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Assessment of Foliar Spray with Stimulant and Acadian on Yield and Berries Physio-Chemical Quality of Roomy Red Grape Cultivar

Waseel A. M.; Ali, H. A.* and Ahmed, M. M.

Hort. Dept. Fac. of Agric. Minia Univ. Egypt

***Corresponding author:** ali.sayed1@mu.edu.eg

Abstract: High temperature regions cause major issues for grapes in terms of yield quality characteristics. Therefore, meeting consumer and market demands necessitates that growers work to improve berry quality. A number of technical advances have recently been suggested as ways to lessen the reliance on agrochemicals, which would have a positive impact on both output and sustainability. Using eco-friendly organic goods like "Biostimulants" is one of the greatest ways to boost crop output. Both “Stimulant and Acadian” are examples of commercially available products with biostimulant properties. Enhancing plant growth, yield, and product quality are crucial functions of these biostimulants. This study was carried out through the seasons of 2019 and 2020 at a private vineyard situated west of Bani Mazar Center in Minia Governorate. Roomy Red grapevines (16 years), a cultivar that used. This research aims to compare the efficacy of two commercially available products—Stimulant and Acadian—when tested with different concentrations (0.25, 0.5 and 1 g/L) on yield and berries physio-chemical quality Roomy Red grapevines compared to the untreated vines. The application of both products was associated with the enhancement of berry yield and physio-chemical properties. In terms of yield, cluster characteristics, berry chemical and physical parameters, reduction of shot berries/clusters, and total acidity, Acadian was more successfully than Stimulant, particularly at 1 g/L and then 0.5 g/L without a discernible change between them. Therefore, it is feasible to suggest spraying 0.5 g/L from Acadian for economical reasons. They provided the highest-quality berries at a manageable output.

Key words: Amino acids, *Ascophyllum nodosum* extract, yield, Roomy Red grapes.

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1. Introduction

It is commonly known that during the past 20 years, the production of grapes has increased significantly, and new kinds have been introduced. Grapes are a popular fruit crop. This is mostly due to the significant financial benefits that farmers receive from it. Grapes are Egypt's third most common fruit crop, behind mango and citrus. Egypt now has 190486 fed grape acres, a substantial increase, according to **Kabsha *et al.* (2023**). In Egypt, the yield is 9.13 tons/fed, and the productive area is 174715 fed. Despite this, Egypt's significant

contribution to grape production is reflected in its ranking of 32nd in the world in the FAO's 2020 report. Egypt now exports 131,000 metric tons of grapes annually, and it intends to increase that amount in the future (**M.A.L.R., 2019**). Enhancing the Roomy Red grapevine's yield in both quantitative and qualitative parameters, along with keeping an eye on cluster looseness and shot berries, are Egypt's top pomologists' concerns.

The current state of the world amply demonstrates the necessity of adopting environmentally friendly farming methods in order to achieve sustainable development. Chemicals have negative effects on the soil, the beneficial microbial communities and soil microorganisms, as well as the plants that are grown on these soils. Meeting the growing demand for organic inputs would require investigating a wide range of feasible options. Bio-stimulants are any material, microorganism, or substance that, aside from fertilizers and pesticides, could encourage plant development (**Brown and Saa, 2015**). Their use has increased dramatically over the last ten years (**Calvo *et al.*, 2014**). The use of amino acids (a stimulant product) and *Ascophyllum nodosum* extract (an Acadian product) is one such substitute.

The prevailing consensus is that amino acids are growth and productivity enhancers for plants (**Kowalczyk *et al.*, 2008**). As part of specific plant hormone coenzymes, they boost photosynthesis and encourage growth in plants (**Amin *et al.*, 2011**). They were selected for their positive impacts on chlorophyll production and vegetative development, the amino acids. It also has a chelating effect on iron, zinc, manganese, and copper, among other micronutrients, by helping the plant absorb and transport them (**Ghasemi *et al.*, 2013**).

The utilization of all-natural plant extracts presents a fresh perspective that could enhance grape yield and quality without endangering humans or the environment. Intertidal marines natural plant extracts, in particular, have several classes of plant-promoting compounds and a wide variety of other compounds that are known to have a positive influence on stress signaling and, by extension, on the growth parameters and biomass of various crops (**Khan *et al.*, 2009; Minocha *et al.*, 2014**). Regarding this matter, it has been noted that extracts from the brown seaweed *Ascophyllum nodosum* can enhance plant development and reduce biotic and abiotic diseases by strengthening plant defenses (**Shukla *et al.*, 2019**). Extracts from *A. nodosum* are manufactured by a number of businesses for use in horticulture and agriculture across the globe. It has been shown that commercial extracts derived from *A. nodosum* can boost the growth and increase the quality of watermelons, apples, and grapes (**Abdel-Mawgoud *et al.*, 2010 and Frioni *et al.*, 2018**).

The purpose of this study was to examine the effects on the physicochemical characteristics and productivity of the berries of Roomy Red grapevines caused by various commercial products that contain amino acids, specifically Stimulant products and natural plant extracts that contain the brown seaweed Ascophyllum nodosum, also known as Acadian.

2. Materials and Methods

2.1. Vineyard location

This experimental was conducted at a private vineyard situated west of Bani Mazar Center in Minia Governorate. Roomy Red grapevines (16 years), a cultivar that used, during two years, 2019 and 2020. This research aims to compare the efficacy of two commercially available products—Stimulant and Acadian—when tested with different concentrations of Roomy Red grapevines.

Planting distances of 2 x 2 m separated the 21 vines that were chosen for standardized growth vigor. In both years, a head pruning method was used to trained the vines in the second week of January with 16 fruiting spurs x 4 eyes + 4 replacement spurs x 2 eyes; thus, the total eyes left on each vine were 72 eyes.

The outcomes of the initial examinations carried out on the physical and chemical characteristics of the used soil in compliance with **Wilde *et al.* (1985)**. The soil texture was clay and the average chemical properties for two years were 296 ppm for EC (1:2.5 extract), 7.48 for pH, 2.16% for $CaCO_3$

and 2.08% for OM, while available nutrients (ppm) were 5.35, 493.5, 2.86, 3.25, 4.13 and 0.89 for P, K, Zn, Fe, Mn and Cu, respectively, while total nitrogen scored 0.13%. There is water that drains well from the soil since the water table is at least 2 m deep. Using surface irrigation from the water Nile. Also, the experimental vines were fertilized according to the Egyptian Ministry of Agriculture's recommendations for general farming, pest control, and fertigation.

2.2. Studied treatments and design

Every treatment was represented by three vines (replicas) in a completely randomized block pattern and each vine served as a representative sample, sprayed using a handgun sprayer on the vine until well wetted. Spraying took place twice: once before blooming, during the first week of March, and again in mid-April after the berry set using 21 vines in total and the treatments were; Control (spray with tap water), (0.25, 0.5 and 1 g/L) for each of Stimulate and Acadian.

The commercial Acadian product is a pure marine natural plant extract that contains 100% *Ascophyllum nodosum* extract. It was used in this study and ordered from Acadian Co. Table (A) displays the chemical composition of the Acadian extract powder as mentioned by (**Doss *et al.*, 2015).**

Table (A). The Chemical content of an extract from an Acadian marine plant

Physical data:	
NPK and mineral (ash)	45 % - 55 %
Moisture	Max 10%
Alganic acid	Min 10%
Mannitol	Min 4 %
Amino acid	Min 4 %
Other organic matter derived from seaweed	Min 20 %
Guaranteed minimum analyses:	
Total nitrogen (N)	0.8 – 1.5 %
Available phosphoric acid (P_2O_5)	1 - 2 %
Soluble potash (K_2O)	17 – 22 %

The commercial Stimulant product contains a special composition of amino acids that interferes in to the formation of growth hormones, flowering, and shoot setting in a natural way that does not stress the plant. In addition to the cytokinins and natural auxins used in this study and brought from Bio-Nano Technology Co. Table (B) displays the chemical composition of the Stimulant powder product.

Table (B). Chemical Composition of Stimulant product

Compounds	**Value**
Amico acids	4.9%
Boron	1%
Magnesium	2%
Zinc	1.5%
Cytokinins+auxin	2%
Vitamins	2%

2.3. Data collection

A. Yield and cluster characteristic

As is customary for commercial harvests, picking occurred in the second week of July across the two seasons as vine yield expressed in (kg), cluster number/vine, cluster weight and dimensions (length and width in (cm) as well as berry setting (%) was computed as the following: Following the initial spraying, two bunches were placed in white cheese bags with holes in them. These bags were flowering, opening, shutting:

$$\text{Berry Setting\%} = \frac{\text{Berries number /cluster}}{\text{Total flower number /cluster}}$$

B. Physical characteristic of the berry

To determine the proportion of shot berries, the percentage of berries in each cluster was tallied, divided by the total number of berries/clusters, and then multiplied by 100.

Physical aspects of the berries, namely berry weight (g) and dimensions (longitudinal and equatorial.

C. Chemical characteristic of the berry

According to (**A.O.A.C., 2000**): total soluble solids (TSS%) as a percentage in berry juice measured with a handheld refractometer, the percentage of titratable acidity (TA %) was determined by titrating 5 ml of berry juice against 0.1 N NaOH and using phenolphthalein as an indicator. The TSS/TA ratio in berry juice was then calculated, total sugar% and the total anthocyaninin content in berry skin was determined using spectrophotometer, according to **Yilidz and Dikmen (1990**).

2.4. Statistical analysis

To compare the means that represented the effects of the tested treatments, the new L.S.D. technique was utilized at a significance level of 0.05, according to **Mead *et al.* (1993).**

3. Results and Discussion

3.1. Yield and cluster characteristic

The impact of commercial products namely Stimulant and Acadian at varying concentrations (0.25, 0.5 and 1 g/L) as foliar spraying on the yield of "Roomy Red" grapevines, as measured in berry setting, shoot berries, average cluster weight, clusters number/vine, yield/vine, cluster length and width, when compared to the untreated vines are indicated in Tables (1 & 2) during seasons of 2019 and 2020.

Variations of the two commercial products applications in the current study significantly changed the berry setting %, cluster number and yield/vine of Roomy Red vines as presented in Table 1. Spraying the six treatments divided in to 0.25, 0.5 and 1 g/L for each of Stimulant and Acadian significantly increased the berry setting %, cluster number and yield/vine compared with the untreated vines. Increasing concentrations under study significantly increased the berry setting %, cluster number and yield/vine without significant difference between 0.5 and 1 g/L. Additionally, Acadian was the most effective than the Stimulant especially under the rate of 0.5 and 1 g/l without differ significantly between them. The highest values of mentioned parameters detected with 1 g/L Acadian as (12.0 & 11.6%) for berry setting%, (27.0 & 36.0) for cluster number and (10.0 & 13.3 kg) for yield/vine followed by the 0.5 g/L Acadian (11.0 & 10.7%) for berry setting%, (27.0 & 35.0) for cluster number and (9.7 & 12.7 kg) for yield/vine, while the lowest values were (5.8 &5.7%) for berry setting%, (25.0 & 26.0) for cluster number and (8.2 & 8.6 kg) for yield/vine under the control vines, respectively during both seasons. The remaining treatments recorded a middle value and the same pattern was true in the two seasons.

Table (1). Effect of Stimulant and Acadian fertilizers on berry setting, number of cluster/vine and cluster wight of Roomy Red grapevines during 2019 and 2020 seasons

Characteristics / Treatments	Berry setting %		Number of cluster/vine		Yield/vine (kg)	
	2019	2020	2019	2020	2019	2020
Control	5.8	5.7	25.0	26.0	8.2	8.6
Stimulant (0.25 g/L)	7.3	7.1	26.0	28.0	8.8	9.5
Stimulant (0. 50 g/L)	9.0	8.8	26.0	31.0	9.2	11.0
Stimulant (1 g/L)	9.9	9.5	26.0	32.0	9.4	11.6
Acadian (0.25 g/L)	9.1	8.9	27.0	32.0	9.3	11.1
Acadian (0. 50 g/L)	11.0	10.7	27.0	35.0	9.7	12.7
Acadian (1 g/L)	12.0	11.6	27.0	36.0	10.0	13.3
New LSD at 0.5	**1.1**	**1.0**	**N.S**	**2.0**	**0.4**	**0.7**

The average of cluster weight, length and width demonstrated in Table (2) showed significant differences among treatments. In a general view, the clusters weight, length and width indicated the utmost value in those received Acadian more than Stimulant and compared to the control treatment. Data in mentioned table showed that the application of the Stimulant and Acadian through using 0.5 or 1 g/L increased such trait without significant difference between the two concentrations for each product (Stimulant or Acadian). The promotion on mentioned parameters were connected to raising the application level of the both commercial products from 0.25 to 1g/L. The maximum values were scored on the vines that were applied with 1 g/L Acadian followed by 0.5 g/L from it. Conversely, the vines that received tap water treatment (control trees) had the lowest values of the cluster weight. The highest cluster weight was (396.0 g for both seasons), cluster length (24.9 & 25.6 cm) and cluster width (15.5 cm for both seasons) due to use 1 g/L Acadian followed by (360.0 &363.0 g), (24.5 & 25.0 cm) and (15.1 & 15.2 cm) for cluster weight, length and width with 0.5 g/L Acadian during the two studied seasons, respectively without significant difference between them. Conversely, the lowest ones over the two seasons under study were (328.0 & 330.0g), (19.3 & 19.5 cm) and (12.3 & 12.2 cm) for cluster weight, length and width as a result of use control (tap water), respectively in the two seasons. Then, the increment percentage of the cluster weight was (12.5 & 11.81%), cluster length was (29.02 & 31.28%), and cluster width was (26.02 & 27.05%) due to application of 1 g/L Acadian, while cluster weight was (9.76 &10.0%), cluster length was (26.94 & 28.21%), and cluster width was (22.76 & 24.59%) due to foliar application by 0.5 g/L from Acadian compared to the check treatment (control), respectively.

Higher rates of chlorophyll biosynthesis and photosynthesis, improved protein biosynthesis, and improved resistance to unfavorable climatic conditions can all contribute to yield increases brought about by the foliar application of amino acids (**Khan *et al.*, 2012; Souri and Hatamian 2019**). Foliar administrations of amino acids improved yield /vine, weights of 100 berry and cluster weight in Flame seedless grapevines, according to **Belal *et al.*, (2016**) compared to the untreated vines. Advantages of amino acids on yield in addition to the cluster's physical characteristics are consistent with those of **Ibrahiem and Radwan (2019), Ahmed (2022), Sayed, (2022) and Zagzog and Qaoud (2023).**

The impacts of the *Ascophyllum nodosum* extract on endogenous levels of growth promoters, cell division, carbohydrates, macro- and micronutrients, hormones, particularly cytokinins, and cluster size and weight may explain the observed results (**Khan *et al.,* 2012**). Furthermore, it may have amplified the fruit's inherent peak polyamine concentration. Previous field trials have demonstrated that *Ascophyllum nodosum* extract increases yield and its component, which is in line with our findings. The results showed that the Ascophyllum nodosum marine plant extract was more effective than the control group when sprayed four times (**Abo-Zaid *et al.,* 2019**). Cluster characteristics and fruit yield would both be improved by this. Cluster number, weight, length, and width yield/vine, were all improved by increasing the concentration of Ascophyllum nodosum extract from 0.05 to 0.2%, as shown by studies conducted on various grapevine varieties by **Omar *et al.,* (2020), El-Senosy (2022), and Al-Sagheer *et al.* (2023**).

Table (2). Effect of Stimulant and Acadian fertilizers on cluster weight, length and width of Roomy Red grapevines during 2019 and 2020 seasons

Characteristics / Treatments	Cluster weight (g)		Cluster length (cm)		Cluster width (cm)	
	2019	2020	2019	2020	2019	2020
Control	328.0	330.0	19.3	19.5	12.3	12.2
Stimulant (0.25 g/L)	340.0	341.0	20.4	20.8	13.2	13.4
Stimulant (0. 50 g/L)	354.0	356.0	21.6	22.6	14.0	14.3
Stimulant (1 g/L)	362.0	363.0	21.9	23.1	14.3	14.6
Acadian (0.25 g/L)	345.0	348.0	23.0	23.3	14.2	14.4
Acadian (0. 50 g/L)	360.0	363.0	24.5	25.0	15.1	15.2
Acadian (1 g/L)	369.0	369.0	24.9	25.6	15.5	15.5
New LSD at 0.5	**10.1**	**9.1**	**0.5**	**0.7**	**0.5**	**0.4**

3.2. Berry physical characteristic

Foliar applications of commercial products, namely Stimulant and Acadian, at varying concentrations were compared to untreated treatments in 2019 and 2020 with respect to the morpho-physical parameters of the grapevine "Roomy Red," which are shown in Table 3. These parameters include shot berry, average berry weight, longitudinal and equatorial of berries. Local, regional, or international marketing success depends on these factors.

Subjecting Roomy Red grapevines to a two-time spray treatment with any of two commercial products, namely Stimulant and Acadian at 0.25, 0.5 and 1 g/L significantly decreased shot berry% and increased the berry weight, longitudinal and equatorial compared to control (Table 3). The best product in the reduction shot berry % and raise berry weight, longitudinal and equatorial were Acadian then stimulant in descending order. The maximum values, hence, the best results, of shot berry % (4.6 & 4.7%), berry weight (5.56 & 5.59 g), berry longitudinal (2.41 & 2.40 cm) and berry equatorial (2.07 & 2.03 cm) were obtained when the vines received the 1 g/L Acadian product, followed by 0.5 g/L Acadian (5.2 & 5.1 %), (5.45 and 5.49 g), (2.35 & 2.36 cm) and (2.03 & 2.00 cm) for shot berry%, berry weight, longitudinal and equatorial in both seasons, respectively without significant difference between them. While, the lowest values produced by the untreated vines. These results were similar in both seasons.

Amino acids, vitamins, and other nutrients (Table C) in Stimulant products may have a beneficial effect on vine fruiting because of the important roles they play in enzyme activation, cell division, and the manufacture of plant pigments and organic feeds. Amino acids positive impact in mitigating the detrimental impacts of salinity and drought on fruiting provides an alternative rationale. The results of **Qaoud and Mohamed (2019), Farouk *et al.* (2021), El-Kenawy (2022)**, confirmed the current findings concerning amino acids' positive impacts on the berry's physical characteristics.

Studies by **Omar *et al.* (2020), El-Senosy (2022) and Al-Sagheer *et al.* (2023)** on different varieties of grapevines, bolster the notion that rising Ascophyllum nodosum extract levels are responsible for the high mean values of berry physical features. All of this research demonstrated that higher *Ascophyllum nodosum* extract treatments on vines increased the berry's physical characteristics, including weight, length, diameter, and shape index.

3.3. Berry chemical quality characteristics

The average berry chemical quality characters (TSS%, total acidity, TSS/acidity ratio, total anthocyanin mg/100g, and total sugar) of grapevine cv. "Roomy Red" were displayed in Table 4 as affected by the foliar application of commercial products, namely "Stimulant and Acadian", at varying concentrations during the 2019 and 2020 growing seasons.

With reference data to Table (4), which display the impact of treatments on the percentage of total soluble solids, total acidity, TSS/acidity ratio, total anthocyanin mg/100g, and total sugar. In both

seasons, the results showed that the treatments differed significantly. The present investigation validated this conclusion by showing that vines treated with Stimulant or Acadian at different concentrations increased chemical berries quality except total acidity was decreased. The maximum percentage of TSS%, TSS/acidity ratio, total anthocyanin mg/100g, total sugar and reduction in total acidity were evidently achieved when Acadian was sprayed into the vines. The highest values of previous quality scored at 1 g/L Acadian followed by 0.5 g/L from it, while the same treatment recorded the lowest value of total acidity. The lowest mean values detected with the control for all parameters except the total acidity scored the highest values under control. The increment over the control were (9.84 & 12.59%) in TSS%, (25.73 & 27.42%) in TSS/ acidity, (21.23 & 22.89%) in total anthocyanin and (11.24 & 10.59%) in total sugar and (8.33 & 10.92%) as well as a reduction in total acidity (12.55 & 11.67%) under control for 1 g/L Acadian followed by (8.33 & 10.92%) in TSS%, (21.54 & 22.86%) in TSS/ acidity, (17.45 & 18.69%) in total anthocyanin and (10.65 & 9.41%) in total sugar as well as a reduction in total acidity was (10.86 & 9.72%) under control for 0.5 g/L Acadian respectively in 2019 and 2020. The other treatments recorded medium values.

Table (3). Effect of Stimulant and Acadian fertilizers on shoot berries, average berry weight (g), berry longitudinal and berry equatorial of Roomy Red grapevines during 2019 and 2020 seasons

Characteristics / Treatments	Shoot berries %		Average berry weight (g)		Average berry longitudinal (cm)		Average berry equatorial (cm)	
	2019	2020	2019	2020	2019	2020	2019	2020
Control	9.8	9.3	4.92	5.00	2.15	2.13	1.81	1.78
Stimulant (0.25 g/L)	8.7	8.1	5.12	5.18	2.21	2.20	1.87	1.84
Stimulant (0. 50 g/L)	7.3	6.8	5.28	5.35	2.29	2.29	1.96	1.92
Stimulant (1 g/L)	6.6	6.3	5.40	5.46	2.34	2.34	2.01	1.96
Acadian (0.25 g/L)	6.5	6.6	5.27	5.34	2.27	2.27	1.93	1.90
Acadian (0. 50 g/L)	5.2	5.1	5.45	5.49	2.35	2.36	2.03	2.00
Acadian (1 g/L)	4.6	4.7	5.56	5.59	2.41	2.40	2.07	2.03
New LSD at 0.5	**0.8**	**0.7**	**0.13**	**0.12**	**0.07**	**0.06**	**0.05**	**0.05**

Very ripe fruits have a dark color mostly due to anthocyanins. A notable drop in chlorophyll content indicates this stage of development (**Vlahov, 1992**). Fruit maturity and quality are undoubtedly advanced by the beneficial effects of amino acids, vitamins, and other nutrients on stimulant products on the translocation and biosynthesis of organic meals, particularly carbohydrates. Since amino acids are involved in the biosynthesis, sugar translocation, and pigment formation in grape juice, it is reasonable to assume that they also have a beneficial influence on the anthocyanin content of berry skin (**Ahmed & Abd El-Hameed, 2003**). According to **Belal *et al.*, (2016)**, adding amino acids to berry skin increased total anthocyanin levels relative to the control group in both summer and winter. The results are in agreement with those obtained by **Qaoud and Mohamed (2019), Ahmed (2022), El-Kenawy (2022)**

Certain enzymes present in commercial Acadian products containing extract from the marine plant *Ascophyllum nodosum* help produce proteins, amino acids, certain phytohormones, and carbohydrates (**Khan *et al.*, 2012; Petoumenou & Patris, 2021)**. This is linked to an increase in grape juice's TSS%, and total sugar percentage in addition to decrease in TA%. The information gathered also agrees with research conducted by **El-Senosy (2022), and Al-Sagheer *et al.*, (2023)** on several grapevine varieties. According to these investigations, TSS%, TSS/acid, and sugar percentage all rose and total acidity % decrease in comparison to the control as Ascophyllum nodosum extract foliar application increased.

Table (4). Effect of Stimulant and Acadian fertilizers on T.S.S%, total acidity, T.S.S/acidity, total anthocyanin mg/100g FW and total sugar% of Roomy Red grapevines during 2019 and 2020 seasons

Characteristics / Treatments	TSS%		Total acidity%		TSS/acidity ratio		Total anthocyanin mg/100g FW		Total sugar%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	18.0	18.3	0.718	0.720	25.07	25.42	2.12	2.14	16.9	17.0
Stimulant (0.25 g/L)	18.6	19.0	0.690	0.695	26.96	27.34	2.23	2.27	17.4	17.3
Stimulant (0. 50 g/L)	19.3	19.9	0.669	0.675	25.85	29.48	2.37	2.42	18.0	17.9
Stimulant (1 g/L)	19.6	20.3	0.653	0.662	30.02	30.66	2.44	2.50	18.2	18.2
Acadian (0.25 g/L)	19.0	19.5	0.662	0.675	28.70	28.89	2.33	2.37	18.0	18.1
Acadian (0. 50 g/L)	19.5	20.3	0.640	0.650	30.47	31.23	2.49	2.54	18.7	18.6
Acadian (1 g/L)	19.7	20.6	0.625	0.636	31.52	32.39	2.57	2.63	18.8	18.8
New LSD at 0.5	**0.4**	**0.5**	**0.017**	**0.015**	**1.06**	**1.07**	**0.09**	**0.10**	**0.3**	**0.4**

Conclusion

Applying 0.5 g/L of stimulant or Acadian foliar spray twice in the first week of March (before blooming) and again in mid-April (after berry set) under Roomy Red vineyard conditions produced the best results for yield and Roomy Red berry quality, according to research conducted under the same conditions.

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