphorus (%) was conducted spectrophotometrically through the application of the Olsen method, as detailed by Wilde *et al.* (1985) and Piper (1950).
- Potassium (%) estimation was performed using a flame photometer, following the methodology established by Chapman and Bratt (1961).
- Microelements (Zn, Fe and Mn) were determined by atomic apparatus using Flame Atomic Absorption Spectrometry Analytical Methods (2017).

Statistical analysis

The collected data were organized into tables and subjected to statistical analysis utilizing New L.S.D at a significance level of 5% to facilitate comparisons among the treatment means under investigation, as outlined by Snedecor and Cochran (1967) and Mead *et al.* (1993).

RESULTS AND DISCUSSION

Vegetative growth traits:

Data presented in Tables (1 to 7) proved the response of Red Roomy grapevines development [main shoot length, weight of pruning wood, leaf area, wood ripening coefficient, leaves number per vine, cane thickness (cm), pigments (chlorophyll a, b, total chlorophylls, and total carotenoids) and leaf nutrition status (N, P, K, Zn, Fe and Mn)] to paclobutrazol during both seasons.

The data presented in Table (1) indicate a significant reduction in main shoot length, leaf area and pruning wood weight across both experimental seasons following the application of all concentrations of paclobutrazol (PBZ) when compared to the control treatment. Specifically, the reductions observed for the three concentrations (500, 750 and 1000 ppm) were 3.12%, 4.44% and 5.58% for shoot length, 1.59%, 2.66% and 4.04% for leaf area and 5.15%, 9.28% and 11.34% for pruning wood weight in the first season, respectively. A similar pattern was noted in the second season for these parameters. The highest concentration of paclobutrazol (1000 ppm) resulted in the shortest shoots, the smallest leaf area, and the lightest pruning wood weight per vine, in both seasons. However, the differences between the concentrations of 750 and 1000 ppm were not statistically significant for the parameters mentioned. The observed effects of the growth retardant (PBZ) on the reduction of shoot length, leaf area pruning wood weight and can be attributed to its ability to inhibit cell division and elongation by disrupting the biosynthesis of gibberellins, as noted by Ghosh *et al*. (2022).

Our data are in harmony with those proved by Shaltout *et al*. (1988) on ‘Roumi Red’, Hunter and Proctor (1992) on *Vitis vinifera* L., Basiouny (1994) on Magnolia muscadine grapevines, Agüero *et al.* (1995) on Malvinas grapevines, Carreno *et al*. (2005) on Napoleon table grape, Todić *et al.* (2012) on grapevine Cabernet Sauvignon cultivar, Sable *et al.* (2016) on Thompson Seedless grape and Wassel *et al*. (2023) on Superior seedless grapevines.

The application time of growth retardants plays a critical role in determining the shoot length, leaf area and pruning wood weight per vine of Red Roomy grapevines. Our findings indicate that all three examined application timings significantly declined shoot length, leaf area and pruning wood weight throughout both seasons facing the control group, with the treatment involving PBZ application occurring two weeks prior to flowering demonstrating the most effective results across all concentrations (Table 1).

Unlike the previous traits, wood ripening coefficient, leaves number per vine and cane thickness were markedly augmented parallel with the increase in PBZ level in both seasons facing check treatment (Table 2). The lowest values were produced from treated vines, while the highest ones were achieved from vines sprayed with 1000 ppm PBZ. Once more, the differences between 750 and 1000 ppm failed to reach the level of significance in both seasons. Paclobutrazol restricts stem stretching or lengthening by inhibiting cell division within the sub-apical meristem. Generally leaving the apical meristem unaffected, which is in stark contrast to the effects of gibberellins. As a result, the metabolic byproducts are redirected towards the formation of new organs such as leaves, leading to the development of thicker stems and an increase in the quantity of branches (Ghosh *et al*., 2022).

Table 1. Effect of different concentrations of paclobutrazol on main shoot length (cm), weight of pruning wood (kg/vine) and leaf area (cm2) of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	Main shoot length (cm)		Weight of pruning wood (kg/vine)		Leaf area (cm^2)	
	2021/2022	2022/2023	2021/2022	2022/2023	2021/2022	2022/2023
Control	105.8	106.5	1.94	1.98	94.1	94.2
PBZ (500 ppm) 3 weeks	102.4	102.8	1.83	1.87	91.4	92.1
PBZ (500 ppm) 2 weeks	103.8	104.4	1.88	1.90	94.2	94.9
PBZ (500 ppm) 1 week	101.2	101.4	1.80	1.84	92.2	93.6
PBZ (750 ppm) 3 weeks	101.0	102.9	1.75	1.77	90.1	90.7
PBZ (750 ppm) 2 weeks	102.3	101.4	1.81	1.83	92.9	93.5
PBZ (750 ppm) 1 week	99.9	100.0	1.71	1.73	91.7	92.3
PBZ (1000 ppm) 3 weeks	99.9	100.0	1.71	1.72	89.7	89.1
PBZ (1000 ppm) 2 weeks	101.2	101.5	1.77	1.78	91.5	92.6
PBZ (1000 ppm) 1 week	98.7	98.7	1.69	1.68	90.2	90.6
New LSD at 5%	1.3	1.5	1.1	1.2	1.4	1.5

Many researchers demonstrated the positive effect of PBZ on wood ripening coefficient, leaves number per vine and cane thickness of different fruit trees, on *Vitis vinifera* L. (Hunter and Proctor, 1992), on Napoleon table grape (Carreno *et al*., 2005), on grapevine Cabernet Sauvignon cultivar (Todić *et al*., 2012) and on Fuji apple (Sha *et al*., 2021).

The application of the three examined treatments resulted in a notable enhancement of the wood ripening coefficient, the number of leaves, and the thickness of the canes through both seasons when compared to the control group, as listed in Table 2. The most pronounced results were observed in vines treated with PBZ at a concentration of 1000 ppm two weeks prior to flowering, yielding the highest measurements. Following closely were the vines treated with PBZ at 750 ppm under the same conditions in the first and second seasons, respectively, with no significant differences noted between these two superior treatments.

Table 2. Effect of different concentrations of paclobutrazol on wood ripening coefficient and leaves number per vine and cane thickness (cm) of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	Wood ripening coefficient		Leaves number per vine		Cane thickness (cm)	
	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
Control	0.65	0.66	15.0	16.0	0.99	1.02
PBZ (500 ppm) 3 weeks	0.70	0.71	16.9	17.5	1.07	1.11
PBZ (500 ppm) 2 weeks	0.76	0.77	18.2	18.8	1.15	1.14
PBZ (500 ppm) 1 week	0.79	0.81	19.2	20.0	1.17	1.16
PBZ (750 ppm) 3 weeks	0.76	0.71	18.1	18.8	1.12	1.15
PBZ (750 ppm) 2 weeks	0.81	0.82	20.3	21.2	1.22	1.21
PBZ (750 ppm) 1 week	0.84	0.86	19.3	20.2	1.18	1.19
PBZ (1000 ppm) 3 weeks	0.79	0.81	19.1	19.9	1.16	1.17
PBZ (1000 ppm) 2 weeks	0.84	0.86	21.2	22.3	1.25	1.22
PBZ (1000 ppm) 1 week	0.86	0.89	20.2	21.1	1.22	1.20
New LSD at 5%	0.04	0.05	1.1	1.2	0.05	0.03

Table 3. Effect of different concentrations of paclobutrazol on chlorophyll (a) and chlorophyll (b) of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	Chlorophyll (a)		Chlorophyll (b)	
	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
Control	2.73	2.78	0.97	0.99
PBZ (500 ppm) 3 weeks	2.89	2.98	1.03	1.06
PBZ (500 ppm) 2 weeks	3.18	3.26	1.13	1.16
PBZ (500 ppm) 1 week	3.09	3.15	1.10	1.12
PBZ (750 ppm) 3 weeks	3.13	3.25	1.11	1.12
PBZ (750 ppm) 2 weeks	3.28	3.39	1.17	1.25
PBZ (750 ppm) 1 week	3.19	3.27	1.15	1.21
PBZ (1000 ppm) 3 weeks	3.20	3.29	1.14	1.17
PBZ (1000 ppm) 2 weeks	3.46	3.51	1.23	1.25
PBZ (1000 ppm) 1 week	3.32	3.40	1.18	1.23
New LSD at 5%	0.14	0.11	0.05	0.03

Paclobutrazol acts as a safeguard by maintaining relative water content, enhancing membrane stability, and encouraging both photosynthesis and pigment production. It protects the photosynthetic machinery by raising the levels of osmolytes, enhancing antioxidant functions, and increasing concentrations of endogenous hormones, as noted by Soumya *et al*. (2017).

These results are in harmony with those reported by Shaltout *et al*. (1988), Baninasab and Shahgholi (2012), Sable *et al.* (2016) and Wassel *et al.* (2023) on *Vitis spp.*; Samini (2014) on peach; Javadi (2016) and Raja *et al.* (2018) on pear trees, and Sha *et al.* (2021) on apple.

The application of PBZ at three different times had a beneficial impact on the pigment contents of Red Roomy grapevines during both growing seasons. The results pointed out that the highest contents of pigments were observed in vines treated with PBZ at a concentration of 1000 ppm, two weeks prior to flowering, yielding chlorophyll a (3.46 and 3.51 mg/g FW), chlorophyll b (1.23 and 1.25 mg/g FW), total chlorophylls (4.69 and 4.71 mg/g FW), and total carotenoids (1.27 and 1.30 mg/g FW). This was closely followed by vines treated with PBZ at 750 ppm under the same conditions, as there were no significant differences between these two effective treatment levels.

With regard to the impact of paclobutrazol on leaf macro and microelements (N, P, K, Zn, Fe and Mn), data listed in Tables (5 to 7) stated that abovementioned nutrients were considerably improved. The increase in such elements concentrations were N (8.75, 11.88 and 14.38%), P (53.33, 86.66 and 93.33%), K (6.96, 12.17 and14.78%), Zn (12.00, 16.00 and 19.37%), Fe (11.79, 16.70 and 21.02%) and Mn (11.60, 17.40 and 22.00%) during the first season over untreated vines due to spraying vines with 500, 750 and 1000 ppm of PBZ, respectively. The enhancement of element uptake attributed to PBZ may stem from its ability to inhibit growth and limit the spread of vines, thereby facilitating a higher concentration of these elements within a unit area (Kumar *et al*., 2021).

Table 4. Effect of different concentrations of paclobutrazol on total chlorophylls and total carotenoids of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	Total chlorophylls		Total carotenoids	
	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
Control	3.70	3.77	1.01	1.03
PBZ (500 ppm) 3 weeks	3.92	4.04	1.07	1.09
PBZ (500 ppm) 2 weeks	4.31	4.42	1.17	1.20
PBZ (500 ppm) 1 week	4.19	4.27	1.14	1.17
PBZ (750 ppm) 3 weeks	4.23	4.27	1.15	1.17
PBZ (750 ppm) 2 weeks	4.43	4.58	1.24	1.27
PBZ (750 ppm) 1 week	4.37	4.54	1.21	1.22
PBZ (1000 ppm) 3 weeks	4.34	4.46	1.18	1.21
PBZ (1000 ppm) 2 weeks	4.69	4.76	1.27	1.30
PBZ (1000 ppm) 1 week	4.50	4.61	1.22	1.25
New LSD at 5%	0.18	0.16	0.03	0.04

Table 5. Effect of different concentrations of paclobutrazol on leaf content of N and P (%) of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	N (%)		P (%)	
	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
Control	1.60	1.57	0.15	0.14
PBZ (500 ppm) 3 weeks	1.69	1.65	0.20	0.21
PBZ (500 ppm) 2 weeks	1.78	1.77	0.26	0.29
PBZ (500 ppm) 1 week	1.74	1.72	0.24	0.26
PBZ (750 ppm) 3 weeks	1.75	1.71	0.25	0.26
PBZ (750 ppm) 2 weeks	1.83	1.81	0.30	0.32
PBZ (750 ppm) 1 week	1.80	1.77	0.28	0.30
PBZ (1000 ppm) 3 weeks	1.79	1.76	0.27	0.29
PBZ (1000 ppm) 2 weeks	1.86	1.86	0.31	0.35
PBZ (1000 ppm) 1 week	1.84	1.82	0.30	0.33
New LSD at 5%	0.05	0.06	0.03	0.04

Our results align with those demonstrated by Intrieri *et al.* (1986), Shaltout *et al.* (1988) and Wassel *et al.* (2023) on grapevines; Arzani and Rousta (2004) on apricot trees; Samini (2014) on peach trees and Raja *et al.* (2018) on pear trees.

The application timing of PBZ had a significant impact on all examined macro- and micro-elements throughout both seasons. The most notable values were observed in vines treated with PBZ at a concentration of 1000 ppm two weeks prior to flowering, closely followed by those treated with PBZ at 750 ppm under the same conditions, with no significant differences detected between these two effective treatments.

Table 6. Effect of different concentrations of paclobutrazol on leaf content of K (%) and Zn (ppm) of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	K (%)		Zn (ppm)	
	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
Control	1.15	1.16	47.5	49.0
PBZ (500 ppm) 3 weeks	1.19	1.20	51.5	53.1
PBZ (500 ppm) 2 weeks	1.27	1.26	54.9	56.6
PBZ (500 ppm) 1 week	1.24	1.24	53.3	54.9
PBZ (750 ppm) 3 weeks	1.25	1.24	55.3	56.8
PBZ (750 ppm) 2 weeks	1.32	1.29	56.1	58.0
PBZ (750 ppm) 1 week	1.30	1.27	54.0	55.5
PBZ (1000 ppm) 3 weeks	1.28	1.26	55.0	56.6
PBZ (1000 ppm) 2 weeks	1.35	1.31	58.4	60.0
PBZ (1000 ppm) 1 week	1.32	1.29	56.8	58.4
New LSD at 5%	0.04	0.03	1.7	1.8

Table 7. Effect of different concentrations of paclobutrazol on leaf content of Fe and Mn (ppm) of Red Roomy grapevines cv. during 2021/2022 and 2022/2023.

Treatments	Fe (ppm)		Mn (ppm)	
	2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
Control	50.9	51.1	50.0	50.5
PBZ (500 ppm) 3 weeks	54.6	54.5	53.4	53.9
PBZ (500 ppm) 2 weeks	59.1	59.2	58.1	58.8
PBZ (500 ppm) 1 week	57.0	57.0	59.9	56.5
PBZ (750 ppm) 3 weeks	57.1	56.9	55.8	56.4
PBZ (750 ppm) 2 weeks	61.6	61.8	60.2	61.0
PBZ (750 ppm) 1 week	59.4	59.5	58.1	58.8
PBZ (1000 ppm) 3 weeks	59.3	59.1	58.0	58.7
PBZ (1000 ppm) 2 weeks	63.8	63.9	62.1	63.3
PBZ (1000 ppm) 1 week	61.7	61.7	60.3	61.1
New LSD at 5%	2.3	2.4	2.3	2.4

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استجابة بعض الصفات الخضرية في كروم العنب الرومي الأحمر للمعاملة بالباكلوبوترازول

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الملخص

أجريت الدراسة الحالية على مدار موسمي نمو متتاليين، 2022/2021 و2023/2022، لدراسة تأثير إضافة الباكلوبوترازول بتركيزات 500 و750 و1000 جزء في المليون على تطور نمو كرمات العنب الرومي الأحمر. ولهذا الهدف، تم اختيار بستان كروم يقع في قرية طُوة، مركز المنيا – محافظة المنيا – مصر، كموقع لإجراء البحث. أدت إضافة جميع تركيزات الباكلوبوترازول على كرمات العنب الرومي الأحمر إلى انخفاض ملحوظ في انتشار الكرمة، كما يتضح ذلك من انخفاض طول الفروع (سم)، ومساحة الورقة (سم^2)، ووزن خشب التقليم (كجم / كرمة) مقارنة بالكرمات غير المعاملة. وعلى العكس من ذلك، أدى استخدام الباكلوبوترازول إلى زيادة كبيرة في معامل نضج الخشب وعدد الأوراق لكل كرمة وسمك السُلامية (سم) خلال كلا الموسمين التجريبيين عند مقارنته بمعاملة الكنترول. بالإضافة إلى ذلك، وُجد أن مستويات صبغات البناء الضوئي وكذلك تركيز المغذيات في الأوراق قد ارتفعا جنبًا إلى جنب مع زيادة تركيزات الباكلوبوترازول خلال الموسمين. ومن الجدير بالملاحظة أن أعلى تركيز من الباكلوبوترازول (1000 جزء في المليون) المضاف قبل أسبوعين من الإزهار أعطى أعلي النتائج، يليه عن كثب تركيز 750 جزء في المليون المُضاف في نفس الوقت، مع ملاحظة عدم وجود أي اختلافات معنوية بين هاتين المعاملتين الفعالتين. بناءً على النتائج التي توصلنا إليها، من المستحسن إضافة الباكلوبوترازول بتركيز 750 جزء في المليون على كرمات العنب الرومي الأحمر قبل أسبوعين من الإزهار من أجل تحقيق أفضل نمو خضري منظم، وخاصة تحت ظروف التجربة في محافظة المنيا.

الكلمات المفتاحية: العنب الرومي الأحمر - مثبطات النمو - الباكلوبوترازول - نمو النبات.