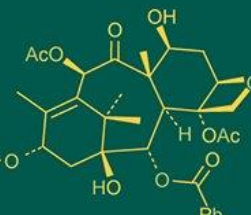
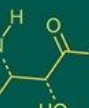
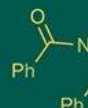


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 NAAS Rating (2026): 5.29
 IJABR 2026; 10(5): 194-199
www.biochemjournal.com
 Received: 15-02-2026
 Accepted: 17-03-2026

Fatima Kadum Jouda
 Department of filed Grops
 University, Collage of
 Agriculture, Al-Qasim Green
 University, Al Qasim, Iraq

Effect of nutrient solution and Moringa (*Moringa oleifera*) leaf extract spraying on fruit quality of Halwani grapevines

Fatima Kadum Jouda

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i5c.8355>

Abstract

Grapevines (*Vitis vinifera* L.) are members of one of the families, Vitaceae. Grapevines are widely grown because of their high nutritional and medicinal value. The quality and yield of grapes is directly associated with the appropriate nutrition and fertilization methods. This research was done in the 2024 growing season of 10-year-old Halwani grapevines in a private orchard in the village of Al-Nakhila, the Al-Hillah district, Babil Governorate. Twenty-seven uniform vines were chosen and put under the standard culture. Organic fertilizer was sprayed with a rate of 3 tons per dunam and NPK (18-18-18) fertilizer was applied with a rate of 500 g per vine. They were treated by spraying flower clusters at three times (March 1, April 1 and May 1, 2024). Leaves of the moringa plant are an excellent source of vital nutrients, amino acids, vitamins, minerals and natural antioxidants and serve as a potential natural biostimulant in the agricultural industry. It is anticipated that the results will prove the hypothesis that foliar application of nutrient solutions and the use of Moringa leaf extract can enhance the parameters of fruit quality by enhancing the growth of plants, nutrient uptake, and physiological functioning. In this paper, it has been noted that the potential of using natural plant extracts as alternative solutions to enhance grape production and quality are well-recognized.

The results can be summarized as follows:

1. Treatment of interaction between Moringa leaf extract and the nutrient solution at a concentration of 4.40 ml showed high performance, recording highest mean values of cluster length, number of berries per cluster, cluster weight, number of clusters, total yield, and total sugars and recorded 23.03 cm, 123.16 berries, 788.8 g, 33.04 clusters, 26.68, and 16.41, respectively.
2. The interaction treatment at 0.0 between Moringa leaf extract and the nutrient solution yielded the lowest mean values of cluster length, number of berries per cluster, cluster weight, number of clusters, total yield and total sugars and the corresponding values were 20.84 cm, 98.76 berries, 600.3 g, 32.32 clusters, 15.61, and 14.48, respectively.
3. In regards to acidity, the interaction between the concentrations 4.40 and 4.20 of the Moringa leaf extract and the nutrient solution gave the lowest acidity percentage at 0.49 and the highest acidity percentage at 0.60 respectively.

Keywords: Grapevine, *Vitis vinifera*, moringa leaf extract, nutrient solution, fruit quality

Introduction

The grapes are members of the family The Vitaceae family, a family of temperate region, deciduous, fruit family with 1000 species and 14 genera, growing in various locations of the world. Grapes are characterized by high nutritional value containing many minerals, including potassium, magnesium, and calcium, various vitamins, organic acids, and carbohydrates, the majority of which are reducing sugars (Manar & Fatima, 2019) [15]. Moreover, grapes have medicinal and therapeutic properties, as a stimulant to brain cells and heart muscle, and as a strengthener to the liver and kidneys. They also help decrease the risk of stomach, intestinal and urinary tract diseases (Jamal Al-Din, 2010) [14]. Improving grape quality involves using fertilizers and providing proper nutrition, which promotes plant growth and improves soil quality, positively impacting yield and production. Moringa has been viewed as one of the most helpful tropical trees. Its leaves have been found to be of very valuable resource; the nutritional break down of the leaves reveals that moringa leaves are rich in nutrients and contain all essential amino acids and is a good source of protein, vitamins A, B, C, minerals (especially iron) and acids.

Corresponding Author:
Fatima Kadum Jouda
 Department of filed Grops
 University, Collage of
 Agriculture, Al-Qasim Green
 University, Al Qasim, Iraq

The amino acid structure of the leaf protein, the sulfur-containing amino acids like methionine and cysteine, and the amino acid composition of these amino acids in the leaf protein, are very balanced. Moringa is regarded as one of the most useful trees in the world, as nearly all the parts of the tree play an important role in areas of food, medicine, and industrial uses (Nunthanawanich and alt, 2016 and Vergara-Jimenez and alt, 2017) ^[8, 9]. It is also applied in agricultural production (George and alt, 2016; Latif and Mohamed, 2016; Maishanu *et al.*, 2017) ^[7, 10]. Besides natural antioxidants, moringa leaves have the potential of being a source of a wide range of nutrients including vitamin A and C, iron, calcium, riboflavin, beta-carotene, and phenolic compounds (Nambiar *et al.*, 2005) ^[16, 17].

Methodology

This experiment was done in a private orchard in the Al-Nakhila village, Al-Hillah district, Babil Governorate, in 2024 to explore the impact of spraying with a nutrient solution and Moringa leaf extract on the quality of fruit of

10-year-old Halwani grapes planted in rows 3 meters apart and 2.5 meters apart. A total of twenty-seven vines were selected, and this selection was done based on uniformity of the trunk and cane diameter, length, number of fruiting spur and the number of buds on the spur. All the new growth of the old wood, suckers, and water spurs had been cleared away. The study standardized all the cultivation practices. Pruning of the vines was done in February. In mid-December, organic fertilizer was added at a rate of 3 tons per dunam, and it was applied equally to all vines. This was achieved through drilling a trench that is 25 cm wide and 30 cm deep, 75 cm away the vine trunks and placing the organic fertilizer in the trench which was then covered with soil. This study did not involve the use of chemical fertilizer. At the start of March the vines were sprayed with NPK (18,18,18), at a rate of 500 grams per vine. The treatments that were performed on the flower clusters of the vines on March 1, 2024, April 1, 2024, and May 1, 2024, early in the morning were spraying with the nutrient solution and Moringa leaf extract treatments.

Table 1: Treatments sprayed on the Halwani grape variety

Sequence	Transactions	The symbol
1	Comparative treatment	T1
2	0 ml Moringa leaf extract and 2 ml nutrient solution	T2
3	0 ml Moringa leaf extract and 4 ml nutrient solution	T3
4	20 ml Moringa leaf extract and 0 ml nutrient solution	T4
5	20 ml Moringa leaf extract and 2 ml nutrient solution	T5
6	20 ml Moringa leaf extract and 4 ml nutrient solution	T6
7	40ml Moringa leaf extract and 0ml nutrient solution	T7
8	40 ml Moringa leaf extract and 2 ml nutrient solution	T8
9	40 ml Moringa leaf extract and 4 ml nutrient solution	T9

The characteristics studied

First: Quantitative indicators of the outcome

1. Average cluster length (centimeter)
2. Average number of berries in a cluster
3. Average weight of the cluster (grams)

4. Average number of clusters per vine (cluster/vine)⁻¹
5. Total yield per vine (cluster/vine)⁻¹

Secondly Chemical indicators of the product

1. Total acidity
2. Total sugars
3. Rate TSS for dissolved solids

Table 2: The nutrient solution used with the Moringa leaf extract consists of

Organic matter	45%
Group Humic + fulvic acid	21%
Organic nitrogen (N)	2%
Water-soluble potassium oxide	5%
PH	4-6

Table 3: The effect of spraying with Moringa leaf extract and nutrient solution and the interaction between them on the quality of grape fruits of the Halwani variety for cluster length.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	20.84	23.38	23.03	22.42
20	21.39	25.77	26.02	24.39
40	23.03	27.03	30.03	26.70
Middle B	21.75	25.39	26.36	
	AB 1.276	B 0.737	A 0.737	LS D

The outcome of the analysis of variance shows that the difference between the Moringa leaf extract and nutrient solution and their interaction are significant in the cluster length characteristic. Table 2 illustrates difference between the Moringa leaf extract and the cluster length characteristic as the concentration provided gave The 40 ml concentration had a higher average of 26.70 as compared to the 0 ml

concentration which gave 22.42, whereas the results of the same table showed significant differences. as the lowest average of 21.75 was obtained with the nutrient solution, whereas the highest average of 26.36 was obtained with the nutrient solution. The results of Table No.2. The two study factors interaction was significantly different in the cluster length trait wherein, the interaction treatment (40,4)

produced the highest average in the trait of 30.03 and the interaction treatment (0,0) yielded the lowest average in the trait of 20.84. This is in line with (Mansour and Alt, 1980) and (Bassiony and Manal, 2016) that the Flame Seedless grapevines which had been sprayed with silicon and Moringa leaf extract proved to be more effective in improving the quality of grape fruits by enhancing the

chemical properties in terms of total soluble solids, acidity, and anthocyanin pigments in the berries. He mentioned (Kliwer, 1971) the addition of nitrogen to the nutrient solution leads to an increase in grain weight and pH because it leads to a linear increase in arginine in grain juice with increasing nitrate levels ^[18, 19, 20].

Table 4: The impact of spraying grapes of the Halwani variety, which is the number of berries in a cluster, on the quality of the grape, which is subsequently used to make wine.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	98.76	110.63	117.33	108.91
20	99.43	111.40	120.56	110.46
40	101.36	114.80	123.16	113.11
Middle B	99.85	112.27	120.16	
	AB 0.5890	B 0.3400	A 0.3400	LS D

The outcome of the analysis of variance shows that there is a significant difference between the Moringa leaf extract and the nutrient solution in terms of the number of berries per cluster. Results of the table indicated a difference in the Moringa leaf extract, where the concentration gave The 40 ml concentration had the highest average of 113.11, as compared to 108.91 with the 0 ml concentration. It was also found that the nutrient solution had significant differences as shown by the same table and the 4 ml concentration yielded the highest average of 120.16 and the 0 ml concentration gave the lowest average of 99.85. The table also showed that the interaction of the two factors of study had a significant influence on the cluster number trait. The highest average

123.16 was obtained with the interaction treatment (4, 40 ml), whereas 98.76 is the lowest average with the interaction treatment (0, 0 ml). As IAr (Siddhuraju, Becker, 2003)) As well as (Anwar, et, al, 2004) indicated that the positive effect of Moringa leaf extract may be due to its content of proteins, vitamins, beta-carotene, amino acids, various phenolic compounds, and a rare mixture of zeatins, in addition to vitamins (A, B1, B2, B3, C, E), sugars, minerals, and many flavonoid pigments. Overall, these findings are in line with the conclusions made Fuglie, 2000) ^[5] (It was found that Moringa leaf extract hastened the development of young plants and yielded larger pear fruits.) ^[21, 22]

Table 5: The impact of spraying grape fruits of the Halwani variety with Moringa leaf extract and nutrient solution and the interaction of the two on the quality of the grape fruits.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	507.5	630.4	671.1	603.0
20	570.8	682.8	720.8	658.1
40	600.3	700.2	788.8	696.4
Middle B	559.5	671.1	726.9	
	AB 253.36	B 14.64	A 14.64	LSD

Table No. (5) The study also revealed that there was a significant effect of Moringa leaf extract on average cluster weight. The 40 ml concentration treatment, which yielded the highest weight, 696.4 g, greatly outperformed the 0 ml concentration treatment which gave the lowest average weight of 603.0 g. The average cluster weight was also significantly changed by the nutrient solution spray treatment with the 40 ml concentration showing significant increase of 726.9 g in comparison to the 0 ml concentration of the treatment, which yielded 559.5 g. In terms of the interaction between the extract of the Moringa leaf and the nutrient solution, the best average interaction weight was found at 4.40 ml treatment of the nutrient solution with the Moringa leaf extract, which was 788.8 g as compared to the 0.0 ml treatment, which yielded 600.3 g. According to him

pointing out Siddhuraju and Becker (2003), as well as Anwar *et al.* (2004) ^[21] suggest that the positive effect of Moringa leaf extract could be due to its content of proteins, vitamins, beta-carotene, amino acids, various phenolic compounds, and a rare combination of zeatins, in addition to vitamins (A, B1, B2, B3, C, E). Overall, these findings are in line with those obtained Fuglie (2000) ^[5], where it was found that Moringa leaf extract increased the growth of young plants and produced larger pear fruits. This is congruent with Alboray (2016), Mustafa, and Kliwer (1971). It also follows the same pattern whereby they explained that the effect of fulvic acid and certain macronutrients and nitrogen lead to a significant increase in various traits studied ^[20, 22, 23].

Table 6: The influence of spraying by the Moringa leaf extract and nutrient solution as well as their interaction on the quality of grape fruits of the Halwani variety in terms of the trait of the number of clusters.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	30.61	31.37	31.27	31.08
20	31.31	31.65	32.65	31.87
40	32.603	32.38	33.04	32.67
Middle	31.51	31.80	32.32	
	AB 0.5623	B 0.3247	A 0.3247	LS D

The following results were studied: The important influence of the Moringa leaf extract on the average number of clusters was also studied. The highest average was achieved at 40 ml, which gave the highest average of 32.67, as compared to an 0 ml concentration which gave the lowest average of 31.08. The average number of clusters was also significantly influenced by spraying with the nutrient solution with a particular concentration of 4 ml having a

significant influence compared to the average number of clusters with a concentration of 0 ml which produced the lowest average number of 31.51. In terms of the interaction between the Moringa leaf extract and the nutrient solution, the 4.40 ml treatment resulted in the highest average of 33.04, in comparison to the 0.0 ml treatment which had the lowest average of 32.32. This is in line with Kliewer (1971) and Siddhuraju and Becker (2003) ^[20, 21].

Table 7: Effect of spraying with Moringa leaf extract and nutrient solution on the quality of grape fruits of the Halwani variety to the trait of total yield.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	15.61	18.16	20.93	18.38
20	14.50	21.35	23.52	19.79
40	19.93	22.66	26.68	23.09
middleB	16.68	20.86	23.71	
	AB 3.316	B 1.915	A 1.915	LS D

The results are presented in Table No. (7) where the highest average of 23.09 was achieved by the concentration of 40 ml that gave the highest average of 23.09 compared to the 0 ml which gave the lowest average of 18.38. There was a significant effect on the treatment of spraying with the nutrient solution where the highest average was obtained at the concentration of 4 ml with the lowest average obtained at the concentration of 0 ml. The interaction coefficients between Moringa leaf extract and the nutrient solution showed that the interaction (4,40) had the highest average of (26.68) as compared to the interaction (0,0) which had the lowest average of (15.61). Extrinsic spraying of the

grapevines at various stages of growth (i.e. flowering, fruit set, and early fruit set) improves the growth, yield and physical and chemical traits of the fruit of some early-maturing commercial grape varieties that will be used in fresh consumption, namely: Cardinal, Flame Seedless, King's Ruby, NARC Black, and Perlette. A control was also undertaken by leaving some of the vines untreated and a significant increase in the total yield of the above mentioned grape varieties was observed when compared to the control treatment. It shows that the leaves of the Moringa tree contain a good supply of plant growth regulators and mineral elements.

Table 8: The effect of spraying with Moringa leaf extract and nutrient solution, and the interaction between them, on the quality of Halwani grape variety fruits with respect to total acidity.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	0.53	0.52	0.51	0.52
20	0.60	0.51	0.49	0.53
40	0.54	0.51	0.49	0.51
Middle B	0.55	0.51	0.49	
	AB 0.0232	B 0.0138	A 0.0138	LS D

Table No.8) The high concentration of Moringa leaf extract The high concentration of 40 ml of Moringa leaf extract caused the lowest average ratio of acidity of 0.051 as compared to the high concentration of 20 ml of Moringa leaf extract which gave the highest average of 0.53. Adding the nutrient solution by spraying had a strong impact with the concentration of 4 ml giving the lowest average of 0.55 and the concentration of 0 ml giving the highest. The interaction

treatments, the interaction treatment of 4, 40 and 4, 20 gave the lowest average acidity ratio of 0.49, and the highest acidity ratio of 0.60 by the interaction treatment of 0.20. The positive effect of moringa leaf extract and silicon on the chemical properties of the seeds can be explained by (SSC, acidity, SSC/acidity ratio, juice pH, and anthocyanins) as indicated by Jia *et al.* (2011) ^[2]

Table 9: The effect of spraying with the Moringa leaf extract and nutrient solution and the interaction between them on the quality of Halwani grape variety fruits in the total sugars characteristic.

Nutrient solution				
Moringa leaf extract	0	2	4	Middle A
0	15.61	18.16	20.93	18.38
20	14.50	21.35	23.52	19.79
40	19.93	22.66	26.68	23.09
Middle B	16.68	20.86	23.71	
	AB 3.316	B 1.915	A 1.915	LS D

Table No. (9) The significant effect of the Moringa leaf extract was seen, with a concentration of 40 ml producing the highest mean score of 15.86, and a concentration of 0 ml producing the lowest mean score of 14.27. A significant

effect was also observed with spray treatment using the nutrient solution with the highest mean score of 15.89 and the lowest mean score of 14.48. The combination of the two treatments (4 and 40 ml) produced the maximum mean

score of 16.41. While the focus gave (The lowest average was 14.48 (0.0). d Fruit quality measurement is a suggested evaluation system. Mansour *et al.* (1981) ^[18] to help determine which treatment gave the best grain quality (as described in Materials and Methods). Where The overall fruit quality data showed that the grapevines Flame Seedless, which was sprayed with silicone and Moringa leaf

extract, was more effective in improving both the chemical properties (total soluble solids SSC, acidity, SSC/acidity ratio, and anthocyanin pigments in the berries) and the physical properties of the fruit (berry firmness, berry separation strength, and percentage of “Shot” berries) compared to the rest of the treatments in both seasons of the study.

Table 10: The influence of spraying with Moringa leaf extract and nutrient solution as well as the interaction between them on the quality of Halwani grape variety fruits in terms of the characteristic of the percentage of total soluble solids.

Moringa leaf extract	Nutrient solution			
	0	2	4	Middle A
0	16.20	17.32	19.21	17.58
20	17.11	19.10	19.01	18.41
40	17.15	19.26	19.30	18.57
Middle B	16.82	18.56	19.17	
	AB 0.0913	B 0.052	A 0.052	LS D

Table No. (10) The significant difference in the Moringa leaf extract was observed with the highest mean of 18.57 with the highest concentration of 40 ml. when compared to a concentration of 0 ml that gave the lowest mean of 17.58. The nutrient solution had a considerable influence when administered as spray treatment with the highest mean of 19.17 attained and a lowest mean of 16.82 was reached. In terms of the interaction treatments, the interaction treatment (4, 40) gives a higher mean of 19.30, as compared to the interaction treatment (0, 0) which gives the lowest mean of 16.20. This is consistent with Ahmed *et al.*, 2020 ^[24].

References

- Epstein E, Bloom AJ. Mineral nutrition of plants: Principles and perspectives. 2nd ed. Sunderland, MA: Sinauer Associates; 2005.
- Jia JX, Cai DL, Liu ZM. New progress in silicon-improvement of quality of crops. In: Proceedings of the 5th International Conference on Silicon in Agriculture; 2011 Sep 13-18; Beijing, China. p. 77.
- Anwar F, Latif S, Ashraf M, Gilani AH. *Moringa oleifera*: A food plant with multiple medicinal uses. *Phytotherapy Research*. 2007;21:17-25.
- Hasegawa PM, Bressan RA, Zhu JK, Bohnert HJ. Plant cellular and molecular responses to high salinity. *Annual Review of Plant Physiology*. 2000;51:463-499.
- Fuglie LJ. The miracle tree: *Moringa oleifera*: Natural nutrition for the tropics. The multiple attributes of *Moringa*. 2000. p. 172.
- Khan AS, Ibrahim MB, Basra SM, Ali SA, Almas MH, Azam MS, *et al.* Post-bloom applied moringa leaf extract improves growth, productivity and quality of early-season maturing grapes (*Vitis vinifera*). *Agriculture Biology*. 2020;24(5):1217-1225.
- George KS, Revathi KB, Deepa N, Sheregar CP, Ashwini T, Das S. A study on the potential of Moringa leaf and bark extract in bioremediation of heavy metals from water collected from various lakes in Bangalore. *Procedia Environmental Sciences*. 2016;35:869-880.
- Nunthanawanich P, Sompong W, Sirikwanpong S, Mäkyänen K, Adisakwattana S, Dahlan W, *et al.* *Moringa oleifera* aqueous leaf extract inhibits reducing monosaccharide-induced protein glycation and oxidation of bovine serum albumin. *SpringerPlus*. 2016;5(1):1908.
- Vergara-Jimenez M, Almatrafi MM, Fernandez ML. Bioactive components in *Moringa oleifera* leaves protect against chronic disease. *Antioxidants*. 2017;6(4):91.
- Maishanu HM, Mainasara MM, Yahaya S, Yunusa A. The use of Moringa leaves extract as a plant growth hormone on cowpea (*Vigna unguiculata*). *Path of Science*. 2017;3(12).
- Mansour KM, El-Tobshy Z, Issawy T. Determination of postharvest losses in Egyptian Romi Red grapes. Bulletin No. 1522. Ain Shams University, Faculty of Agriculture; 1981. p. 1-24.
- Al-Rawi KM, Khalaf Allah AAM. Design and analysis of agricultural experiments. Mosul, Iraq: Dar Al-Kutub Foundation for Printing and Publishing, University of Mosul; 2000.
- Al-Janabi FKJ, Jassim MI. Comparison of some quantitative and qualitative characteristics of four varieties of European seedless grapes [master's thesis].
- Jamal al-Din FA. Encyclopedia of medicinal plants. 2nd ed. Alexandria, Egypt: Dar al-Ma'arif; 2010.
- Manar AA, Fatima MM. Effect of foliar spray of moringa leaf extract and nutrients on growth and quality of grapevines. *J Plant Prod*. 2019;10(5):421-430.
- Latif HH, Mohamed HI. Exogenous applications of moringa leaf extract effect on growth, biochemical contents and yield of plants under stress conditions. *S Afr J Bot*. 2016;106:221-231. DOI:10.1016/j.sajb.2016.07.010.
- Nambiar VS, Matela H, Baptist A. Total antioxidant capacity and phenolic composition of fresh and dried *Moringa oleifera* leaves. *Int J Green Pharm*. 2005;7(1):1-8.
- Mansour AE, Alt HA. Effect of nutrient sprays on growth and fruit quality of grapevines. *Ann Agric Sci*. 1980;25(2):455-462.
- Bassiony SS, Manal MM. Effect of silicon foliar sprays combined with moringa leaves extract on yield and fruit quality of Flame Seedless grape (*Vitis vinifera* L.). *J Plant Prod*. 2016;7(10):1127-1135. DOI:10.21608/jpp.2016.46946.
- Kliwer WM. Effect of nitrogen on growth and composition of grapes. *Am J Enol Vitic*. 1971;22(3):172-178.

21. Siddhuraju P, Becker K. Antioxidant properties of various solvent extracts of total phenolic constituents from *Moringa oleifera* leaves. J Agric Food Chem. 2003;51(8):2144-2155. DOI:10.1021/jf020444+.
22. Alboray AA. Effect of moringa leaf extract on growth, yield and fruit quality of grapevine. Middle East J Agric Res. 2016;5(4):706-715.
23. Mustafa NS, Kliewer WM. The influence of day temperature and light intensity on growth and composition of grape berries. Am J Enol Vitic. 1971;22(2):96-100.
24. Ahmed SF, Quadeer AA, McKay MR. Preliminary identification of potential vaccine targets for the COVID-19 coronavirus (SARS-CoV-2) based on SARS-CoV immunological studies. Viruses. 2020 Feb 25;12(3):254.