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(Original Article)

Response of Thompson Seedless Grape Cultivar to some Foliar Application Treatments

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Abstract

Almost half of all fruits produced worldwide are produced from grapes, making them the most frequently planted fruit crop worldwide. For two seasons in a row, 2023 and 2024, experiments were carried out on the Thompson seedless grape cultivar. Treatments used by foliar spraying were 50 ppm potassium citrate, 100 ppm potassium citrate, 200 ppm tyrosine, 200 ppm lysine, 200 ppm methionine, 200 ppm glycine, 30 ppm B6, 30 ppm B12, 70 ppm ZnO, 70 ppm $ZnSo_4$, and control with three replicates/ treatment. Tyrosine at 200 ppm exceeded all the other treatments as it recorded 8.57 and 7.43 kg/vine in the two seasons of study. Furthermore, it produced the highest leaf area (110.67 and 109.07 cm^2) during the two seasons of study in addition to the highest cluster weight (429.14 and 513.95 g). Glycine at 200 ppm registered the highest values of TSS/ acid (199.83 and 111.30) during the two seasons of study, respectively. Glycine at 200 ppm and $ZnSO_4$ at 70 ppm registered the highest reducing sugar values (22.43 and 24.75 %) during the two seasons of study, respectively.

Keywords: *Berries quality, Grapevines, Spraying, Yield.*

Introduction

Egypt's most widely planted fruit crop, grapevine, is farmed all over the world using enhanced nutrition to improve yield and berry quality through different vineyard management methods.

Foliar sprayings of K fertilizers are often recommended as a quick cure for K deficiency, particularly for grape wilting prevention. However, there is limited knowledge about their effects on grapevine physiology and nutrient supply, leading to a need for further research.

Amino acid consumption improves plant development, quality, and fruiting by supporting plant cell defense against oxidation, protein biosynthesis, pigments, hormones, and cell division. This improves nutritional status and fruiting (Davies, 1982; Yagodin, 1990; Rai, 2002).

Vitamin B is essential for both physiological processes and development. It works as a coenzyme in the process of decarboxylation. Its influence on the meristem could be partially mediated by its availability tissue (Samiullah *et al.,* 1988).

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Foliar spray of microelements such as Zn, B, Cu, Mn, and Fe are quick, easy, and effective methods, after soil application, in preventing poisoning symptoms (Fernández *et al.,* 2013; Obreza *et al.,* 2010).

The study conducted by El-Sese *et al.* (2020) concluded that grape cultivars such as "Bez-El-Anza", "Thompson Seedless", and "Red Roomy" exhibited enhanced fruit characteristics, yield, and vine C/N ratio when treated with seaweed extract, amino acid and vitamins.

According to Shaaban *et al.* (2024), zinc spraying enhanced the yield and berry quality components of the Thompson seedless grape cultivar, with nano zinc oxide treatment proving to be the most effective.

The current study assessed the effects of potassium citrate, vitamins, amino acids, and zinc on Thompson seedless grape cultivar yield and fruit quality in the Assiut environment, Egypt.

Materials and Methods

1- Experimental site

The trial was executed during 2023 and 2024 seasons on 33 “Thompson Seedless” grapevines grown in the experimental orchard of pomology department, Faculty of Agriculture, Assiut University, Egypt. The vines were 15 years-old, cultivated at 2 x 2.5 m apart (840 vines/fed, 1 fed =4200m^2), the selected vines were all about the same level of vigorousness.

The main target of this study was examining the effect of spraying some amino acids (Tyrosine, Lysine, Glycine, and Methionine), potassium, Zinc Sulfate, Zinc oxide and vitamins B (B_6 + B_{12}) on some features of Thompson Seedless grapevines.

The vines were trained according to the head training system and pruned during the second week of January. The head pruning system was applied for leaving total bud load of 64 buds /vine (18 fruiting spurs and 3 eyes on each spur and 5 replacement spurs (2 eyes on each spur)). The chosen vines received the recommended agriculture practices in the vineyard including soil fertilization, irrigation, and pest control except for the tested treatments throughout the two studied seasons.

2-Experimental treatments

The following treatments were executed on each vine: -

-Spraying with potassium citrate (50 ppm).

-Spraying with potassium citrate (100 ppm).

-Spraying with Tyrosine at 200 ppm.

-Spraying with Lysine at 200 ppm.

-Spraying with Glycin at 200 ppm.

-Spraying with Methionin at 200 ppm.

-Spraying with Vit. B6 at 30 ppm.

-Spraying with Vit. B12 at 30 ppm.

-Spraying with zinc citrate 70 ppm.

-Spraying with Zinc oxide 70 ppm.

-Control (sprayed with tap water).

A Knapsack (20 L) sprayer was used to spray the vines. Spraying three vines at maximum vine growth required a total volume of 15 lit. As a wetting agent, Triton B was added to all spraying solutions at a rate of 0.05 percent. Depending on the date of spraying, spraying continued until runoff (5.0 L/Vine).

The compounds were sprayed three times: At full bloom, at 10 cm shoot length, and a month following full bloom. There were three vines in each treatment (3 replications).

3-Experimental design

The present study included eleven treatments, each of which was replicated three times, with one vine per treatment, from single applications of certain amino acids, vitamins B complex, potassium, and zinc citrate. The experiments were carried out using a complete randomized block design (CRBD) (Rangaswamy, 1995 and Rao, 2007).

Measurements

1-Vegetative growth parameters

Ten current season's shoot/vine were labeled to measure some growth parameters during the growth cycle of each season. These parameters were:

-Average main shoot length (cm).

-Leaf number/shoot.

-The diameter of twenty mature leaves from the opposing basal clusters on the main shoot or vine was measured to determine the average leaf area (cm^2).

-Leaf area (cm^2): The following equation was used to measure twenty leaves from each vine that were in opposite to the basal clusters according to (Ahmed and Morsy, 1999).

Leaf area = 0.56 (0.79 x w^2) + 20.01, where W = the maximum leaf width then average leaf area was registered.

2- Cluster and berry characteristics

At harvest, two clusters were taken at random from the yield of each vine and the following characters were determined.

- Yield components

At harvesting date, the yield per vine was recorded in terms of weight (in kg) and number of clusters per vine.

- Cluster number/vine.

- Cluster weight (g)

- Average weight of berry (g).

- Berries number/cluster.

- Cluster height (cm)

- Cluster diameter (cm).

- Cluster shape index (H/D)

3-Chemical measurements

-Percentage of total soluble solids in the juice using hand refractometer.

-Percentage of total acidity (as a tartaric acid/ 100 ml juice) by titration against 0.1N NaOH using phenolphthalein as an indicator A.O.A.C. (1985).

-The ratio between total soluble solids and total acidity was calculated.

-Percentage of reducing sugars in the juice by Lane and Eynon (1965) volumetric method as described in A.O.A.C. (1984).

4-Statistical analysis

The collected data were tabulated and subjected to substantial analysis in accordance with Mead *et al.* (1993), Gomez and Gomez (1984), and Snedecor and Cochran (1967). According to Steel and Torrie (1981), differences in treatment means were compared at the 5% level of probability during the revised L.S.D. test.

Results

Vegetative growth parameters

1-Shoot length (cm)

The effect of some spraying treatments on shoot length (cm) of Thompson Seedless grape cultivar is shown in Table 1.

The data presented revealed that, during the two seasons of study, all of treatments significantly exceeded the control (except for $ZnSO_4$ at 70 ppm which has a non-significant effect on shoot length)

During the two seasons of study, Tyrosine 200 ppm represented the highest shoot length (120.00 and 101.67 cm), respectively.

2-Leaf number/shoot

The presented data (Table 1) showed that, during the two seasons of study, all treatments surpassed the control.

During 1st season of study, all treatments significantly exceeded the control except for $ZnSO_4$ at 70 ppm which has a non-significant effect on leaves number/shoot).

During the 2nd season of study, only amino acid treatments and Vit.B12 at 30 ppm have a significant difference compared to the control.

During the two seasons of study Tyrosine at 200 ppm recorded the highest values (73.00 and 38.33 leaves /shoot), respectively.

3-Leaf area (cm^2)

The results shown in Table 1 revealed that there were no distinguish variations between most of the treatments on this respect during the two seasons of study.

Tyrosine at 200 ppm registered the highest leaf area (110.67 and 109.07 cm^2) during the two seasons of study, respectively.

2-Cluster and berry characteristics

1- Yield (Kg/vine)

Data presented in Table 2 show the effect of some spraying treatments on the yield of Thompson Seedless grape cultivar. All treatments exceeded the control during the two seasons of study. However, only the differences between amino acid treatments and control were significant.

During the two seasons of study, Tyrosine at 200 ppm exceeded all the other treatments as it recorded (8.57 and 7.43 kg/vine), respectively.

2- Clusters number/vine

Data presented in Table 2 showed the effect of various treatments on clusters number/vine of Thompson Seedless grape cultivar during 2023 and 2024 seasons. The results obtained revealed that most treatments significantly exceeded the control during the 1st season of study, whereas there were no significant variations between all treatments during the 2nd season of study.

Tyrosine at 200 ppm exhibited the best results (22.67 and 17.00 clusters/ vine) during the two seasons of study, respectively.

3- Cluster weight (g)

The presented data (Table 2) suggested that during the two seasons, all treatments surpassed the check treatment.

During the 1st season of study, there were no differences between all the treatments. Whereas, during the 2nd season, there were significant differences between amino acids and vitamins treatments.

Tyrosine at 200 ppm registered the highest values (429.14 and 513.95 g) during the two seasons of study, respectively.

4- Berry weight (g)

Data presented in Table 2 revealed that during the two seasons, all treatments exceeded the control treatment.

During the 1st season of study, there was no difference between most of the treatments. Whereas, during the 2nd season, there were significant differences between most of the treatments.

Tyrosine at 200 ppm registered the highest values (1.53 and 1.27 g) during the two seasons of study, respectively.

5- Berries number/ cluster

The results obtained in Table 2 showed that during the two seasons, all treatments surpassed the control. During the 1st season of study, there were distinguish differences between most of the treatments. Whereas, during the 2nd season, there were significant differences between all the treatments. Tyrosine at 200 ppm registered the highest values (328.00 and 427.083 berries / cluster) during the two seasons of study, respectively.

Table 1. Effect of some spraying treatments on shoot length (cm), leaves number/shoot and Leaf area (cm^2) of Thompson seedless grape cultivar during 2023 and 2024 seasons

Treatments	Shoot length (cm)		Leaves number/shoot		Leaf area (cm^2)	
	2023	2024	2023	2024	2023	2024
Potassium citrate 50 ppm	80.00 de	82.23 c	30.00 de	27.00 def	88.74 def	95.41 cd
Potassium citrate 100 ppm	80.83 cde	83.33 c	30.33 de	29.67 cdef	92.82 cde	95.107 d
Tyrosine 200 ppm	120.00 a	101.67 a	73.00 a	38.33 a	110.67 a	109.07 a
Lysine 200 ppm	112.17 a	100.50 a	44.33 b	34.33 ab	103.39 ab	104.27 ab
Methionine 200 ppm	91.67 bc	93.50 b	35.67 c	30.67 bcd	101.55 abc	98.04 bcd
Glycine 200 ppm	93.33 b	97.50 ab	42.67 b	31.67 bc	101.58 abc	101.75 bc
Vit. B6 30 ppm	83.17 bcde	83.67 c	30.67 cd	29.67 cdef	97.65 bcd	97.38 cd
Vit. B12 30 ppm	86.83 bcd	84.67 c	33.00 cd	30.33 bcde	99.97 bc	97.64 cd
ZnO 70 ppm	77.50 de	82.17 c	29.67 de	26.33 ef	88.30 def	95.26 cd
$ZnSO_4$ 70 ppm	73.00 ef	82.00 c	25.33 ef	26.00 f	58.88 ef	93.89 d
Control (water only)	65.50 f	68.83 b	23.33 f	25.67 f	82.25 f	91.52 d
LSD (0.05)	11.43	2.74	2.62	2.23	5.50	3.41

*Means with the same alphabetical letters within the same column are not differ significantly (P>0.05).

Table 2. Effect of some spraying treatments on Yield (Kg/vine), Clusters number/vine, Cluster weight (g), Berry weight (g) and Berries number/ cluster of Thompson seedless grape cultivar during 2023 and 2024 seasons.

Treatments	Yield (Kg/vine)		Clusters number/vine		Cluster weight(g)		Berry weight(g)		Berries number/ cluster	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Potassium citrate 50 ppm	6.32 bc	5.19 cd	19.00 bcd	13.33 a	325.25 a	370.83 de	1.17 bc	1.07 ab	264.00 cde	359.76 ef
Potassium citrate 100 ppm	6.54 bc	5.44 bcd	19.33 bcd	14.00 a	338.40 a	380.08 de	1.23 abc	1.07 ab	270.00 cde	374.21 de
Tyrosine 200 ppm	8.57 a	7.43 a	22.67 a	17.00 a	429.14 a	513.95 a	1.53 a	1.27 a	328.00 a	427.083 a
Lysine 200 ppm	7.38 ab	7.37 a	20.67 ab	16.00 a	410.67 a	485.67 ab	1.43 ab	1.27 a	324.33 a	423.89 ab
Methionine 200 ppm	7.33 ab	6.48 abc	19.67 bcd	14.33 a	376.73 a	442.86 bc	1.30 abc	1.13 ab	286.33 abcd	391.67 cd
Glycine 200 ppm	7.36 ab	7.09 ab	20.33 abc	15.67 a	378.23 a	479.26 ab	1.40 bc	1.20 a	303.67 abc	401.59 bc
Vit. B6 30 ppm	6.72 bc	5.80 abcd	19.33 bcd	14.00 a	356.30 a	404.68 cd	1.27 abc	1.13 ab	284.33 bcd	374.44 de
Vit. B12 30 ppm	6.78 bc	6.39 abcd	19.44 bcd	14.33 a	372.30 a	436.98 bc	1.30 abc	1.13 ab	284.33 bcd	386.04 de
ZnO 70 ppm	6.14 bc	4.94 cd	18.00 cde	13.33 a	317.52 a	370.46 de	1.13 bc	0.93 bc	257.00 de	351.39 ef
$ZnSO_4$ 70 ppm	5.72 bc	4.70 d	17.67 de	13.00 a	305.85 a	346.94 e	1.13 bc	0.93 bc	240.00 e	349.17 f
Control (water only)	5.40 c	4.64 d	15.67 e	12.67 a	301.18 a	331.16 e	0.97 c	0.80 c	239.33 e	322.22 g
LSD (0.05)	0.92	0.92	1.32	2.34	69.46	26.600	0.18	0.13	22.57	12.92

*Means with the same alphabetical letters within the same column are not differ significantly (P>0.05).

6- Cluster height (cm)

The results obtained in Table 3 suggested that during the two seasons, all treatments surpassed the control (whereas $ZnSO_4$ at 70 ppm recorded the same value as the control).

During the 1st season of study, there were no significant differences between most of the treatments. Whereas, during the 2nd season, there were significant differences between all the treatments compared to the control.

Tyrosine at 200 ppm registered the highest values (28.33 and 21.33 cm) during the two seasons of study, respectively.

7- Cluster diameter (cm)

The results shown in Table 3 revealed that during the two seasons, all treatments surpassed the control.

During the 1st season of study, there were no significant differences between most of the treatments. Whereas, during the 2nd season, there were significant differences between most of the treatments compared to the control.

Tyrosine at 200 ppm registered the highest values (14.33 and 13.67 cm) during the two seasons of study, respectively.

8- Cluster shape index (H/D)

Data in Table 3 issued that, during the two seasons of study, there were no significant differences between all the treatments.

Control and $ZnSO_4$ at 70 ppm treatments surpassed all other treatments and registered the highest values (2.05 and 2.04) during the two seasons of study, respectively.

3-Chemical measurements

1- Total soluble solids (TSS %)

Table 4 showed that, during the two seasons, all treatments surpassed the control treatment. During the 1st season of study, there were clear differences between all treatments. Whereas, during the 2nd season, there were significant differences between most of the treatments. Glycine at 200 ppm registered the highest value (25.33 %) during the 1st season of study. ZnO at 70 ppm and potassium citrate at 50 ppm also registered the same highest value (25.67 %) during the 2nd season of study.

2- Total acidity %

Data presented in Table 4 suggested during the two seasons, the control treatment surpassed all other treatments.

During the 1st season of study, there were differences between the treatments (at the same degree of significance). Whereas, during the 2nd season, there were significant differences between most of the treatments.

Glycine at 200 ppm registered the lowest values (0.13 and 2002 %) during the two seasons of study, respectively.

Table 3. Effect of some spraying treatments on Cluster height (cm), Cluster diameter (cm) and Cluster shape index (H/D) of Thompson seedless grape cultivar during 2023 and 2024 seasons.

Treatments	Cluster height (cm)		Cluster diameter(cm)		Cluster shape index (H/D)	
	2023	2024	2023	2024	2023	2024
Potassium citrate 50 ppm	23.00 c	19.00 abc	12.00 ab	9.33 cd	1.98 a	2.03 a
Potassium citrate 100 ppm	23.33 bc	19.33 abc	12.33 ab	10.00 bcd	1.90 a	2.00 a
Tyrosine 200 ppm	28.33 a	21.33 a	14.33 a	13.67 a	1.98 a	1.75 a
Lysine 200 ppm	26.00 ab	20.67 ab	14.00 a	13.67 a	1.88 a	1.53 a
Methionine 200 ppm	24.33 bc	20.00 abc	13.00 ab	12.00 ab	1.88 a	1.70 a
Glycine 200 ppm	24.67 bc	20.00 abc	13.67 ab	13.67 a	1.83 a	1.48 a
Vit. B6 30 ppm	23.67 bc	19.67 abc	12.67 ab	10.67 bc	1.88 a	1.85 a
Vit. B12 30 ppm	24.33 bc	19.67 abc	12.67 ab	11.00 bc	1.95 a	1.79 a
ZnO 70 ppm	22.67 c	18.33 bc	12.00 ab	9.33 cd	1.89 a	1.98 a
$ZnSO_4$ 70 ppm	22.33 c	17.67 c	11.67 ab	9.00 cd	1.97 a	2.04 a
Control (water only)	22.33 c	14.33 d	11.00 b	7.67 d	2.05 a	1.89 a
LSD (0.05)	1.56	1.30	1.50	1.32	0.28	0.3000.300

*Means with the same alphabetical letters within the same column are not differ significantly (P>0.05).

Table 4. Effect of some spraying treatments on total soluble solids (TSS %), acidity %, TSS/acidity and reducing sugars (%) of Thompson seedless grape cultivar during 2023 and 2024 seasons

Treatments	TSS (%)		Acidity (%)		TSS/ acidity		Reducing sugars (%)	
	2023	2024	2023	2024	2023	2024	2023	2024
Potassium citrate 50 ppm	20.33 d	25.67 ab	0.41 abc	0.33 ab	49.59 cd	77.79 cd	19.87 c	23.26 ab
Potassium citrate 100 ppm	20.67 d	25.00 abc	0.45 ab	0.33 ab	45.93 cd	75.81 cd	17.52 d	23.54 ab
Tyrosine 200 ppm	24.33 ab	25.00 abc	0.28 cd	0.25 cd	86.89 cd	100.00 ab	21.13 abc	23.08 ab
Lysine 200 ppm	25.00 ab	25.00 abc	0.21de	0.23 cd	119.5 b	108.70 a	22.19 ab	23.89 ab
Methionine 200 ppm	23.33 abc	24.00 abcd	0.33 bcd	0.28 bcd	70.70 cd	85.71 bc	20.97 abc	22.51 ab
Glycine 200 ppm	25.33 a	24.33 abcd	0.13 e	0.22 d	194.85 a	110.59 a	22.43 a	22.53 ab
Vit. B6 30 ppm	22.33cd	23.33 cd	0.43 ab	0.30 bc	51.93 cd	77.77 cd	20.42 bc	21.64 bc
Vit. B12 30 ppm	23.00 bc	23.67 bcd	0.36 bc	0.30 bc	63.89 cd	78.90 bcd	20.62 abc	22.15 bc
ZnO 70 ppm	19.67 d	22.67 ab	0.43 ab	0.35 ab	45.74 cd	64.77 cd	17.24 d	23.24 ab
$ZnSO_4$ 70 ppm	23.67 abc	26.00 a	0.50 a	0.28 bcd	47.34 cd	92.86 abc	16.63 d	24.75 a
Control (water only)	17.67 e	22.67 d	0.51 a	0.38 a	34.65 d	59.66 d	15.83 b	19.93 c
LSD (0.05)	1.18	1.18	0.07	0.039	23.33	11.55	1.004	1.34

*Means with the same alphabetical letters within the same column are not differ significantly (P>0.05).

3- TSS/acid

The results obtained (Table 4) revealed that during the two seasons, all treatments surpassed the control.

During the 1st season of study, there were no differences between most of the treatments. Whereas, during the 2nd season, there were significant variations between the treatments (at the same degree of significance).

Glycine at 200 ppm registered the highest values (199.83 and 111.30) during the two seasons of study, respectively.

4- Reducing sugars (%)

The obtained results for the 1st season (Table 4) demonstrated that during the two seasons, all treatments surpassed the control.

During the 1st season of study, there were distinguished differences between the treatments. Whereas, during the 2nd season, there were significant variations between most of the treatments.

Glycine at 200 ppm and $ZnSO_4$ at 70 ppm registered the highest values (22.43 and 24.75 %) during the two seasons of study, respectively.

Discussion

The process by which ribosomes catalase the polymerization of amino acids results in the formation of proteins, with amino acids serving as the building blocks for protein synthesis (Davies, 1982). Numerous theories have been put up to explain the function of amino acids in plants.

The potential reason for the increase in yield per vine and better berry quality could be attributed to the advantageous effects of glutamic acid and vitamin B on the nutritional status and vegetative growth of vines. The berry quality and cluster attributes were enhanced by these substances. Due to their capacity to improve protein production through the polymerization of amino acids, ethylene, GA_3, and plant pigments. Glutamic acid and vitamin B treatments may promote growth (Belal *et al*. 2016; Stino *et al*. 2017; Gonzalez-Santamariaa *et al*. 2018).

Also, results, in terms of spraying amino acids on the yield, cluster weight and berries quality, are online with those issued by Ahmed and Abd El- Hameed (2003), Ahmed *et al*. (2007), Wassel *et al*. (2011), Qaoud and Mohamed (2019), Amin (2007) and Masoud *et al* (2024).

Vitamins may have a beneficial effect on the growth and fruiting of Flame seedless grapevines because of their critical function in preventing plant cells senescence and other disorders. Furthermore, they promote cell division, biosynthesis of natural hormones like ethylene and IAA, uptake of nutrients and water, photosynthesis, protein and pigments' synthesis in plants, and metabolism of plants. These crucial roles of vitamins undoubtedly contributed to improved growth and nutritional condition of the vine, which improved fruit quality and yield (Samiulla *et al*., 1988).

Results – in respect of vegetative growth characters, yield, cluster weight and quality of the berries – are online with Ahmed and Abd El-Hameed (2003), Ahmed *et al*. (2011), and Mekawy (2012).

Mpelasoka *et al.* (2003) indicated that potassium is the most prevalent cation in plant tissue and is essential for the general health of the plant. According to Wang and Wu, (2013), potassium is required for cellular osmoregulation, electrochemical reactions, enzyme activation, cell division, photosynthesis, and the synthesis and transportation of proteins and carbohydrates. Growers must closely check potassium levels because insufficient potassium might result in decreased growth of shoots, roots, and fruits.

Results, in terms of spraying Potassium citrate, Zinc sulphate and Zinc oxide on yield and fruit quality, are online with those found by Abada (2014) on Thompson Seedless Grapevine, EL-Boray *et al.* (2015), Abdel-Salam, Maha (2016) and Mostafa *et al*. (2017) on King Ruby grapevine.

Recommendation

This work recommends the spraying Tyrosine at 200 ppm, three times: at 10 cm. of shoot length, full bloom, and a month after full bloom to improve most vegetative and physical properties. Spraying Glycine at 200 ppm or $ZnSO_4$ at 70 ppm for improving chemical properties of Thompson Seedless grape cultivar under Assiut climatic conditions.

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استجابة صنف العنب "طومسون سيدلس" لبعض معاملات الرش الورقى

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الملخص

تم إجراء التجربة في المزرعة البحثية ومعامل قسم الفاكهة بكلية الزراعة، جامعة أسيوط خلال مواسم 2023، .2024 واشتملت التجربة على صنف العنب "طومسون سيدلس (البناتى)" في تصميم قطاعات كاملة العشوائية.

تم رش الكرمات (3 مكررات / معاملة) بالمركبات الاتية: -

سترات بوتاسيوم بتركيز 50 جزء/ مليون، سترات بوتاسيوم بتركيز 100 جزء/ مليون، حمض أمينى تيروسين بتركيز 200 جزء/ مليون، حمض أمينى ليسين بتركيز 200 جزء/ مليون، حمض أمينى ميثيونين بتركيز 200 جزء/ مليون، حمض أمينى جليسين بتركيز 200 جزء/ مليون، فيتامين ب 6 بتركيز 30 جزء/ مليون، فيتامين ب 12 بتركيز 30 جزء/ مليون، اكسيد زنك بتركيز 70 جزء/ مليون، كبريتات زنك بتركيز 70 جزء/ مليون، الكنترول (ماء فقط).

ويمكن تلخيص النتائج كما يلي

خلال موسمي الدراسة تفوق التيروسين بنسبة 200 جزء/ مليون على جميع المعاملات الأخرى حيث سجل (8.57، 7.43 كجم/كرمة) على التوالي. كما سجل التيروسين بتركيز 200 جزء/ مليون أعلى مساحة ورقية (110.67 ،109.07 سم2) خلال موسمي الدراسة على التوالي. سجل التيروسين بتركيز 200 جزء/ مليون أعلى وزن للعنقود (429.14 ،513.95 جرام) خلال موسمي الدراسة على التوالي. سجل الجليسين بتركيز 200 جزء/ مليون أعلى قيم للمواد الصلبة الذائبة/الحموضة (199.83، 111.30) خلال موسمي الدراسة على التوالي. سجل الجليسين بتركيز 200 جزء/ مليون وكبريتات الزنك بتركيز 70 جزء/ مليون أعلى قيم للسكريات المختزلة (22.43 ،24.75%) خلال موسمي الدراسة على التوالي.

الكلمات المفتاحية: *الرش، المحصول، جودة الحبات، كرمات العنب.*