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Effect of Brassinolide and Forchlorfenuron on Yield and Fruit Quality of Prime Seedless Grapevines

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Abstract: This study was conducted during two seasons (2022 & 2023) to study the influence of brassinolide (BRs) at 0.5 & 1 ppm and forchlorfenuron (CPPU) at 3 & 6 ppm application, either alone or together, on the fruit quality and yield of Prime Seedless grapevines. This investigation was carried out in a commercial vineyard located in the Samalut district, Minia Governorate, Egypt, on 10-year-old vines grown in sandy loam soil, irrigated with drip irrigation system, and all vines were trained using the Spanish Parron system support. All vines are uniform and winter-pruned in the 1st week of December, and all treatments are subjected to the same agricultural practices during two seasons. The application of BRs or CPPU alone or in combination gives significant enhancement of quality characteristics such as the physical characters of clusters and berries, and improves the chemical characters of berries compared with control treatment. Eventually, the best results of yield and physical attributes of the cluster and berry were obtained from treatment of BRs at a rate of 1 ppm and CPPU at a rate of 6 ppm during the two seasons compared to the control treatment. In contrast, the highest values of TSS content and TSS/acidity ratio and the lowest values of total acidity were obtained by the application of BRs at 1 ppm during the two seasons.

Key words: Prime Seedless, brassinolide, forchlorfenuron, fruit quality.

1. Introduction

One of the most significant fruit a commodity in the world is the grapevine (*Vitis vinifera* L.), whose market demand and economic value are continuously rising. Recently, the demand for seedless grapes has increased on a large scale, with large berries that have rich flavour and berry firmness that has transport tolerance and storability as market demand increases. To meet previous needs, the use of different plant growth hormones has become an essential element in improving the quality of seedless grapes, as stated by **Dong *et al*. (2025) and Han *et al*. (2025)**. Regarding this, **Hassan and Behary**

(2021) reported that application of plant growth regulators such as forchlorfenuron (CPPU) has a positive distinctive effect on quality and quantity of Early Sweet grapes. Also, **Li *et al*. (2022)** revealed that foliar application of plant hormones like brassinolide enhances antioxidants and berry quality of Ruidu Hongyu grapevine cultivar.

Brassinolide (BRS) is defined as a type of brassinosteroid, the novel family of various hormones found in plants that have been defined by various names, including polyhydroxylated steroidal plant hormone, new class of plant hormones, and new and unique class of plant growth regulators (**Fariduddin *et al*., 2014**). They were originally known as brassins, but they were later called brassinosteroids after being found in the pollen grains of Brassica napus. They were found throughout the kingdom of plants and have also been documented in various plant components. However, the amount varies depending on the part of the plant. Compared to mature tissues, younger growing tissues have a higher brassinolide concentration. BRs are also involved in the regulation of numerous genes in plants, **Chen *et al*. (2017)** showed that BRs stimulated WRKY46, WRKY54, and WRKY70 genes that were identified to have beneficial roles in BR-regulated plant growth in A. thaliana. Further, **Trevisan *et al*. (2020)** Through its interaction with plant growth regulators or other plant hormones, BRs can enhance plant performance and participate in physiological processes in response to stress. According to **Sirhindi (2013**), they are essential and crucial in a variety of growth and developmental reactions. Cell division and elongation in stems and roots, reproductive development, photomorphogenesis, leaf withering, and stress responses are among the activities that brassinolide affect. In the kingdom of plants, BRs are naturally occurring steroid-like hormones that are essential to a number of growth and development processes, including cell division and elongation, photomorphogenesis, vascular differentiation, flowering, senescence, and tolerance to biotic and abiotic stresses (**Wei *et al*., 2020**). Interestingly, numerous earlier studies have verified the beneficial effects of BRs on the ripening process of grapes. In addition to significantly increasing the accumulation of soluble sugars and other phenolics, the exogenous spray of brassinolide also increased the activity of enzymes and the expression of genes linked to sugar biosynthesis pathways **(Xi *et al*., 2013).** Also, they reported that BRs, often referred to as the environmentally friendly hormone, have been widely employed to increase yield and provide resistance in the face of various stressors. Interestingly, **Liu *et al*., (2025)** stated that the fruit ripening and the transcription level of BR biosynthesis genes are positively correlated. Eventually, a number of physio-biochemical and developmental processes of plants, including cell enlargement, nutrient uptake, leaf formation, enzymatic activity, CO2 fixation, photosynthetic activity, stomatal behavior, protein synthesis, and fruit ripening, are regulated by brassinolide, a bioactive, most stable analogue and active form of BRs **(Tanveer *et al*., 2019)**

Forchlorfnuron (CPPU), is a synthetic cytokinin group member having a phenyl urea structure (**Hota *et al*., 2017).** Also, they reported that fruit size has been successfully increased in a variety of fruit crops using CPPU, also known as N- (2-Chloro-4-pyridyl)-N-phenylurea. According to **Hajam *et al*. (2018**), the mode of action of CPPU in increasing fruit size is as follows: 1st, increasing cell expansion in the late stages of fruit development; 2nd, accelerating cell division in the early stages. Additionally, CPPU applications showed several benefits, such as enhancing of fruit firmness and, fruit firmness is a complex attribute encompassing both mechanical and sensory properties. Mechanical assessments of firmness have shown a strong correlation with consumer satisfaction and feedback from taster panels (**Rojas *et al*., 2021**). Moreover, CPPU could reduce oxidation factors that affect the cell structure of plants by decreasing the levels of cytochrome oxidase, whereas it prevents the deterioration of plant cell walls by decreasing the levels of ascorbic acid oxidase, as a result increasing the fruit characters such as adhesion power between plant cells **(Yu *et al*., 2021**). In addition, CPPU works best in the early phases of fruit development, especially immediately following fruit set, and mainly affects meristematic cells, which are responsible for cell division. Cell division is quite active during this stage, enabling CPPU to increase fruit size by producing more cells **(Wu *et al*., 2020**).

The target of this investigation is to study the influence of exogenous application of brassinolide (BRs) and forchlorfenuron (CPPU) on the performance and berry quality of Prime Seedless grapevines.

2. Materials and Methods

The experiment was conducted over two growing seasons (2022 and 2023) at a private commercial vineyard situated in Samalout district, El-Minya Governorate, Upper Egypt. Soil texture is sandy loam on 10-year-old vines Prime Seedless grapevines and irrigated with drip irrigation system. Common horticultural practices were applied to the all treatment vines. Vines at a spacing of 2 × 3 m and trained on the Spanish Parron system support, which is the all vines uniform and winter pruned in 1st week of December.

Three replications of each treatment were made, using two vines for each. All different doses of brassinolide (BRs) were foliar sprayed twice: after the bud burst stage and again after fruit set stage when the berry diameter reaches 2-3 mm, while cluster sprayed with forchlorfenuron (CPPU) twice: once on a date with a berry diameter of 4 to 5 mm, and again after two weeks following the berry set stage.

Nine treatments were used in this study, and they are as follows:

1. Control (spraying with water)
2. BRs at 0.5 ppm
3. BRs at 1 ppm
4. CPPU at 3 ppm
5. CPPU at 6 ppm
6. BRs at 0.5 ppm + CPPU at 3 ppm
7. BRs at 0.5 ppm + CPPU at 6 ppm
8. BRs at 1 ppm + CPPU at 3 ppm
9. BRs at 1 ppm + CPPU at 6 ppm

Throughout the two experimental seasons, the following measurements were taken:

Cluster and berry yield and physical attributes

Five clusters per vine were taken at the ripening stage when juice TSS% reached roughly 16–17% on the harvest date (the last week of May) in both seasons in order to measure the following parameters:

- Yield: yield/vine (kg) was computed by multiplying number of clusters/vine by cluster weight and expressed in (kg).
- The average cluster width and length in centimeters. Weight of the average cluster (g). The average number of clusters per vine.
- The weight of berries on average (g).
- Average berry size (cm^2), diameter (cm), and length (cm)
- The average berry firmness (g/cm^2) was measured using an Italian penetrometer (Model FT 011).

Berry chemical characters

- Total soluble solids (TSS %): was calculated in juice using a hand refractometer.
- Acidity: The **A.O.A.C. (2005)** technique was used to measure titratable acidity.

- The ratio of acid to TSS.
- Juice's antioxidant activity (DPPH) was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging method in accordance with **Cheng*et al*. (2008)**.

Design of experiments and statistical analysis

For this experiment, the complete randomized block design was used. The current data was statistically analyzed in accordance with **Snedecor and Cochran (1980)**. The new L.S.D. values at the 5% level were used to compare averages **(Steel and Torrie, 1980**).

3. Results

Physical cluster characteristics

It was clear from Table (1) that the application of BRs and CPPU has positive impacts on cluster characteristics such as cluster length, cluster width, cluster weight, and No. of clusters / vine during two seasons. The individual use of both BRs and CPPU significantly affected cluster characteristics compared to the control treatment during the 2022 and 2023 seasons. The combined use of both BRs and CPPU at different concentrations was better than individual treatment in terms of cluster characteristics during two seasons. In this regard, the best values in this regard, the highest value obtained for improving the various cluster properties was achieved by using both BRs at a concentration of 1 ppm and CPPU at a concentration of 6 ppm mixed together.

Table (1). Impact of brassinolide (BRs) and forchlorfenuron (CPPU) on physical cluster characteristics of Prime Seedless grapevines

Treatments	Cluster length (cm)		Cluster width (cm)		Cluster weight (g)		No. of clusters /vine	
	2022	2023	2022	2023	2022	2023	2022	2023
Control	15.0	15.1	14.1	14.0	350.1	350	25.3	24.9
BRs at 0.5 ppm	16.7	17.5	15.6	16.0	430.1	445.8	25.2	26.2
BRs at 1 ppm	17.2	18.5	16.2	16.4	448.8	467.9	25.1	27.6
CPPU at 3 ppm	17.9	18.7	16.4	16.7	466.9	481.6	25.3	27.1
CPPU at 6 ppm	19.6	20.3	17.2	17.8	520.4	572.8	25.2	27.7
BRs at 0.5 ppm + CPPU at 3 ppm	20.4	20.7	17.5	18.0	567.1	592.3	25.4	28.2
BRs at 0.5 ppm + CPPU at 6 ppm	22.6	23.8	18.7	19.7	622.1	643.7	25.3	30.4
BRs at 1 ppm + CPPU at 3 ppm	21.2	22.9	18.2	19.1	611.6	636.7	25.3	29.5
BRs at 1 ppm + CPPU at 6 ppm	23.4	25.2	19.2	20.3	635.2	667.4	25.0	33.6
New L.S.D at 5 %	0.4	0.3	0.2	0.2	8.3	9.5	N.S.	0.4

Yield, berry firmness and antioxidants

Based on Table (2), it was obvious that yield, antioxidant activity and berry firmness were influenced by different BRs or CPPU application in each treatment per vine during two seasons compared by control. During the 2022 and 2023 seasons, the mentioned characters had higher values when both BRs and CPPU were higher. On the other hand, the combined application of CPPU or BRs has greater values than the individual application. In this regard, treatment of BRs at rate 1 ppm + CPPU at rate 6 ppm produced the best values of the aforementioned characters, followed by treatment of BRs at rate 0.5 ppm + CPPU at rate 6 ppm over two seasons. In this respect, the best values of the mentioned characters were obtained from treatment of BRs at a rate of 1 ppm + CPPU at a rate of 6 ppm, followed by treatment of BRs at a rate of 0.5 ppm + CPPU at a rate of 6 ppm during two seasons.

Table (2). Impact of brassinolide (BRs) and forchlorfenuron (CPPU) on yield, berry firmness, and antioxidants of Prime Seedless grapevines

Treatments	Yield/ vine (kg)		Berry firmness (g/cm²)		Antioxidants (DPPH %)	
	2022	2023	2022	2023	2022	2023
Control	8.86	8.72	492.1	493.3	43.2	42.3
BRs at 0.5 ppm	10.84	11.68	628.1	639.0	47.4	47.7
BRs at 1 ppm	11.26	12.91	636.2	645.0	50.2	51.1
CPPU at 3 ppm	11.81	13.05	649.4	660.5	51.6	52.5
CPPU at 6 ppm	13.11	15.87	637.2	649.6	53.2	54.3
BRs at 0.5 ppm + CPPU at 3 ppm	14.40	16.70	655.3	667.1	54.4	54.8
BRs at 0.5 ppm + CPPU at 6 ppm	15.74	19.57	668.9	682.7	56.2	56.9
BRs at 1 ppm + CPPU at 3 ppm	15.47	18.78	664.2	677.9	55.6	56.4
BRs at 1 ppm + CPPU at 6 ppm	15.88	22.42	678.8	700.2	59.7	61.0
New L.S.D at 5 %	0.80	1.20	1.1	1.3	0.2	0.3

Berry physical characteristics

It is quite clear from data showed in Table (3) that berry characteristics, including weight, length, width, and size of Prime Seedless grape berries were impacted by different application of BRs and CPPU at different concentration per vine during 2022 and 2023 seasons. When compared to other treatments over both seasons, it is clear that BRs and CPPU individually provided significantly higher values for the mentioned characters than the control treatment during both seasons. In 2022 and 2023, the combination application of CPPU at 3 or 6 ppm with BRs at 0.5 or 1 ppm produced better results than the application alone. Eventually, the best values of the mentioned characters were obtained from treatment of BRs at a rate of 1 ppm + CPPU at a rate of 6 ppm, followed by treatment of BRs at a rate of 0.5 ppm + CPPU at a rate of 6 ppm during 2022 and 2023 seasons.

Berry chemical parameters

The results in Table (4) make it quite evident that varied the applications of plant hormones (BRs & CPPU) during the 2022 and 2023 seasons had varied impacts on the TSS content, total acidity, and T.S.S./acidity ratio of Prime Seedless berries. It's obvious that using CPPU at 3 or 6 ppm in individual applications had the lowest values in TSS content and TSS/acidity ratio, whereas it had the highest values in total acidity in the grape berry compared to the control treatment during two seasons. However, when combined, the application of CPPU, either 3 or 6 ppm, with the application of BRs, either 0.5 or 1 ppm, had higher values on TSS content and TSS/acidity ratio while having lower values on total acidity compared to the control treatment in both seasons. In this regard, the best result in the highest values of TSS content and TSS/acidity ratio and the lowest values of total acidity was obtained by the application of BRs at 1 ppm, followed by BRs at 1 ppm + CPPU 3 ppm during the 2022 and 2023 seasons.

Table (3). Impact of brassinolide (BRs) and forchlorfenuron (CPPU) on berry physical characteristics of Prime Seedless grapevines

Treatments	Berry weight (g)		Berry length (cm)		Berry diameter (cm)		Berry size (cm^3)	
	2022	2023	2022	2023	2022	2023	2022	2023
Control	3.17	3.16	2.17	2.18	1.79	1.78	3.74	3.73
BRs at 0.5 ppm	3.91	4.05	2.25	2.33	1.95	2.00	3.83	4.07
BRs at 1 ppm	4.08	4.26	2.31	2.38	2.05	2.12	3.96	4.21
CPPU at 3 ppm	4.25	4.37	2.37	2.42	2.10	2.14	4.13	4.33
CPPU at 6 ppm	4.73	5.20	2.43	2.46	2.14	2.18	4.22	4.49
BRs at 0.5 ppm + CPPU at 3 ppm	5.14	5.38	2.48	2.54	2.17	2.20	4.31	4.57
BRs at 0.5 ppm + CPPU at 6 ppm	5.65	5.85	2.52	2.60	2.22	2.25	4.42	4.69
BRs at 1 ppm + CPPU at 3 ppm	5.55	5.78	2.49	2.58	2.15	2.22	4.53	4.83
BRs at 1 ppm + CPPU at 6 ppm	5.71	6.02	2.64	2.70	2.24	2.28	4.59	4.91
New L.S.D at 5 %	0.04	0.05	0.01	0.02	0.03	0.04	0.03	0.04

Table (4). Impact of brassinolide (BRs) and forchlorfenuron (CPPU) on berry Chemical Characteristics of Prime Seedless grapevines

Treatments	TSS (%)		Acidity (%)		TSS/ acid ratio	
	2022	2023	2022	2023	2022	2023
Control	16.76	16.78	0.63	0.61	26.60	27.51
BRs at 0.5 ppm	17.03	17.08	0.53	0.51	32.13	33.49
BRs at 1 ppm	17.39	17.50	0.47	0.42	37.00	41.67
CPPU at 3 ppm	16.73	16.75	0.65	0.61	25.74	27.46
CPPU at 6 ppm	16.03	16.04	0.66	0.63	24.29	25.46
BRs at 0.5 ppm + CPPU at 3 ppm	16.86	16.92	0.59	0.57	28.58	29.68
BRs at 0.5 ppm + CPPU at 6 ppm	16.80	16.84	0.61	0.59	27.54	28.54
BRs at 1 ppm + CPPU at 3 ppm	17.17	17.21	0.51	0.48	33.67	35.85
BRs at 1 ppm + CPPU at 6 ppm	16.99	17.05	0.55	0.52	30.89	32.79
New L.S.D at 5 %	0.01	0.01	0.01	0.01	1.20	1.30

4. Discussion

One of the most important ways to improve the flavor, size, and sensory qualities of grape berries is by the exogenous application of plant hormones **(Crupi *et al.*, 2019)**. Based on the various beneficial impacts of plant growth hormones in enhancing grape berry characteristics, we applied two plant hormones, such as brassinolide (BRs) and forchlorfenuron (CPPU).

Brassinolide **(**BRs) have many roles in plants; according to **Sirhindi (2013)**, they are essential and crucial in a variety of growth and developmental reactions. Cell division and elongation in stems and roots, reproductive development, photo-morphogenesis, leaf withering, and stress responses are among the activities that brassinolide affect. In the kingdom of plants, BRs are naturally occurring steroid-like hormones that are essential to a number of growth and development processes, including cell division and elongation, photo-morphogenesis, vascular differentiation, flowering, senescence, and tolerance to biotic and abiotic stresses (**Wei *et al*., 2020**).The mode of action of BRS effects on the physical characteristics of berries occurs in three ways: First, BRS encourages the activation of H^+-ATPase, which is involved in enzymes that loosen cell walls, leading to cell elongation and growth promotion **(Alam*et al*., 2019**). 2nd, by preventing chlorophyll distortion and safeguarding the chloroplast membrane and cell ultrastructure, the BRs treatment improves the photosynthetic characteristics of plants. 3rd According to **Sirhindi (2013),** the recovery of photosynthetic pigments following external EBL application is anticipated because of the modification of transcription and translation processes that result in their production or decrease in breakdown. Moreover, **Xi *et al*. (2013)** reported that BRs, often referred to as the environmentally friendly hormone, have been widely employed to increase yield and provide resistance in the face of various stressors.BRS application increased the expression of the positive regulator of ethylene signaling, VvERF1 and this suggests that EBR application enhances ethylene signal transduction during grape berry ripening. Similarly, by raising ethylene levels, BRs start a chain reaction that results in ripening (**Liu *et al*., 2025).** Moreover, **Wang *et al*. (2019)** indicated that the foliar application of BRS has been increasing ABA levels, and it also induces the genes' biosynthesis transcription of ABA and signaling genes that are responsible for berry ripening. Furthermore, Additionally, EBL has a role in the translocation and facilitation of photosynthates from the source to the sink as well as the structural alteration of the plasma membrane **(Manghwar *et al*., 2022**). The previous positive effects of BRs on ethylene and ABA levels in grape berries explain the increase in the berry chemicals characteristics of Prime Seedless grapes during the two seasons.

Forchlorfnuron (CPPU) is one in which fruit size has been successfully increased in a variety of fruit crops. According to **Hajam *et al*. (2018**), the mode of action of CPPU in increasing fruit size is as follows: 1st, increasing cell expansion in the late stages of fruit development; 2^{nd}, accelerating cell division in the early stages. Additionally, CPPU applications showed several benefits, such as enhancing of fruit firmness and, fruit firmness is a complex attribute encompassing both mechanical and sensory properties. Mechanical assessments of firmness have shown a strong correlation with consumer satisfaction and feedback from taster panels (**Rojas *et al*., 2021**). Also, CPPU has many roles in increasing antioxidant activity by the following mechanisms: 1^{st}, CPPU could reduce oxidation factors that affect the cell structure of plants by decreasing the levels of cytochrome oxidase; 2^{nd}, it prevents the deterioration of plant cell walls by decreasing the levels of ascorbic acid oxidase, as a result increasing the fruit characteristics such as adhesion power between plant cells **(Yu *et al*., 2021**). In addition, CPPU can affect the physical properties of grape berries, but it works best in the early phases of fruit development, especially immediately following fruit set, and mainly affects meristematic cells, which are responsible for cell division. Cell division is quite active during this stage, enabling CPPU to increase fruit size by producing more cells (**Wu *et al*., 2020**).

5. Conclusion

From this investigation, it could be concluded that the application of BRs and CPPU had different effects on cluster parameters, berry parameters, antioxidant activity, and the yield of Prime Seedless grapevines during two seasons. In this regard, the best results of yield and physical attributes of the cluster and berry were obtained from treatment of BRs at 1 ppm + CPPU at 6 ppm compared to the control treatment. On the other side, the best result in the highest values of TSS content and TSS/acidity ratio and the lowest values of total acidity was obtained by the application of BRs at 1 ppm.

References

A.O.A.CA (2005). *Association of Official Analytical Chemists*, 18^{th} Ed. A.O.A.CA PenjaminEranklin Station, Washington, D.C.A., S.E.A. 510.

Alam, P., Albalawi, T.H., Altalayan, F.H., Bakht, M.A., Ahanger, M.A., Raja, V. and Ahmad, P. (2019). 24–Epibrassinolide (EBR) confers tolerance against NaCl stress in soybean plants by up-regulating antioxidant system, ascorbate-glutathione cycle, and glyoxalase system. Biomolecules, 9:640.

Chen, J., Nolan, T.M., Ye, H., Zhang, M., Tong, H., Xin, P., Chu, J., Chu, C., Li, Z. and Yin, Y. (2017). Arabidopsis WRKY46, WRKY54, and WRKY70 transcription factors are involved in brassinosteroid-regulated plant growth and drought responses. Plant Cell, 29, 1425-1439.

Cheng, H., Liao, J.W., Yang, H.L. Lu, F.J., Huang, C.J., Hsu, H.K., Chen, C.S., Chia, Y.C., Wu, J.J. and Chang, W.H. (2008). Antioxidant activities of ToonaSinensis leave extract using different antioxidant models. *Food ChemToxi*., 46. *Food and Chemical Toxicology*, 46 (5), 1751-1758. https://doi.org/10.1016/j.fct.2008.01.013

Crupi, P., Alba, V., Masi, G., Caputo, A.R. a. and Tarricone, L. (2019). Effect of two exogenous plant growth regulators on the color and quality parameters of seedless table grape berries. Food Research International 126:108667.

Dong, J., Zhang, P., Li, W., Li, H., Zhou, G., Chen, K., Fang, Y. and Zhang, K. (2025). Effects of seedlessness and swelling treatments based on GA3 and CPPU on the fruit Quality of "Shine Muscat" grapes. Sci. Agric. Sin., 58, 2008-2021.

Fariduddin, Q., Yusuf, M., Ahmad, I. and Ahmad, A. (2014). Brassinosteroids and their role in response of plants to abiotic stresses. Biol. Plant, 58, 9-17.

Hajam, M.A., Hassan, G.I., Parray, E.A., Wani, M.A., Shabir, A., Khan, I.F., Wani, A.W., Bhat, T.A. and Masoodi, L. (2018). Transforming fruit production by plant growth regulators. Journal of Pharmacognosy and Phytochemistry, 7(1):1613- 1617.

Han, X., Mi, Y., Wang, H., Ye, S., Abe-Kanoh, N. and Ji, W. (2025). Influence of GA3 and CPPU on the quality Attributes and peelability of 'WuheCuibao' Grape. Agronomy, 15:1986.

Hassan, A.E. and Behary, E.H.M. (2021). Effect of some gibberellic acid and forchlorfnuron application on productivity and berries development of early sweet grapes. Menoufia J. Plant Prod., 6, 289-298.

Hota, D., Sharma, D.P. and Sharma, N. (2017). Effect of forchlorfenuron and N-acetyl thiazolidine 4-carboxylic acid on vegetative growth and fruit set of apricot (*Prunus armeniaca* L.) cv. New Castle. Journal of Pharmacognosy and Phytochemistry, 6(2): 279 -282.

Li, J., Javed, H.U., Wu, Z., Wang, L., Han, J., Zhang, Y., Ma, C., Jiu, S., Zhang, C. and Wang, S. (2022). Improving berry quality and antioxidant ability in 'RuiduHongyu' grapevine through preharvest exogenous 2, 4–epibrassinolide, jasmonic acid and their sign inhibitors by regulating endogenous phytohormones. Front. Plant Sci., 13, 1035022.

Liu, Y., You, R., Gong, D., Zhao, P. and Ji, X. (2025). Effect of brassinosteroids on grape berry ripening by coordinating transcriptomic and metabolic analysis. Food Innovation and Advances 4(2): 253-265 https://doi.org/10.48130/fia-0025-0024

Manghwar, H., Hussain, A., Ali, Q. and Liu, F. (2022). Brassinosteroids (BRs) role in plant development and coping with different stresses. Int. J. Mol. Sci. 23, 1012.

Rojas, B., Suárez-Vega, F., Saez-Aguayo, S., Olmedo, P., Zepeda, B., Delgado-Rioseco, J., Defilippi, B.G., Pedreschi, R., Meneses, C. and Pérez-Donoso, A.G. (2021). Pre-anthesiscytokinin applications increase table grape berry firmness by modulating cell wall polysaccharides. Plants, 10, 2642.

Sirhindi, G. (2013). Brassinosteroids biosynthesis and role in growth, development, and thermotolerance responses. In: Rout, G.R., Das, A.B. (Eds.), Molecular Stress Physiology of Plants. Springer, India, pp. 309-329.

Snedecor, A.G.W.B. and Cochran, E.W.G. (1980). *Statistical Methods*, 8th ed., Iowa State, Press. Amese., Iowa, 593.

Steel, F.R.G. and Torrie, A.J.H. (1980). *Reproduced from principles and procedures of statistics, Permission from C. I. Bliss*, printed, 449.

Tanveer, M., Shahzad, B., Sharma, A. and Khan, E.A., (2019) .24-Epibrassinolide application in plants: an implication for improving drought stress tolerance in plants. Plant Physiol. Biochem.135:295-303.

Trevisan, S., Forestan, C., Brojanigo, S., Quaggiotti, S. and Varotto, S. (2020). Brassinosteroid application affects the growth and gravitropic response of maize by regulating gene expression in the roots, shoots and leaves. Plant Growth Regul., 92:117-130.

Wang, Y.T., Chen, Z.Y., Jiang, Y., Duan, B.B. and Xi, Z.M. (2019). Involvement of ABA and antioxidant system in brassinosteroid-induced water stress tolerance of grapevine (*Vitis vinifera* L.). ScientiaHorticulturae 256:108596.

Wei, Z., Li, J. and Jia L. (2020). Regulation of brassinosteroid homeostasis in higherplants. Frontiers in Plant Science 11:583622.

Wu, L., Lan, J., Xiang, X., Xiang, H., Jin, Z., Khan, S. and Liu, Y. (2020). Transcriptome sequencing and endogenous phytohormone analysis reveal new insights in CPPU controlling fruit development in Kiwifruit (*Actinidia chinensis*). PLoS ONE, 15, e0240355.

Xi, Z.M., Zhang, Z.W., Huo, S.S., Luan, L.Y. and Gao, X. (2013). Regulating thesecondary metabolism in grape berry using exogenous 24-epibrassinolidefor enhanced phenolics content and antioxidant capacity. FoodChemistry 141:3056-65.

Yu, Y.H., Li, X.F., Yang, S.D., Bian, L., Yu, K.K., Meng, X., Liu, H.N., and Guo, D.L. (2021). CPPU-induced changes in energy status and respiration metabolism of grape young berry development in relation to berry setting. cientiaHorticulturae, 283:110084.

تأثير البراسينوليد والفوركلورفينورون على المحصول وجودة الثمار لكرمات العنب البرايم سيدليس

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الملخص

أُجريت هذه الدراسة خلال موسمين (2022 و2023) لدراسة تأثير استخدام البراسينوليد بتركيز 0،5 ، 1 جزء في المليون، والفوركلورفينورون بتركيز 3 ، 6 جزء في المليون، سواءً بشكل منفرد أو مخلوطا معا ، على جودة ثمار وإنتاجية كرمات العنب صنف البرايم سيدليس. نُفذت هذه الدراسة في مزرعة عنب تجارية تقع في منطقة سمالوط، محافظة المنيا، مصر، على كرمات عمرها 10 سنوات مزروعة في تربة رملية ، تُروى بنظام الري بالتنقيط، وتم تدعيم جميع الكرمات باستخدام نظام بارون الإسباني. جميع الكرمات متجانسة، وتُقلم تقليمًا شتويًا في الأسبوع الأول من شهر ديسمبر، وتم توحيد جميع المعاملات لنفس الممارسات الزراعية خلال الموسمين. أدى استخدام البراسينوليد أو الفوركلورفينورون، منفردين أو مجتمعين، إلى تحسين ملحوظ في خصائص الجودة، مثل الخصائص الفيزيائية للعناقيد والثمار، كما حسّن الخصائص الكيميائية للثمار مقارنةً بمعاملة الكنترول. وأخيرا، تم الحصول على أفضل النتائج من حيث المحصول والخصائص الفيزيائية للعناقيد والثمار عند استخدام البراسينوليد بتركيز 1 جزء في المليون ومبيد فوركلورفينورون بتركيز 6 جزء في المليون خلال الموسمين، مقارنةً بمعاملة الكنترول. وفي المقابل، سُجلت أعلى قيم لمحتوى المواد الصلبة الذائبة الكلية ونسبة المواد الصلبة الذائبة الكلية إلى الحموضة، بالإضافة إلى أدنى قيم للحموضة الكلية، عند استخدام البراسينوليد بتركيز 1 جزء في المليون خلال الموسمين.