# Enhancing the performance of Red Globe grapevines via foliar spraying with brassinolide and Jasmonic acid

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## ABSTRACT

The present research was conducted during 2022 and 2023 seasons in a private vineyard in Matay center, Minia Governorate, Egypt to enhance the vegetative growth, productivity and berry quality of Red Globe grapevines via foliar spraying with brassinolide and jasmonic acid. Fourteen-year-old vines were planted 2*3 meters apart in sandy soil with drip irrigation and trellised using the Gable system. In the last week of January, the vines were cane pruned with a bud load of 96 buds/vine. Twelve treatments were conducted as follows: three concentrations of brassinolide (0.5, 1 and 2 ppm) and two concentrations of jasmonic acid (10 and 20 ppm) were foliar sprayed either alone or together, in addition to the control treatment (foliar spraying with water). All treatments were applied three times; the 1st time (following the bud burst stage), the 2nd time (at fruit set stage) and the 3rd time (two weeks following the fruit set stage). The results displayed that the combined application of brassinolide at 2 ppm plus jasmonic acid at 20 ppm attained the best results in terms of enhancing the vegetative growth traits and leaf chlorophyll content, which reflected therapy in increasing yield and improving berry physiochemical attributes of Red Globe grapevines.
**Keywords:** Grape- Red Globe- Brassinolide- Jasmonic Acid- Yield

## INTRODUCTION

Red Globe is a late ripening seeded grape cultivar and one of the promising cultivars to extend its' cultivation in Egypt. Yet unfortunately this cultivar is of quite a low vigour which leads in a way to quite low quality attributes, uneven ripening and high risk of sun burn (Sabry et al., 2009).

Brassinolide (BL) is a crucial endogenous phytohormone with the capacity to greatly boost productivity and growth in plants at low doses (Kim et al., 2005), additionally it contributes in raising the amount of chlorophyll, enhancing the efficiency of photosynthesis, encouraging root growth, and accelerating fruit maturity (An et al., 2018). In the meantime, it might be charged of enhancing plants' ability to withstand harsh environmental conditions like drought and salt (Tanveer et al., 2018). Furthermore, it plays a vital role in the regulation of fruit quality (Li et al., 2023).

Jasmonic acid (JA) is an internal plant regulator that improves plant's capacity to scavenge free radicals and strengthen its antioxidant system, which in turn affects the growth and defense of the plant (Wang and Lin, 2000). Also, it regulates stress responses (Aubert et al., 2015). Moreover, it increases the transcription levels of several color-associated genes, which has a positive effect on qualitative attributes and increases the manufacture of anthocyanins and antioxidant activity in various types of fruits (Jia et al., 2016 and Wei et al., 2017). In addition, it lessens the signs of ageing, which include increased respiratory rate, the activity of protease and peroxidase, and a significant loss of chlorophyll **(**Hussein et al., 2023).

The scope of the present investigation is to enhance vegetative growth, yield and berry quality of Red Globe grapevines via foliar spraying with brassinolide and jasmonic acid.

## MATERIALS AND METHODS

The present research was conducted during 2022 and 2023 seasons in a private vineyard in Matay, Minia governorate, Egypt to enhance the vegetative growth,

productivity and berry quality of Red Globe grapevines via foliar spraying with brassinolide and jasmonic acid. Fourteen-year-old vines were planted 2*3 meters apart in sandy soil with drip irrigation system and trellised using the Gable system. In the last week of January, the vines were cane pruned (8 canes*12 buds) with a bud load of 96 buds/vine.

108 vines were chosen. Every three vines acted as a replicate, with three replicates for each treatment.

Twelve treatments were foliar sprayed as follows:

1. Tap water (Control)
2. Brassinolide at 0.5 ppm
3. Brassinolide at 1 ppm
4. Brassinolide at 2 ppm
5. Jasmonic acid at 10 ppm
6. Jasmonic acid at 20 ppm
7. Brassinolide at 0.5 ppm + Jasmonic acid at 10 ppm
8. Brassinolide at 0.5 ppm + Jasmonic acid at 20 ppm
9. Brassinolide at 1 ppm + Jasmonic acid at 10 ppm
10. Brassinolide at 1 ppm + Jasmonic acid at 20 ppm
11. Brassinolide at 2 ppm + Jasmonic acid at 10 ppm
12. Brassinolide at 2 ppm + Jasmonic acid at 20 ppm

Brassinolide (BL) was used as mark Blank® and purchased from European group for agricultural development, Alexandria, Egypt, with the active ingredient (1% BL), while Jasmonic acid (JA) was obtained from Sigma-Aldrich Company, with the active ingredient (99% JA).

All treatments were applied three times; the 1st time (following the bud burst stage), the 2nd time (at fruit set stage) and the 3rd time (two weeks following the fruit set stage). Spraying continued until runoff, with 0.1% of Triton B employed as a wetting agent in all foliar treatments.

**Quality parameters:**

**1- Vegetative growth traits:**

At growth cessation, 6 non-fruiting shoots were randomly selected to measure the average length of shoots (cm), No. of leaves/shoot and leaf area ($cm^2$) of the $6^{th}$ and $7^{th}$ nodes from the tip of the shoot according to Montero et al. (2000). In addition to, the total chlorophyll content of leaves (mg/g F.W.) was estimated in accordance with Mackinny (1941).

**2-Yield and cluster physical characteristics:**

When TSS reached approximately 16–17% at maturity, representative random samples of nine clusters per vine were harvested (Tourky et al., 1995). The following attributed were assessed: yield/vine (kg), cluster weight (g) and dimensions (cm).

**3- Physical properties of berries:**

For every treatment, sixty berries were chosen at random, and the following gauges were estimated: average berry weight (g), size ($cm^3$), dimensions (cm) and firmness ($g/cm^2$).

**4- Chemical properties of berries:**

Total soluble solids (TSS %) and total acidity as (g tartaric acid/100 ml juice) were determined as ascribed to A.O.A.C. (2005). TSS/acid ratio was calculated. In addition to, total anthocyanin (mg/100 g FW) was identified ascribed to Yildiz and Dikmen (1990).

**Experimental design and statistical analysis:**

A completely randomized design was conducted. The statistical analysis of the data was carried out (Snedecor and Cochran, 1980). At the 5% level, the means among treatments were compared using the new LSD values (Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

### 1. Vegetative growth traits

Data presented in **Table (1)** show that all different concentrations of brassinolide and jasmonic acid either solely or in combination significantly enhanced the average length of shoots, No. of leaves,

leaf area and leaf content of total chlorophyll in comparison with control in both seasons.

Highest significant all vegetative growth traits were obtained by treatment of brassinolide at 2 ppm plus jasmonic acid at 20 ppm, whereas the least values of these ones was referred to the control in both seasons.

The stimulatory effect of brassinolide on plant growth may be due to its effect on physiological processes, including accelerating cell division and growth in the apical tissue, enhancing thermal protection, improving the efficiency of photosynthetic and the capacity of antioxidant as well as reducing the production of reactive oxygen species, and enhancing the assimilation of metals, leading to improved vegetative growth (Ahanger et al., 2020).

As for the effect of jasmonic acid, is as a result of its participation in maintaining the integrity of the cell wall and its effective role in building carbohydrates, this was reflected in improving the characteristics of vegetative growth (Satuor et al., 2019).

The outcomes attained are consistent with El-Kenawy and Abo-El-Wafa (2021) on King Ruby grape and El-Banna et al. (2022) on Thompson Seedless grape; they reported that vegetative growth features were enhanced by brassinolide application. On the other hand, Sabry et al. (2011) on Flame Seedless grape and El-Kenawy (2018) on Crimson Seedless grape mentioned that foliar spray with jasmonic acid improved vegetative growth aspects.

**Table (1). Influence of foliar spraying with brassinolide (BL) and jasmonic acid (JA) on vegetative growth traits of Red Globe grapevines during 2022 and 2023 seasons**

| Characteristics / Treatments | Shoot length (cm) | | Number of leaves/ shoot | | Leaf area ($cm^2$) | | Total chlorophyll (mg/g F.W) | |
|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 |
| Control | 146.5 | 152.5 | 20.6 | 22.1 | 125.9 | 132.3 | 29.1 | 32.6 |
| 0.5 ppm BL | 148.1 | 153.2 | 21.9 | 23.4 | 134.6 | 138.2 | 30.7 | 34.3 |
| 1 ppm BL | 154.4 | 160.3 | 23.2 | 24.8 | 140.7 | 146.3 | 33.1 | 36.5 |
| 2 ppm BL | 151.2 | 155.9 | 22.2 | 23.8 | 137.0 | 140.1 | 31.4 | 35.7 |
| 10 ppm JA | 155.9 | 162.1 | 23.5 | 25.3 | 143.7 | 148.6 | 33.3 | 37.8 |
| 20 ppm JA | 152.8 | 157.6 | 22.7 | 24.2 | 139.3 | 144.4 | 32.5 | 35.9 |
| 0.5 ppm BL + 10 ppm JA | 157.6 | 165.5 | 23.9 | 26.0 | 144.2 | 150.1 | 34.1 | 38.2 |
| 0.5 ppm BL + 20 ppm JA | 160.0 | 167.9 | 24.4 | 26.6 | 146.3 | 151.7 | 35.4 | 40.2 |
| 1 ppm BL + 10 ppm JA | 164.8 | 170.7 | 24.9 | 27.1 | 149.4 | 153.9 | 36.7 | 41.3 |
| 1 ppm BL + 20 ppm JA | 168.9 | 173.7 | 25.1 | 27.4 | 151.7 | 154.7 | 38.1 | 41.8 |
| 2 ppm BL + 10 ppm JA | 170.1 | 176.3 | 25.3 | 27.9 | 155.1 | 156.3 | 38.7 | 42.3 |
| 2 ppm BL + 20 ppm JA | 172.2 | 178.1 | 25.7 | 28.2 | 156.4 | 157.5 | 39.4 | 42.9 |
| New L.S.D at 5% | 1.9 | 1.6 | 0.3 | 0.2 | 1.1 | 0.9 | 0.6 | 0.5 |

**2. Yield and cluster physical characteristics**

As indicated in **Table (2),** the yield per vine, cluster weight and dimensions were notably improved by all different concentrations of brassinolide and jasmonic acid either alone or together in comparison with control during the two seasons.

The combined application of brassinolide at 2 ppm plus jasmonic acid at 20 ppm significantly recorded the maximum values of these parameters. Conversely, control had the minimum values of these ones in both seasons.

The improvement in yield and physical properties of clusters resulting from the use of brassinolide can be attributed to its' important role in

enhancing photosynthesis, carbohydrate assimilation, cell division and elongation (Sasse,2003).

Regarding the effect of jasmonic acid, Wang and Lin (2000) found that jasmonic acid enhances the antioxidant system and has the ability to scavenge free radicals, which had a positive effect on the yield and physical properties of the cluster.

Our results are in agreement with Champa et al. (2015) on Flame Seedless grapes, Ghorbani et al. (2017) and Belal (2019) on Thompson Seedless grape, Isci (2019) on Sultani grape, Babalık *et al.* (2020) on Alphonse lavallée grape, El-Kenawy and Abo-ELwafa (2021) on King Ruby grape and Belal et al. (2022) on Crimson Seedless grape; they showed that yield, cluster weight and dimensions were enhanced by brassinolide application.

On the other hand, Sabry et al. (2011) on Flame Seedless grape and El-Kenawy (2018) on Crimson Seedless grape mentioned that foliar spray with jasmonic acid improved the yield and fruit quality attributes.

**Table (2). Influence of foliar spraying with brassinolide (BL) and jasmonic acid (JA) on yield and cluster physical characteristics of Red Globe grapevines during 2022 and 2023 seasons.**

| Characteristics / Treatments | Yield/vine | | Average cluster weight (g) | | Average cluster length (cm) | | Average cluster width (cm) | |
|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 |
| Control | 12.01 | 12.66 | 622.3 | 649.1 | 21.1 | 21.4 | 12.8 | 13.1 |
| 0.5 ppm BL | 12.22 | 13.55 | 636.7 | 664.2 | 21.3 | 21.5 | 12.9 | 13.3 |
| 1 ppm BL | 12.89 | 14.20 | 671.1 | 699.6 | 21.5 | 22.0 | 13.2 | 13.7 |
| 2 ppm BL | 12.33 | 13.74 | 645.6 | 673.3 | 21.4 | 21.7 | 13.1 | 13.4 |
| 10 ppm JA | 13.12 | 14.11 | 683.2 | 712.4 | 21.7 | 22.3 | 13.4 | 13.7 |
| 20 ppm JA | 12.78 | 13.88 | 662.3 | 690.7 | 21.4 | 21.9 | 13.2 | 13.6 |
| 0.5 ppm BL + 10 ppm JA | 13.40 | 14.55 | 701.4 | 731.3 | 21.8 | 22.3 | 13.5 | 13.9 |
| 0.5 ppm BL + 20 ppm JA | 13.71 | 15.18 | 710.5 | 740.6 | 22.1 | 22.4 | 13.6 | 14.0 |
| 1 ppm BL + 10 ppm JA | 13.80 | 15.43 | 718.7 | 749.2 | 22.2 | 22.6 | 13.8 | 14.2 |
| 1 ppm BL + 20 ppm JA | 13.92 | 15.18 | 721.4 | 751.4 | 22.4 | 22.7 | 13.9 | 14.4 |
| 2 ppm BL + 10 ppm JA | 13.97 | 15.31 | 723.9 | 754.1 | 22.5 | 22.9 | 14.0 | 14.6 |
| 2 ppm BL + 20 ppm JA | 14.27 | 15.66 | 731.7 | 760.3 | 22.7 | 23.2 | 14.2 | 14.7 |
| **New L.S.D at 5%** | **0.29** | **0.27** | **6.4** | **6.1** | **0.2** | **0.1** | **0.2** | **0.1** |

**3. Physical properties of berries**

Data displayed in **Table (3)** demonstrated that various concentrations of brassinolide and jasmonic acid either solely or in combinations significantly enhanced berry weight, size, dimensions and firmness in comparison with control in both seasons.

Highest significant magnitudes of all tested parameters were attained by combined application of brassinolide at 2 ppm plus jasmonic acid at 20 ppm, whereas the least values of these ones was referred to the control in both seasons.

The favorable influence of brassinolide on enhancing berry physical properties can be due to their key role in stimulating cell division and growth, the assimilation of carbohydrates, and the process of photosynthesis, thereby increasing fruit quality (Senthilkumar et al., 2018).

Regarding the impact of jasmonic acid, the improvement in the characteristics of physical berries may be as the result it is enhancing plant hormones and carbohydrates which is reflected promoting cell division (Avanci et al. ,2010).

Several studies have verified that external brassinolide application can notably enhance the physical quality of grape (Champa et al., 2015, Ghorbani et al., 2017, Belal, 2019, Isci, 2019, Babalık et al.,

2020, El-Kenawy and Abo-ELwafa, 2021 and Belal et al., 2022).

On the other hand, Sabry et al. (2011) on Flame Seedless grape as well as Samra (2015) and El-Kenawy (2018) on Crimson Seedless grape mentioned that foliar spray with jasmonic acid enhanced berry physical properties.

**Table (3). Influence of foliar spraying with brassinolide (BL) and jasmonic acid (JA) on berry physical properties of Red Globe grapevines during 2022 and 2023 seasons**

| Characteristics / Treatments | Average berry weight (g) | | Average berry size ($cm^3$) | | Average berry length (cm) | | Average berry diameter (cm) | | Average berry firmness ($g/cm^2$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 |
| Control | 8.32 | 8.41 | 8.04 | 8.12 | 2.69 | 2.72 | 2.57 | 2.63 | 452.9 | 467.9 |
| 0.5 ppm BL | 8.46 | 8.57 | 8.19 | 8.29 | 2.75 | 2.78 | 2.64 | 2.69 | 479.7 | 487.2 |
| 1 ppm BL | 8.78 | 8.91 | 8.52 | 8.64 | 2.88 | 2.92 | 2.78 | 2.81 | 505.3 | 520.3 |
| 2 ppm BL | 8.54 | 8.66 | 8.27 | 8.38 | 2.79 | 2.83 | 2.69 | 2.73 | 491.4 | 494.6 |
| 10 ppm JA | 8.96 | 9.07 | 8.70 | 8.80 | 2.90 | 2.93 | 2.79 | 2.84 | 518.2 | 527.8 |
| 20 ppm JA | 8.67 | 8.78 | 8.41 | 8.50 | 2.82 | 2.87 | 2.73 | 2.78 | 493.6 | 511.8 |
| 0.5 ppm BL + 10 ppm JA | 9.06 | 9.19 | 8.81 | 8.93 | 2.92 | 2.96 | 2.82 | 2.85 | 525.7 | 534.2 |
| 0.5 ppm BL + 20 ppm JA | 9.20 | 9.31 | 8.96 | 9.05 | 2.94 | 2.97 | 2.83 | 2.87 | 534.2 | 539.6 |
| 1 ppm BL + 10 ppm JA | 9.31 | 9.43 | 9.08 | 9.18 | 2.95 | 2.99 | 2.85 | 2.88 | 538.5 | 544.9 |
| 1 ppm BL + 20 ppm JA | 9.34 | 9.48 | 9.11 | 9.23 | 2.97 | 3.00 | 2.86 | 2.90 | 541.3 | 548.7 |
| 2 ppm BL + 10 ppm JA | 9.39 | 9.51 | 9.15 | 9.27 | 2.98 | 3.02 | 2.88 | 2.91 | 543.8 | 551.2 |
| 2 ppm BL + 20 ppm JA | 9.47 | 9.58 | 9.22 | 9.33 | 3.01 | 3.03 | 2.91 | 2.93 | 547.1 | 554.9 |
| **New L.S.D at 5%** | **0.07** | **0.06** | **0.06** | **0.05** | **0.02** | **0.01** | **0.02** | **0.01** | **3.2** | **2.9** |

## 4. Chemical properties of berries

As indicated in **Table (4),** data demonstrated that all berry chemical properties were notably affected by all different concentrations of brassinolide and jasmonic acid either alone or combined in comparison with control during the two seasons.

The combined application of brassinolide at 2 ppm plus jasmonic acid at 20 ppm significantly achieved the highest magnitude of TSS, TSS/acid ratio and total anthocyanin as well as the lowest magnitude of acidity in berry juice. Conversely, control had the lowest magnitude of TSS, TSS/acid ratio and total anthocyanin as well as the highest magnitude of acidity in both seasons.

Exogenous application of brassinide enhances the activities of sucrose phosphate synthase, cell wall acid invertase, and sucrose transporter, resulting in the accumulation of TSS, anthocyanin pigment, and decreasing acidity from veraison stage to the ripening stage (Yan et al., 2022).

Regarding the effect of jasmonic acid, according to (Yilmaz et al., 2007), jasmonic acid and abscisic acid share similar biological characteristics. It has also been demonstrated to have senescence-promoting effect in the leaves of many plant families, reflected in decreasing total acidity and increasing TSS. Furthermore, Aubert et al. (2015) found that the favorable influence of jasmonic acid on anthocyanin synthesis could be referred to the enhancement of the system of antioxidant and the capacity of free radical scavenging.

These results are in accordance with those obtained by Champa et al. (2015) on Flame Seedless grape, Ghorbani et al. (2017) and Belal (2019) on Thompson Seedless grape, Isci (2019) on Sultani grape, Babalık et al. (2020) on Alphonse lavallée grape, El-Kenawy and Abo-ELwafa (2021) on King Ruby grape and Belal et al. (2022) on Crimson Seedless

grape; they showed that the internal quality of grapes were enhanced by brassinolide application. On the other hand, Sabry et al. (2011) on Flame Seedless grape as well as Samra (2015) and El-Kenawy (2018) on Crimson Seedless grape mentioned that foliar spray with jasmonic acid enhanced berry chemical properties.

## CONCLUSION

From the previous results, it can be concluded that the combined application of brassinolide at 2 ppm plus jasmonic acid at 20 ppm attained the best results in terms of enhancing the vegetative growth traits and leaf chlorophyll content, which reflected therapy in increasing yield and improving berry physiochemical attributes of Red Globe grapevines.

**Table (4). Influence of foliar spraying with brassinolide (BL) and jasmonic acid (JA) on berry chemical properties of Red Globe grapevines during 2022 and 2023 seasons**

| Characteristics / Treatments | TSS (%) | | Total acidity (%) | | TSS/acid ratio | | Total anthocyanin (mg/100g F.W) | |
|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 | 2022 | 2023 |
| Control | 16.1 | 16.4 | 0.61 | 0.57 | 26.4 | 28.8 | 23.5 | 26.1 |
| 0.5 ppm BL | 16.3 | 16.5 | 0.58 | 0.55 | 28.1 | 30.0 | 25.8 | 27.9 |
| 1 ppm BL | 16.5 | 16.8 | 0.54 | 0.53 | 30.6 | 31.7 | 29.8 | 32.2 |
| 2 ppm BL | 16.4 | 16.7 | 0.56 | 0.55 | 29.3 | 30.4 | 28.4 | 30.8 |
| 10 ppm JA | 16.6 | 16.9 | 0.54 | 0.52 | 30.7 | 32.5 | 30.9 | 33.1 |
| 20 ppm JA | 16.5 | 16.7 | 0.55 | 0.54 | 30.0 | 30.9 | 29.6 | 31.6 |
| 0.5 ppm BL + 10 ppm JA | 16.7 | 16.9 | 0.53 | 0.51 | 31.5 | 33.1 | 32.2 | 34.3 |
| 0.5 ppm BL + 20 ppm JA | 16.7 | 17.0 | 0.53 | 0.50 | 31.5 | 34.0 | 33.5 | 35.9 |
| 1 ppm BL + 10 ppm JA | 16.9 | 17.1 | 0.52 | 0.48 | 32.5 | 35.6 | 34.4 | 36.5 |
| 1 ppm BL + 20 ppm JA | 17.0 | 17.2 | 0.51 | 0.48 | 33.3 | 35.8 | 34.9 | 37.1 |
| 2 ppm BL + 10 ppm JA | 17.1 | 17.4 | 0.51 | 0.46 | 33.5 | 37.8 | 35.7 | 37.9 |
| 2 ppm BL + 20 ppm JA | 17.3 | 17.5 | 0.49 | 0.45 | 35.3 | 38.9 | 36.4 | 38.5 |
| **New L.S.D at 5%** | **0.2** | **0.1** | **0.02** | **0.01** | **1.7** | **1.1** | **0.5** | **0.4** |

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## الملخص العربى

## تحسين أداء كرمات العنب الريد جلوب عن طريق الرش الورقي بمركب البرسينولايد وحمض الجاسمونيك

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قسم بحوث العنب- معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة

تم إجراء البحث الحالي خلال موسمي (2022 و 2023) في مزرعة عنب خاصة تقع في مركز مطاي بمحافظة المنيا بهدف تحسين صفات النمو الخضري والمحصول وجودة الحبات لكرمات العنب الريد جلوب من خلال الرش الورقي بالبرسينولايد وحمض الجاسمونيك. كان عمر الكرمات أربعة عشر عامًا نامية فى تربة رملية، وتروى بنظام الرى بالتنقيط ومنزرعة على مسافة 2 × 3 متر ومربأة تحت نظام الجيبل. فى الأسبوع الأخير من شهر يناير تم تقليم الكرمات تقليما قصبيًا مع الحفاظ على حمولة 96 عين/كرمة.

وقد اشتملت الدراسة على اثنتي عشرة معاملة على النحو التالى: تم الرش الورقي بثلاثة تركيزات من البرسينولايد (0,5 ، 1 ، 2 جزء في المليون) وتركيزين من حمض الجاسمونيك (10 ، 20 جزء في المليون) إما بصورة منفردة أو بالاشتراك مع بعضهما البعض، بالإضافة إلى معاملة الكنترول. تم إجراء الرش الورقى لجميع المعاملات في ثلاث مواعيد: بعد إكتمال تفتح البراعم، عند مرحلة العقد، بعد أسبوعين من مرحلة العقد.

أشارت نتائج الدراسة إلى أن الرش الورقى للمعاملة المشتركة لكل من البرسينولايد بتركيز 2 جزء في المليون وحمض الجاسمونيك بتركيز 20 جزء في المليون حققت أفضل النتائج من حيث تحسين صفات النمو الخضري ومحتوى الأوراق من الكلوروفيل الكلى، مما انعكس ذلك فى زيادة المحصول وتحسين الصفات الطبيعية والكيميائية لحبات العنب صنف الريد جلوب.