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Influence of Foliar Spray of Salicylic Acid, Fulvic Acid and Bio-Fertilizer on Growth, Yield and Quality of Grapevine Cv. Taifi

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ABSTRACT

The experiment was carried out at the private vineyard located in Duhok Governorate, Bare-Buhar village Kurdistan region-Iraq, during growing season (2024) to investigate the influence of foliar spraying of three levels, (0, 200 and 400 mg.L^{-1}) Salicylic acid, three levels (0,3 and 6 mg.L^{-1}) of Fulvic acid, spraying was conducted at April and May and Bio-fertilizer (mycorrhiza) applied by soil at three amounts (0, 50 and 100 g.vine^{-1}), once per season (before bud burst) and their interaction on green parts, yield, physical , chemical characteristics on Taifi grapevine cv. irrigated with a drip irrigation. The vines were 10 years old, trained with T-Trills, and vines pruned in the second week of March by leaving four renewal spurs, each with two eyes, and eight fruiting canes, each with seven eyes. The inter-row spacing of these vines was 2.5 × 2.5 m. There were 81 experimental units in all due to the three replications and 27 treatments in the experiment. One vine was used as the experimental unit of a factorial study carried out in an RCBD with three replications. The obtained results indicated that every trait like total chlorophyll, leaf area, number of clusters per vine^{-1} and yield per vine^{-1} as well as vitamin C in berries juice were significantly increased as compared with control, while Nitrate % in berries juice was reduced by all treatments as compared with control. The combination between high concentrations of Salicylic acid, Fulvic acid and Bio-fertilizer were improved all traits in compares with control.

Key words: foliage application, mycorrhizae, quality, Taifi, *Vitis vinifera* L.

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INTRODUCTION

Grape (*Vitis vinifera* L.) belongs to the Vitaceae family. Around the world, Grapevines can be grown in a wide range of environmental conditions. One of the regional kinds that is frequently grown in Kurdistan area, and Iraq is Taifi, it’s one of the table grapes, and its flowers are hermaphrodite. For both conventional and organic growers in a certain area, there are some similarities in grape production procedures and considerations. For instance, same planting, pruning, and training techniques are used and organic grape cultures (Friend and Trought, 2007). Iraq's entire cultivated grapevine area is estimated to be 5,869 hectares, with an annual yield of 95,725000 Kg, or approximately (16.300 t/ha). Regretfully, The output yield has decreased by 11%. However, the five years prior (OIV, O. 2021). Latitudes 20°–50° north and 20°–40° south were where it was cultivated (Mustafa, 2013). The grape is among the most delectable, reviving, and healthful subtropical fruits. Berries are rich in minerals and vitamins B1, B2, and C. A percentage of grape harvest is used to make grape juice that can be substituted for "100% natural" and "with no added sugar" canned fruits" 27% of the world's grape production is utilized as fresh fruit, 2% is used as dried fruit, and 71% is used for wine (Nabi *et al.*, 2020; O’Byrne *et al.*, 2002). One of the plant hormones produced by the plant is Salicylic acid and its derivatives. It is a naturally occurring member of the phenolic acid group and is composed of hydroxyl and carboxyl groups attached to a ring, with cinnamic acid acting as the first component (Hassoon, and Abduljabbar, 2020). Salicylic acid (SA) compounds play a main role in the mechanism leading to acclimation for changing environments. SA has long been known as a

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signal molecule in the induction of defense mechanisms in plants (Selosse *et al.*, 2015). Salicylic acid applications showed a positive effect on reducing clusters weight loss, decay incidence and berry softening rate of "Thompson seedless" grape by reducing the activation of cell wall degrading enzymes as cellulose, xylanase and poly galactouronase during storage (Lotfi *et al.*, 2015; Babalar *et al.*, 2007). Fulvic acid (FA) is very important compound of organic and natural materiality in hydrous arrangement as well as on interest for plant and soil. It is causes to increase microbial activity and activates nutrient transmission as a chelating component and enhances leaf colors, nutritional condition, and vegetative characteristic traits (Harhash *et al.*, 2021; El-Salhy *et al.*, 2023; Manaa *et al.*, 2014). Fulvic acid has oxygen content twice that of humic acids and it has many carboxyl and hydroxyl groups much than humic acid (Lotfi *et al.*, 2015; Chen *et al.*, 2004). Fulvic acid spraying significantly increased the average size, weight, and morphological index (diameter versus length) of table grape fruit (Ferrara and Brunetti, 2010; Canellas *et al.*, 2015). In addition to protecting plants from environmental stress and boosting their resilience to pests and diseases, the symbiosis of bio-fertilizers (mycorrhizae) is essential to the ecosystem's nutrient cycling (Youssef and Eissa, 2014; Barea and Jeffries, 1995). Bio-fertilizers (mycorrhizae) fungi form a beneficial relationship between plants and microorganisms (Shah, 2003; Chen, *et al.*, 2018.). To complete growing and developing, a fungus consumes nutrients (organic carbon) from the host plant. In addition, it provides stress tolerance and helps the plant absorb nutrients (nitrate and phosphate) and water. For 400 million years, there has been a reciprocal relationship like this (Schreiner, 2007).

MATERIALS AND METHODS

Studied traits: Total chlorophyll content (SPAD), Leaf area (cm^2), Yield (Kg. vine^{-1}), Number of cluster. vine^{-1}, Vitamin C (mg.100 g^{-1} F W) and Nitrate in berries juice This study was carried out at private vineyard, located in Duhok Governorate, Bare-Buhar village Kurdistan Region-Iraq, during the growing season (2024) in order to examinate the effects of applying three amounts of bio-fertilizer (mycorrhizae) (0, 50, and 100 g. vine^{-1}) to the soil, three Salicylic acid levels (0, 200, and 400 mg. L^{-1}), and Fulvic acid at three different levels (0, 3, and 6 mg. L^{-1}) on the physical and chemical properties, yield, and vegetative growth of grapevine cultivars. Taifi, using a drip irrigation system. Each vine was foliar sprayed to drip point (run off) with a solution containing salicylic acid and fulvic acid twice per season, first at April -25th and 27th - 2023 (two weeks before flowering) second at May 25 and 27-2023 (at swelling berries or at cluster began to hanging) for salicylic acid and fulvic acid respectively. All of the spraying solution was mixed with a detergent powder (1-2 g.L-1) as a wetting agent using 16 liters sprayer were used. Bio- fertilizer (Mycorrhizae Fungi) was applied as soil application once per season (before bud burst). The examined vines were pruned and trained on T-Trills in the second week of March. By leaving four renewal spurs with two eyes apiece and eight fruiting canes includes seven eyes apiece, leaving each vine with a total of 64 eyes, the experimental vines were selected to have the most consistent vigor possible (stem diameter measured at 30 cm above the soil), size, and bloom density. These 10-year-old, Between rows and spaces, vines were planted at 2.5 x 2.5 m intervals. May 13, full flowering took place. The experiment consisted of 27 treatments with three replications, therefore the total number of grapevines that use in this study were 81vines. The conventional horticultural and agricultural techniques frequently employed in commercial vineyards were applied to each vine utilized in this investigation. The harvest date had been recorded after the TSS of berries reached 16 % and the color changed to rose or purple. SAS software was used to analyze the data, and Duncan's multiple range tests (DMRT) were used to compare the treatment means at the 5% significant level (Al-Rawi and Khalafalla, 2000). Changes in leaf area, chlorophyll, cluster weight, and yield per vine, as well as chemical parameters including vitamin C and nitrate content in berry juice, were assessed as potential effects of foliar spraying of Fulvic

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acid, Salicylic acid and mycorrhiza as soil injection. Chlorophyll content was determined using a SPAD-502-meter (Minolta Camera Co.,Osaka, Japan). (Konica, 2009).

RESULTS AND DISCUSSION

Total chlorophyll content (SPAD): In contrast to the control, which produced the lowest total chlorophyll content (38.99 SPAD), Table 1 demonstrates that the foliar spraying (400 mg. L^{-1}) of SA concentrations considerably enhanced total chlorophyll content, recording the maximum (46.90 SPAD). The same table shows that Chlorophyll content in leaves enhanced significantly as increasing Fulvic acid concentration d from 0 to 6 mg. L^{-1} (46.68 SPAD) while control produced minimum chlorophyll content (40.49 SPAD). Total chlorophyll content increased significantly by increasing levels of Mycorrhizae, the highest content (49.67 SPAD) obtained by applying (100 g.L^{-1}) of mycorrhizae to the soil, as opposed to other levels that yielded (42.53 and 38.16 SPAD) respectively. The highest values (50.72 and 52.53 SPAD) were obtained when 6 mg. L^{-1} FA + 400 mg. L^{-1}SA and 100 g. $vine^{-1}$ Myco +6 mg. L^{-1} FA were combined, for the combination data in Table 1, which indicates that FA + SA and Myco + FA varied considerably. In comparison to the control, Myco had the lowest chlorophyll content values (35.79 and 34.83 SPAD), respectively. However, the overlap with 100 g. $vine^{-1}$ Myco and 400 mg. L^{-1} SA value (35.02 SPAD) was the lowest. There was a notable rise in the interaction between SA and Myco; untreated vines had the highest value (54.78 SPAD). In contrast, data in the same table showed that interaction of 6 mgL^{-1} FA + 400 mg. L^{-1}SA produced the highest value (58.43 SPAD) for the interaction among SA, FA, and Myco 100 g. $vine^{-1}$ in comparison to the untreated group's lowest value (32.22 SPAD).

Table 1. The effect of Salicylic acid, Fulvic acid, Mycorrhiza and combinations them on total chlorophyll (%) Grapevine cv. Taifi

SA mg. L^{-1}	Fulvic acid mg. L^{-1}	Myco g.$vine^{-1}$ 0	50	100	SA * FA	Mean Effect of SA
0	0	32.22 k	35.71 jk	39.67 g-j	35.79 f	38.99
	3	35.40 jk	38.06 h-j	43.97 d-g	39.14 e	
	6	37.64 ij	43.15 e-h	45.28 d-f	42.02 de	c
200	0	35.22 jk	41.22 f-i	48.59 cd	41.68 bc	44.48
	3	38.00 h-j	44.08 d-g	51.34 bc	44.47 b-d	
	6	42.33 f-j	45.65 d-f	53.88 ab	47.29 b	b
400	0	37.28 ij	42.48 f-j	52.25 bc	44.00 cd	46.90
	3	40.20 f-j	44.05 d-g	53.68 ab	45.97 bc	
	6	45.33 d-f	48.40 c-e	58.43 a	50.72 a	a
SA	0	35.02 f	38.97 e	42.97 cd	Mean	
x	200	38.52 e	43.65 cd	51.27 b	effect of	
MYCO	400	40.93 de	44.97 c	54.78 a	Fulvic acid	
FA	0	34.83 f	39.80 de	46.83 c	40.49 c	
x	3	37.87 e	42.06 d	49.66 b	43.20 b	
Myco	6	41.77 d	45.73 c	52.53 a	46.68 a	
Mean effect of Myco		38.16 c	42.53 b	49.67 a		

The Duncan multiple ranges test at the 5% level shows that the means within a row, column, and their interactions are not significantly different, as shown by the same letters.

Leaf area (cm^2): Compared to the untreated vines, Table 2's data shows that there were significant differences across the usual treatments. Rising concentrations of SA, FA

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and levels of Myco greatly expanded leaf area, the highest leaf area was recorded when vines received 100 g. vine^{-1} Myco by soil application and applied with 6 mg. L^{-1} FA, 400 mg. L^{-1} SA, which were (136.40, 134.59 and 135.25 cm^{2}) respectively. In contrast, the data in Table 2 indicated that 6 mg. L^{-1} FA + 400 mg. L^{-1} SA, 100 g. vine^{-1} Myco + 400 mg. L^{-1} SA and 100 g. vine^{-1} Myco +6 mg L^{-1} FA greatly increased leaf area. In contrary to the lowest leaf area values (110.15, 109.59, and 111.17 cm^{2}) from control, the largest values (145.32, 148.26, and 146.03 cm^{2}) were achieved. In the same table demonstrated that the combinations among SA, FA and Myco, the mixture of spraying 400 mg. L^{-1} SA and 6 mg. L^{-1} FA produced the biggest leaf area (163.75 cm^{2}) and applying 100 g. vine^{-1} Myco by soil as compared with smallest value (99.13 cm^{2}) from untreated vines.

Table 2. Effect of Salicylic acid, Fulvic acid, Mycorrhiza and combinations them on leaf area (cm^{2}) of Grapevine cv. Taifi

SA mg. L^{-1}	**Fulvic acid mg. L^{-1}**	**Myco g.vine^{-1}** 0	50	100	**SA * FA**	**Mean Effect of SA**
0	**0**	99.13 d	113.31 b-d	118.02 b-d	110.15 d	118.86 b
	3	112.41 cd	124.46 b-d	125.91 b-d	120.93 b-d	
	6	117.25 b-d	125.77 b-d	133.49 bc	125.50 b-d	
200	**0**	114.68 b-d	118.56 b-d	120.32 b-d	117.85 cd	125.87 b
	3	118.79 b-d	127.68 b-d	133.92 a-c	126.79 bc	
	6	123.08 b-d	134.99 a-c	140.86 a-c	132.98 a-c	
400	**0**	119.70 b-d	128.27 b-d	135.96 a-c	127.98 bc	136.40 a
	3	124.65 b-d	137.98 a-c	145.08 ab	135.90 ab	
	6	133.04 bc	139.16 a-c	163.75 a	145.32 a	
SA x MYCO	**0**	109.59 c	121.18 bc	125.80 bc	Mean effect of Fulvic acid	
	200	118.84 bc	127.07 b	131.70 b		
	400	125.79 bc	135.13 ab	148.26 a		
FA x Myco	**0**	111.17 c	120.04 bc	124.76 bc	118.66 b	
	3	118.61 bc	130.03 ab	134.96 ab	127.87 b	
	6	124.45 bc	133.30 ab	146.03 a	134.59 a	
Mean effect of Myco		118.08 b	127.79 a	135.25 a		

The Duncan multiple ranges test at the 5% level shows that the means within a row, column, and their interactions are not significantly different, as shown by the same letters.

Yield (Kg. vine^{-1}): (Table 3) makes it noticeable that increasing the levels of SA, FA and Myco significantly increased total yield per vine. The highest yield (28.48, 26.50 and 26.32 Kg. vine^{-1}) were obtained in vine received 400 mg. L^{-1}SA and 6 mg. L^{-1}FA as foliar spraying and 100 g. vine^{-1} Myco as soil application respectively in contrast to the treatment under control. Concerning the interaction of SA + FA, SA + Myco and FA + Myco, the combination of 6 mg.L^{-1} FA +400 mg.L^{-1} SA, 100 g.vine^{-1} Myco + 400 mg.L^{-1} SA and 100 g. vine^{-1} Myco + 6 mg.L^{-1} FA which shows in (Table 3) had the higher yield per vine (33.50, 31.67 and 30.61 Kg.vine^{-1}) respectively, which were differed from other treatments.The same table also shows that the combination between SA, FA and Myco were

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significant surpassing at the combination of 100 g.vine^{-1} Myco, 6 mg.L^{-1} FA + 400 mg.L^{-1} SA (38.41 Kg per vine) compared to the lower yield .vine^{-1} (10.22 Kg. vine^{-1}) from control vines.

Table 3. Effect of Salicylic acid, Fulvic acid, Mycorrhiza and combinations them on total yield (Kg. vine^{-1}) of Grapevine cv. Taifi

SA mg. L^{-1}	Fulvic acid mg. L^{-1}	Myco g.vine^{-1} 0	50	100	SA * FA	Mean Effect of SA
0	**0**	10.22 l	15.06 j-l	19.62 f-k	14.96 g	18.02 c
	3	14.23 kl	18.75 h-k	22.46 f-g	18.48 f	
	6	16.41 i-k	20.41 f-j	25.04 c-g	20.62 ef	
200	**0**	14.93 j-l	19.97 f-k	22.72 e-h	19.21 ef	22.10 b
	3	19.21 g-k	22.21 f-h	23.65 d-h	21.69 de	
	6	23.03 e-h	24.77 c-g	28.40 b-e	25.40 bc	
400	**0**	21.14 f-i	24.88 c-g	25.32 c-f	23.78 cd	28.48 a
	3	24.18 c-h	29.05 b-d	31.30 b	28.17 b	
	6	29.53 bc	32.56 b	38.41 a	33.50 a	
SA x MYCO	**0**	13.62 d	18.07 c	22.37 b	Mean effect of Fulvic acid	
	200	19.05 c	22.31 b	24.92 b		
	400	24.94 b	28.82 a	31.67 a		
FA x Myco	**0**	15.42 f	19.96 de	22.55 cd	19.31 c	
	3	19.20 e	23.33 bc	25.80 b	22.78 b	
	6	22.99 bc	25.91 b	30.61 a	26.50 a	
Mean effect of Myco		19.20 c	23.07 b	26.32 a		

The Duncan multiple ranges test at the 5% level shows that the means within a row, column, and their interactions are not significantly different, as shown by the same letters

Number of cluster. vine^{-1}: It's cleared data in (Table 4) that by increasing level of SA and FA and Myco caused substantially raised the number of cluster per vine, the highest value (48.41, 47.51 and 52.11) were obtained when the vine sprayed by 6 mg. L^{-1} FA + 400 mg. L^{-1} SA and 100 g. vine^{-1} Myco as soil application respectively as compared with control. Regarding the interactions of SA + FA, SA + Myco and FA + Myco. Contents in (Table 4) indicates that combination of 6 mg.L^{-1} FA +400 mg.L^{-1} SA, 100 g.vine^{-1} Myco + 400 mg.L^{-1} SA and 100 g. vine^{-1} Myco + 6 mg.L^{-1} FA had higher numbers of clusters per vine (53.00, 51.11 and 52.11) respectively as compared with other treatments. It's obvious from data in the same table that the interaction treatments SA+FA and Myco showed that the highest number of clusters (56.00) was remarkable from spraying 400 mg. L^{-1} SA+ 6 mg. L^{-1} FA and 100 g. vine^{-1} Myco as soil application as compared with lowest number of clusters (26.33) control.

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Table 4. Effect of Salicylic acid, Fulvic acid, Mycorrhiza and combinations them on number of cluster. vine^{-1} of grapevine cv. Taifi

SA mg. L^{-1}	Fulvic acid mg. L^{-1}	Myco g.vine^{-1} 0	50	100	SA * FA	Mean Effect of SA
0	**0**	26.33 k	33.67 ij	40.67 f-i	33.56 e	38.33
	3	32.67 j	40.33 c-g	46.00 b-g	39.67 d	
	6	34.67 h-i	41.67 d-h	49.00 a-e	41.78 cd	c
200	**0**	34.00 h-j	41.33 e-i	43.67 c-g	39.67 d	43.96
	3	41.00 e-i	45.00 c-g	47.33 b-g	44.44 bc	
	6	44.67 c-g	47.33 b-g	51.33 a-c	47.78 b	b
400	**0**	41.00 e-i	46.33 b-g	47.00 b-g	44.78 bc	48.41
	3	43.33 c-g	48.67 a-f	50.33 a-c	47.44 b	
	6	49.67 a-d	53.33 ab	56.00 a	53.00 a	a
SA	**0**	31.22 d	38.55 c	45.22 b	Mean	
x	**200**	39.88 c	44.55 b	47.44 ab	effect of	
MYCO	**400**	44.66 b	49.44 a	51.11 a	Fulvic acid	
FA	**0**	33.77 e	40.44 cd	43.77 bc	39.33 c	
x	**3**	39.00 d	44.66 bc	47.88 b	43.85 b	
Myco	**6**	43.00 cd	47.44 b	52.11 a	47.51 a	
Mean effect of Myco		38.593 c	44.185 b	47.926 a		

The Duncan multiple ranges test at the 5% level shows that the means within a row, column, and their interactions are not significantly different, as shown by the same letters

Vitamin C (mg.100 g^{-1} F. W): Data in the (Table 5) illustrates that there were significant differences between effect of SA, FA and Myco treatments on Vitamin C (%) in berries juice, the maximum values had (4.06, 3.43 and 3.38%) respectively when the vine received 6 mg. L^{-1} FA + 400 mg. L^{-1} SA as foliar spraying and 100 g. vine^{-1} Myco as soil application compared with the minimum values (2.11, 2.73 and 2.81%) respectively from control. Pertaining to the interactions of SA + FA, SA + Myco and FA + Myco, (Table 5) cleared that combination of 6 mg. L^{-1} FA +400 mg. L^{-1} SA, 100 g. vine^{-1} Myco + 400 mg. L^{-1} SA and 100 g. vine^{-1} Myco + 6 mg. L^{-1} FA had the higher Vitamin C % (4.37, 4.39 and 3.63%) respectively, which were significantly differed from other interactions. Furthermore, data in the (Table 5) indicates that the highest significant Vitamin C (4.66 %) resulting from grapevine treated with triple combinations 6 mg.L^{-1} FA, 400 mg.L^{-1} SA and 100 g.vine^{-1} Myco which was significantly higher than control grapevine (1.73 %).

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Table 5. Effect of Salicylic acid, Fulvic acid, Mycorrhiza and combinations them on vitamin C (mg 100 g^{-1} F W) of grapevine cv. Taifi

SA mg. L^{-1}	**Fulvic acid mg. L^{-1}**	**Myco g.vine^{-1} 0**	**50**	**100**	**SA * FA**	**Mean Effect of SA**
0	**0**	1.73 n	1.84 mn	2.18 kn	1.92 f	2.11 c
	3	1.91 mn	2.02 l-n	2.27 km	2.06 f	
	6	2.08 kn	2.45 jl	2.52 jk	2.35 e	
200	**0**	1.85 mn	2.77 ij	3.21 g-i	2.61 d	3.11 b
	3	3.02 hi	3.10 g-i	3.35 f-h	3.16 c	
	6	3.49 e-h	3.53 e-g	3.71 d-f	3.58 b	
400	**0**	3.04 hi	3.82 c-e	4.15 b-d	3.67 b	4.06 a
	3	4.03 b-d	4.00 b-d	4.37 ab	4.13 a	
	6	4.21 a-c	4.25 a-c	4.66 a	4.37 a	
SA	**0**	1.90 h	2.10 gh	2.32 g		Mean
x	**200**	2.78 f	3.13 e	3.42 d		effect of
MYCO	**400**	3.76 c	4.02 b	4.39 a		Fulvic acid
FA	**0**	2.20 f	2.80 e	3.18 b-d		2.73 c
x	**3**	2.98 de	3.03 c-e	3.33 b-c		3.11 b
Myco	**6**	3.26 b	3.40 ab	3.63 a		3.43 a
Mean effect of Myco		2.81 c	3.08 b	3.38 a		

The Duncan multiple ranges test at the 5% level shows that the means within a row, column, and their interactions are not significantly different, as shown by the same letters

Nitrate in berries juice: Data in the (Table 6) indicates that all of treatments differed from the control. The percentage of nitrate in berry juice was considerably reduced by raising the concentrations of SA, FA, and Myco levels, the lowest concentrate of nitrate obtained when spraying vine with 6 mg. L^{-1} FA + 400 mg. L^{-1} SA and 100 g. vine^{-1} Myco as soil application which were (10.55, 11.85 and 11.83 %) respectively as compared to the highest Nitrate % from the control. Concerning the interactions, the data in (Table 6) shows that the interactions of SA + FA, SA + Myco and FA + Myco, were differed significantly, the lowest concentrate (8.21, 9.04 and 10.72 %) were gained by the interactions of 6 mg. L^{-1} FA + 400 mg. L^{-1} SA, 100 g. vine^{-1} Myco + 400 mg. L^{-1} SA and 100 g. vine^{-1} Myco + 6 mg. L^{-1} FA compared with highest acidity % (16.38, 16.47 and 16.33 %) respectively. The same Table also cleared that the interactions between SA, FA and Myco were significantly decreased the Nitrate %, the lowest concentrate (7.05%) when the vine received 6 mg. L^{-1} FA + 100 g. vine^{-1} Myco and 400 mg. L^{-1} SA as contrasted with highest concentrate (18.42%) from untreated vines.

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Table 6. Effect of Salicylic acid, Fulvic acid, Mycorrhiza and combination of them on the percentage of nitrate in grapevine cv. Taifi berry juice

SA mg. L^{-1}	Fulvic acid mg. L^{-1}	Myco g.vine^{-1} 0	50	100	SA * FA	Mean Effect of SA
0	**0**	18.42 a	16.52 ab	14.21 b-g	16.38 a	15.18 a
	3	16.46 a-c	15.64 b-d	13.39 d-g	15.16 b	
	6	14.54 b-g	14.64 b-g	12.83 f-h	14.00 bc	
200	**0**	16.41 a-c	14.91 b-f	13.54 d-g	14.95 b	14.22 b
	3	15.48 b-e	14.45 b-g	13.08 f-h	14.34 bc	
	6	14.50 b-g	13.30 e-g	12.30 gh	13.36 cd	
400	**0**	14.17 c-g	12.84 f-h	10.92 hi	12.65 d	10.55 c
	3	12.36 gh	10.89 hi	9.16 ij	10.80 e	
	6	9.27 ij	8.32 jk	7.05 k	8.21 f	
SA x MYCO	**0**	16.47 a	15.59 a	13.47 bc	Mean effect of Fulvic acid	
	200	15.46 a	14.21 b	12.97 cd		
	400	11.93 d	10.68 e	9.04 f		
FA x Myco	**0**	16.33 a	14.75 b	12.89 cd	14.66 a	
	3	14.76 b	13.65 bc	11.87 d	13.43 b	
	6	12.77 cd	12.08 d	10.72 e	11.85 c	
Mean effect of Myco		14.62 a	13.49 b	11.83 c		

The Duncan multiple ranges test at the 5% level shows that the means within a row, column, and their interactions are not significantly different, as shown by the same letters

CONCLUSION

It's shown in (Tables 1-6) that applying mycorrhiza to the soil and spraying salicylic and Fulvic acids significantly improved the study traits of grapes, the reason could be explained by the impacts of salicylic acid on senescence, photosynthesis, respiration, vegetative growth, flower production, and a kind of cell death unrelated to the hypersensitive reaction. Furthermore, SA may help preserve cellular redox equilibrium by controlling the activity of antioxidant enzymes (Al-Boray *et al.*, 2015), and the purpose of Fulvic acid in promoting the absorption of elements into plant tissues from plant surfaces. Fulvic acids carry trace minerals straight to plant cell metabolic sites after being applied to leaves. Therefore, the main method for increasing plants' productive potential is to apply foliar sprays containing chelated minerals during particular periods of plant growth (Mostafa *et al.*, 2017; El-Boray *et al.*, 2015), likewise, Bio-fertilizers could enhance the health of plants and production while lowering the requirement for synthetic fertilizers (El-Boray *et al.*, 2018; Jugnake, 2017). The majority of the bio-fertilizers are prepared from microorganisms capable of decomposing organic waste and converting mineral components into soluble forms that are used by plants (Torres and Kurtural, 2021; Karoglan *et al.*, 2021).

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR/S DECLARATION

We confirm that all Figures and Tables in the manuscript are original to us. Additionally, any Figures and images that do not belong to us have been incorporated with the required permissions for re-publication, which are included with the manuscript.

AUTHORS' CONTRIBUTION STATEMENT

All authors made equal contributions to the study design, methodology, experimental work, data analysis, and manuscript writing. All authors reviewed and approved the final version of the manuscript.

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تأثير الرش الورقي بحمض الساليسيليك وحمض الفولفيك والسماد الحيوي على النمو والحاصل ونوعية العنب، صنف طائفي

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المستخلص

اجريت هذه الدراسة في مزرعة عنب أهلية تقع في محافظة دهوك- قرية بري بهار – اقليم كوردستان العراق، اثناء الموسم الزراعي 2024 م لدراسة تأثير رش الورقي بثلاثة تراكيز من حمض السالساليك اسيد (صفر,200 و 400 ملغم-1) وثلاثة تراكيز من حمض الفولفيك اسيد (صفر, 3 و6 ملغم-1) تم الرش في شهري نيسان وأيار والتسميد الارضي بثلاثة تراكيز من السماد الحيوي (ميكورايزا) (صفر, 50 و 100 غم. كرمة-1) تم إضافة السماد الحيوي مرة واحدة في الموسم (قبل تفتح البراعم) وتداخلتهما على النمو الخضري والصفات الفيزيائية والكيمياوية لحاصل الكرمة العنب صنف طايفي المروى بنظام الري بالتنقيط. كان عمر الكرمة 10 سنوات، مرباة بنظامT-Trellis ، وقُلمت في الأسبوع الثاني من شهر آذار، وذلك بترك 8 قصبات مثمرة، كل منها تحمل 7 عيون، بالإضافة إلى 4 دوابر تجديدية، كل منها يحمل برعمين. زُرعت هذه الكروم على مسافة 2.5 × 2.5 متر بين الصفوف والكرمات. شملت التجربة 27 معاملة بثلاثة تكرارات. وبناءً على ذلك، بلغ إجمالي عدد الوحدات التجريبية 81 وحدة. تم تطبيق التجربة العاملية بثلاثة مكررات في تصميم القطاعات العشوائية الكاملة، باستخدام كرمة واحدة كوحدة تجريبية. اظهرت النتائج ان جميع الصفات المدروسة مثل مساحة الورقة ومحتوى الكلوروفيل الكلي وعدد العناقيد والحاصل للكرمة الواحدة, كذلك كمية فيتامين سي في العصير زادت معنوياً مقارنةً بمعاملة المقارنة, بينما أدت جميع المعاملات الى خفض نسبة النترات في عصير الحبات مقارنةً بمعاملة المقارنة. فضلاً عن جميع التداخلات بين حمض السالساليك و حمض الفولفيك والسماد الحيوي حسنت من جميع الصفات مقارنةً بمعاملة المقارنة.

الكلمات المفتاحية: الاضافة الورقية، مايكورايزا، النوعية،، طائيفي ، Vitis vinifera L .