USING SOME TREATMENTS TO IMPROVE VEGETATIVE GROWTH CHARACTERISTICS OF THREE GRAPE CULTIVARS

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Article info	Abstract
  	The study was conducted in research station in Al-Bu'itha area Belong to College of Agriculture - University of Anbar during growing season 2023 on Three grape Cultivars, Black Hamburg, Kamaly, and Zytuny, 3 years old, to investigate the effect of adding Nanofertilizer NPK at concentrations (0, 10, 15 and 20 g Plant^{-1} and adding Humic acid at two concentrations (0 and 100 g Plant^{-1}) in characteristics of vegetative growth, A factorial experiment was carried out according to a split -split plot design with three replicates, The results showed significant superiority to the Humic acid addition treatment at a concentration of 100g plant^{-1} in percentage of dry matter in leaves, stem diameter, length of mature part of canes, ratio of mature wood to total wood of and number of main branches and leaves Chlorophyll content of, The treatment of adding NPK Nanofertilizer at a concentration of 20g plant^{-1} also had a positive effect on all traits studied, As for three Cultivars, there were significant differences in Vegetative growth characteristics and leaves chlorophyll content, except for leaves dry weight percentage, As for the two- and three interactions between study factors, there were significant differences in most of the traits studied.

استخدام بعض المعاملات في تحسين مواصفات النمو الخضري لثلاثة أصناف من العنب

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الخلاصة

اجري البحث في محطة الأبحاث الزراعية التابع لكلية الزراعة – جامعة الانبار للموسم 2023 على شجيرات العنب صنف بلاكهمبرك وكمالي وزيتوني بعمر 3 سنوات لمعرفة تأثير اضافة السماد النانوي بالمستويات (0، 10، 15 و20 غم نبات$^{-1}$) واضافة حامض الهيومك بتركيزين (0 و100 غم نبات$^{-1}$) في بعض صفات النمو الخضري لشجيرات العنب، نفذت التجربة عامليه وفق تصميم القطع المنشقة المنشقة بثلاثة مكررات، أظهرت النتائج التفوق المعنوي لمعاملة إضافة حامض الهيومك بتركيز 100 غم نبات$^{-1}$ في النسبة المئوية للمادة الجافة في الاوراق وقطر الساق وطول الجزء الناضج من القصبة ونسبة الخشب الناضج الى الخشب الكلي وعدد الافرع الرئيسة ومحتوى الاوراق من الكلوروفيل، كما تفوقت معاملة إضافة السماد النانوي NPK بتركيز 20 غم نبات$^{-1}$ في جميع الصفات المدروسة، اما بالنسبة للأصناف الثلاث فقد كانت هنالك فروقات معنوية في صفات النمو الخضري ومحتوى الاوراق من الكلوروفيل عدا النسبة المئوية للمادة الجافة في الاوراق، اما بالنسبة للتداخلات الثنائية والثلاثي بين عوامل الدراسة فقد كانت هنالك فروقات معنوية في أغلب الصفات المدروسة.

كلمات مفتاحية: بلاكهمبرك، السماد النانوي، زيتوني، كمالي.

Introduction

Grapes belong to Vitaceae family, and their scientific name is *Vitis vinifera* L. It is one of the economically and commercially important fruit crops. The grape crop is the largest in terms of production quantity among other fruit crops and is grown in moderately hot areas (8 and 14). Its cultivation has also been known in Iraq since ancient times, where it was grown by the Sumerians. Its cultivation also began in Central Asia in the region south of the Black Sea and Caspian Sea. In addition, grape bushes were found in Hanging Gardens of Babylon (2). in addition to great importance of grapes due to their nutritional value and multiple uses, as well as their high economic returns, they are also a source of sugars, vitamins, nutrients, and amino acids, in addition to their many other uses, including health (15). Nanofertilizer have begun to be widely used in agricultural sciences because of the ability of this Nanofertilizer to increase vegetative growth and chemical content, which in turn is reflected in an increase in production and improvement in the quality

of fruit. Nanotechnology has become a priority in all fields. The word nanotechnology means fine materials, a unit of measurement equal to 10^{-9} m (4, 17 and 18).

Humic acid is one of organic acids that is produced naturally and is one of compounds of humic matter that is from decomposition of organic matter, as it contains in its composition C, H, N, and O in varying proportions resulting from formation of compounds with varying molecular weights (7). When humic acid is added to soil, it increases absorption of nutrients by plant and serves as a transport medium for nutrients from soil to the plant. It also works to increase growth strength of root group and improve it by increasing dry and wet weight of roots (1 and 9).

There is a group of grape Cultivars in local orchards, which are considered among the important Cultivars for local production of grapes due to their importance from the economic and commercial standpoints. Among important and widespread Cultivars in our regions are Black Hamburg, Kamaly, and Zytuny, in addition to other Cultivars. The three mentioned Cultivars were chosen to conduct study on because they are the most widespread.

This research aims to find out best appropriate amount of nano-fertilizer (NPK) and Humic acid to improve growth and production. To know the best combination between nano-fertilizer (NPK) and Humic acid to reach best growth of grapes, which is reflected in increased quantitative and qualitative production.

Materials and Methods

The research was carried out at agricultural research station located in Al-Bu'itha area Belong to College of Agriculture - Anbar University during growing seasons 2023-2024 on three year old grapes. All service operations were carried out, including irrigation, pruning, and fertilization for all plants included in experiment, the experiment was carried out as a factorial experiment within a split -split plot design, The first factor represents the main plots which include Cultivars, and the second factor represents sub plots which include adding Nanofertilizer. And third factor sub-sub plot which include adding Humic acid and the results were analyzed using Genestat program and comparing the means using the least significant difference (LSD) selection at a 5% significance level (3). The study included three factors: first was Cultivars used: Black Hamburg cultivar (V1), Kamaly cultivar (V2), and the Zytuny cultivar (V3). The second was add of NPK Nano-fertilizer at four concentrations (0, 10, 15, 20 g Plant^{-1}), and it was added in four batches on 1/4, 1/5, 1/6 and 1/9/2023 and third factor, Humic Acid, was added in two concentrations (0, 100 g plant^{-1}) on dates 1/4, 1/6 and 1/9/2023, Characters studied Main stem diameter (mm), Percentage of dry matter in Leaves, Length of the mature part of the canes (cm): measured with a tape measure, Ratio of mature wood to total wood (%), Number of main branches (branch plant^{-1}) and Leaves content of total chlorophyll (mg 100 g^{-1} fresh weight): According to method (9).

Results and Discussion

Main stem diameter (mm): The results in (Table 1) showed there was significant differences the treatments of three types, The V1 Cultivar reached of 15.50 mm, V3

Cultivar reached of 10.66 mm. The Nanofertilizer adds also had a positives effect, as treatment N3 reached 14.40 mm N0 reached of 11.72mm. As for Humic acid addition, treatment H1 reached of 14.00 mm treatment H0 reached of 11.97 mm. The interaction between addition of humic acid and Nanofertilizer had a positive effect, the N3H1 reached of 15.97 mm, while N0H0 reached of 10.97 mm. As for the interaction between humic acid and the Cultivars, the H1V1 treatment excelled by giving it the highest rate of 16.47 mm. The H0V3 treatment gave the lowest rate of 10.12 mm, while there were no significant differences between the interaction between the Cultivars and the addition of Nanofertilizer.

The V1N3H1 reached of 18.19 mm while treatment V3N0H0 reached of 8.92 mm.

Table 1: Effect of Nanofertilization and Humic acid and their interaction on Main stem diameter (mm) Three grape cultivars.

Humic Acid H	Nano Fertilization N	Cultivars			H×N	Mean H
		V_1 Black Hamburg	V_2 Kamaly	V_3 Zytuny		
H_0	N_0	12.28	9.71	8.92	10.97	11.97
	N_1	15.56	11.69	10.05	12.43	
	N_2	13.53	10.88	10.60	11.67	
	N_3	14.75	12.49	11.25	12.83	
H_1	N_0	13.37	12.58	11.46	12.47	14.00
	N_1	16.47	13.96	9.87	13.43	
	N_2	17.85	14.62	9.92	14.13	
	N_3	18.19	16.49	13.22	15.97	
LSD $_{0.05}$		1.89			1.00	0.31
H×V		H_0	H_1		Mean V	
	V_1	14.53	16.47		15.50	
	V_2	11.19	14.41		12.80	
	V_3	10.21	11.12		10.66	
LSD $_{0.05}$		1.08			1.10	
N×V		V_1	V_2	V_3	Mean N	
	N_0	13.82	11.14	10.19	11.72	
	N_1	16.02	12.82	9.96	12.93	
	N_2	15.69	12.75	10.26	12.90	
	N_3	16.47	14.49	12.23	14.40	
LSD $_{0.05}$		N.S			0.79	

Percentage of dry matter in Leaves (%): The results of (Table 2) show effect of study factors on percentage of dry matter in leaves, while it was not found Significant differences between Cultivars in this trait, while NPK Nanofertilizer, as this trait increased to 48.63% at the N3 concentration and decreased to 42.72% when compared to control treatment. as it was observed that dry matter increased in leaves at second concentration, H1, as it reached 47.07%, while percentage of dry matter Was lowest at first concentration, H0, to 43.91%, while twice interaction between Humic and NPK did not have a significant effect, as for interaction between Cultivars and Humic, there was no significant effect for both study factors on this trait. Likewise, interaction between level of Nanofertilizer and the Cultivar did not significantly affect this trait.

The triple intervention on the percentage of dry matter in leaves, V1N3H1 treatment gave highest percentage of 50.73%, while this percentage decreased to 41.45% in V2N0H0 treatment.

Table 2: Effect of Nanofertilization and Humic acid and their interaction on Percentage of dry matter in Leaves (%) Three grape cultivars.

Humic Acid H	Nano Fertilization N	Cultivars			H×N	Mean H
		V_1 Black Hamburg	V_2 Kamaly	V_3 Zytuny		
H_0	N_0	42.29	41.45	39.00	40.91	43.91
	N_1	45.23	44.14	43.19	44.52	
	N_2	44.17	44.96	45.32	44.18	
	N_3	42.27	44.81	50.09	45.39	
H_1	N_0	44.12	46.73	42.71	44.82	47.07
	N_1	46.11	44.47	45.60	46.84	
	N_2	46.49	47.11	46.93	45.72	
	N_3	50.73	57.36	46.53	51.54	
LSD $_{0.05}$		5.92			NS	2.43
H×V		H_0	H_1		Mean V	
	V_1	43.49	46.87		45.18	
	V_2	43.84	48.92		46.38	
	V_3	44.40	45.44		44.92	
LSD $_{0.05}$		NS			NS	
N×V		V_1	V_2	V_3	Mean N	
	N_0	43.21	44.09	40.85	42.72	
	N_1	45.67	44.30	44.39	44.79	
	N_2	45.33	46.03	46.13	45.83	
	N_3	46.50	51.09	48.31	48.63	
LSD $_{0.05}$		NS			2.31	

Length of the mature part of the canes (cm): The results of Table 3 indicate that there are V1 Cultivar also excelled. Significantly, highest rate was recorded at 363.9 cm, compared to lowest value recorded for V3 Cultivar, which amounted to 237.4cm. significant differences between addition treatments for humic acid and NPK nano-fertilizer, as H1 and N3 treatments recorded highest values of 337.8 cm and 339.9 cm H0, N0 treatments that reached of 284.6cm and 276.2cm.

The treatment N3H1 reached of 356.1 cm, while treatment N0H0 reached of 231.6 cm. From same table we note that binary interaction between humic acid and Cultivars had a significant effect on length of mature part. From stalk, treatment V1H1 recorded highest rate of 413.7 cm, while lowest rate of 226.9 cm was recorded in treatment V3H0. on other hand, the binary interaction treatment between Nanofertilizer and Cultivars gave a significant effect on this characteristic in interaction V1N3, as a value of 405.9 cm was recorded compared to comparison interaction V3N0. Which gave lowest value of 213.3 cm.

The interaction treatment V1N3H1 reached of 440.6 cm compared to V3N0H0, reached of 186.3 cm.

Table 3: Effect of Nanofertilization and Humic acid and their interaction on Length of the mature part of the canes (cm) Three grape cultivars.

Humic Acid H	Nano Fertilization N	Cultivars			H×N	Mean H
		V_1 Black Hamburg	V_2 Kamaly	V_3 Zytuny		
H_0	N_0	232.4	276.0	186.3	231.6	284.6
	N_1	292.2	316.9	226.5	278.5	
	N_2	360.7	326.2	254.1	313.7	
	N_3	371.2	332.0	240.9	314.7	
H_1	N_0	377.3	344.9	240.3	320.9	337.8
	N_1	404.6	359.1	229.8	331.2	
	N_2	432.3	323.0	246.3	333.9	
	N_3	440.6	379.6	275.2	365.1	
LSD $_{0.05}$		19.00			11.54	8.74
H×V		H_0	H_1		Mean V	
	V_1	314.1	413.7		363.9	
	V_2	312.8	351.7		332.2	
	V_3	226.9	247.9		237.4	
LSD $_{0.05}$		12.58			9.91	
N×V		V_1	V_2	V_3	Mean N	
	N_0	304.8	310.4	213.3	276.2	
	N_1	348.4	338.0	228.1	304.8	
	N_2	396.5	324.6	250.2	323.8	
	N_3	405.9	355.8	258.0	339.9	
LSD $_{0.05}$		13.15			7.20	

Ratio of mature wood to total wood (%): The results of Table 4 showed that V2 Cultivar had a rate of 83.82% compared to V1 Cultivar, which recorded the lowest rate of 76.00%, which gave a rate of 75.44%. It also showed superiority of N3 treatment by a rate of 81.87% compared to comparison treatment. add of humic acid significant effect on the ratio of mature wood to total wood by a rate of 83.29% at H1 concentration compared to H0 concentration.

While the bilateral interaction between Humic acid and NPK did not have a significant effect on this characteristic, as for the interaction between Humic acid and the Cultivars, treatment V2H1 recorded the highest percentage, amounting to 87.61%, compared to the lowest percentage recorded by treatment V3H0, which amounted to 72.63%. The interaction between the Nanofertilizer and Cultivar. Transaction V2N3 recorded the highest percentage, which amounted to 86.96%, compared to the lowest percentage recorded by transaction V1N3, which amounted to 74.36%.

We note that the triple intervention significant effect on ratio of mature wood to total wood, as the V2N3H1 treatment gave the highest percentage, reaching 91.30%, while this percentage decreased to 66.78% in the V3N2H0 treatment.

Table 4: Effect of Nanofertilization Humic acid and their interaction on Ratio of mature wood to total wood (%) Three grape cultivars.

Humic Acid H	Nano Fertilization N	Cultivars			H×N	Mean H
		V_1 Black Hamburg	V_2 Kamaly	V_3 Zytuny		
H_0	N_0	74.48	78.93	68.65	74.02	75.44
	N_1	76.59	75.68	72.89	75.05	
	N_2	70.11	82.93	66.78	73.27	
	N_3	73.46	82.61	82.20	79.42	
H_1	N_0	76.88	90.74	84.34	83.99	83.29
	N_1	79.36	84.89	76.57	80.27	
	N_2	81.85	83.51	88.41	84.59	
	N_3	75.25	91.30	86.38	84.31	
LSD $_{0.05}$		7.26			NS	2.04
H×V		H_0	H_1		mean V	
	V_1	73.66	78.33		76.00	
	V_2	80.04	87.61		83.82	
	V_3	72.63	83.92		78.28	
LSD $_{0.05}$		4.61			4.60	
N×V		V_1	V_2	V_3	Mean N	
	N_0	75.68	84.84	76.49	79.00	
	N_1	77.97	80.29	74.73	77.66	
	N_2	75.98	83.22	77.59	78.93	
	N_3	74.36	86.96	84.29	81.87	
LSD $_{0.05}$		5.60			2.88	

Number of branches growing on main branch (branch plant^{-1}): The results of the statistical analysis in Table 5 indicated that the addition of humic acid and NPK Nanofertilizer had a significant effect in increasing number of growing branches on main branch, as it reached 10.33 and 10.50 branch plant^{-1} in the H1 and N3 treatment, respectively, compared to the comparison treatment, H0 and N0, which It gave lowest rates of 8.67 and 8.83 branch plant^{-1}, while there were not significantly in the Cultivars. While binary interaction between Humic acid and Nanofertilizer, as treatment N3H1 reached of 12.11 branch plant^{-1}, compared to treatment N0H0, which gave the lowest value of 8.11 branch plant^{-1}, while there were not significantly in either interaction between Humic acid. Cultivars, Nanofertilizer, and Cultivars.

Moreover, the three-way interactions between coefficients did not have a significant effect on this characteristic.

Table 5: Effect of Nanofertilization and Humic acid and their interaction on Number of branches growing on main branch (branch plant^{-1}) Three grape cultivars.

Humic Acid H	Nano Fertilization N	V_1 Black Hamburg	V_2 Kamaly	V_3 Zytuny	H×N	Mean H
H_0	N_0	9.00	7.33	8.00	8.11	8.67
	N_1	10.33	8.00	8.00	8.78	
	N_2	9.33	8.33	9.00	8.89	
	N_3	9.67	7.67	9.33	8.89	
H_1	N_0	10.33	9.00	9.33	9.56	10.33
	N_1	10.67	10.00	8.33	9.67	
	N_2	11.00	9.33	9.67	10.00	
	N_3	13.33	11.67	11.33	12.11	
LSD $_{0.05}$		NS			1.47	1.13
H×V		H_0	H_1		Mean V	
	V_1	9.58	11.33		10.46	
	V_2	7.83	10.00		8.92	
	V_3	8.58	9.67		9.12	
LSD $_{0.05}$		NS			NS	
N×V		V_1	V_2	V_3	Mean N	
	N_0	9.67	8.17	8.67	8.83	
	N_1	10.50	9.00	8.17	9.22	
	N_2	10.17	8.83	9.33	9.44	
	N_3	11.50	9.67	10.33	10.50	
LSD $_{0.05}$		NS			0.89	

Leaves content of total chlorophyll (mg 100 g^{-1} fresh weight): The results of the statistical analysis in Table 6 indicated that treatments of the Cultivars had a moral superiority, as the V1 Cultivar recorded the highest rate of 42.84 mg 100g^{-1} fresh weight, while the V2 Cultivar recorded the lowest rate of 25.60 mg 100g^{-1} fresh weight. The treatments of adding nano-fertilizer significant of Chlorophyll, N3 reached of 37.12 mg 100g^{-1} fresh weight, N0 reached of 31.46 mg 100g^{-1} fresh weight. adding humic acid had a significant effect, as the H2 treatment recorded the highest rate of 35.91 mg 100g^{-1} fresh weight, while the control H0 recorded the lowest rate of 30.97 mg 100g^{-1} fresh weight. The N3H1 reached of 40.75 mg 100g^{-1} fresh weight, while the comparison N0H0 reached of 28.38 mg 100g^{-1} fresh weight, while the interaction had The addition of Humic acid and the Cultivars chlorophyll, the H1V1 reached of 44.48 mg 100g^{-1} fresh weight, while the lowest rate of 22.38 mg 100 g^{-1} fresh weight was recorded in the H0V2 treatment, while the interaction between adding Nano fertilizer and Cultivars, as the V1N3 reached of 48.93 mg 100 g^{-1} fresh weight, while the lowest rate of 22.28 mg 100 g^{-1} fresh weight was recorded in the V2N0 treatment.

The V1N3H1 gave the highest rate of 52.88 mg 100 g^{-1} fresh weight, while this percentage decreased to 19.41 mg 100 g^{-1} fresh weight in the V2N0H0 treatment.

Table 6: Effect of Nanofertilization and Humic acid and their interaction on Leaves content of total chlorophyll (mg 100 g^{-1} fresh weight) Three grape cultivars.

Humic Acid H	Nano Fertilization N	Cultivars			H×N	Mean H
		V_1 Black Hamburg	V_2 Kamaly	V_3 Zytuny		
H_0	N_0	37.18	19.41	28.55	28.38	30.97
	N_1	40.21	23.38	31.12	31.57	
	N_2	42.41	21.75	27.07	30.41	
	N_3	44.98	24.99	30.53	33.50	
H_1	N_0	45.85	25.15	32.65	34.55	35.91
	N_1	39.49	27.92	32.95	33.45	
	N_2	39.69	29.24	35.71	34.88	
	N_3	52.88	32.99	36.38	40.75	
LSD $_{0.05}$		4.33			2.28	0.83
H×V		H_0	H_1		Mean V	
	V_1	41.20	44.48		42.84	
	V_2	22.38	28.82		25.60	
	V_3	29.32	34.42		31.87	
LSD $_{0.05}$		2.59			2.64	
N×V		V_1	V_2	V_3	Mean N	
	N_0	41.51	22.28	30.60	31.46	
	N_1	39.85	25.65	32.03	32.51	
	N_2	41.05	25.50	31.39	32.65	
	N_3	48.93	28.99	33.45	37.12	
LSD $_{0.05}$		3.36			1.78	

The reason for the increase in vegetative growth characteristics and improvement of nutritional status of trees when adding Humic acid may be attributed to its role in improving Soil physical and chemical properties, which provides a suitable environment for Roots spread and growth and thus leads to an increase in the absorption of nutrients and their accumulation in the leaves and their transfer to the branches. Humic acid stimulates growth through the organic compounds, mineral elements, and organic acids it contains (13). Organic matter also increases availability of plant nutrients such as potassium, phosphorus, and nitrogen as the role of organic matter in providing the raw materials and energy necessary to build new tissues in the plant's structure becomes clear. Organic matter also contributes to increasing microbial organisms in the soil and increasing Enzymes effectiveness. This effect leads to increased growth rates, which in turn increases the diameter of the stem (Table 1) (6). Adding organic fertilizer (Humic acid) leads to improving the physical and chemical properties of the soil, and provides a suitable environment for the growth and spread of roots. Most of the vital processes that occur within the plant contribute to increasing the rate of cell division and increasing their number, size, and elongation, which results in an increase in the percentage of dry matter in the plant. Leaves (Table 2), number of main branches (Table 5) (5 and 16). Increasing the number of branches and leaf area led to an increase in the products of photosynthesis, so the dry weight of the leaves increased (11). This perhaps explains reason for increase in percentage of dry matter in leaves (Table 2). It can also be attributed to increase in percentage of dry matter to increase increasing efficiency of

photosynthesis process, which leads to an increase in net carbon dioxide represented in the leaves, which represents basic unit in building carbohydrates (19), or it may be due to role of nitrogen and phosphorus in increasing vegetative growth, which increase root growth, leading to increased water absorption, or it may be due to role of nitrogen and phosphorus in increasing vegetative growth, which increase root growth, leading to increased water absorption. This is attributed to their role in building chlorophyll, so percentage of synthetic materials increases with increased photosynthesis, and these materials accumulate in plant tissues, thus causing an increase in percentage of dry matter in leaves and branches (6 and 12). The results of (tables 1, 2, 3, 4, 5 and 6) show that there is a significant increase in studied traits between cultivars, and this is due to genetic variation, nature of gene expression, the response to various environmental factors for each cultivar, and extent of cultivars response to these changes and its suitability to the conditions surrounding it, and that this It led to a difference in vegetative growth indicators (15).

Conclusions

We conclude through this study that adding organic fertilizer (Humic acid) to grape Cultivars led to a significant increase in vegetative growth characteristics and that this increase is in turn reflected in an increase in yield. The Nanofertilizer addition treatments also had a significant effect in improving vegetative growth indicators and increasing vegetative growth. It is reflected in improving the nutritional status of the plant and thus the yield increases in quality and quantity.

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No Supplementary Materials.

Author Contributions:
Author 1; Review and editing. The authors have read and approved the published version.

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