Effect of mineral nutrition with NPK and organic with humic acid on the vegetative growth of seedlings of three grape cultivars *Vitis vinifera* L.

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Abstract

A factorial experiment was conducted in the nursery of the Department of Horticulture and Landscaping - College of Agriculture and Forestry, University of Mosul/Iraq. During the 2019 growing season to study the effect of chemical fertilization with NPK compound fertilizer (20: 20: 20) at three concentrations (zero, 125, 250) mg NPK. L^{-1} and organic fertilization with humic acid at three concentrations (zero, 10, 20) HA mg.L^{-1} in the vegetative growth characteristics of three cultivars of grapes, Rashmio, Taifii and Halawani, and studying all the interactions between the studied factors using the randomized complete block design (RCBD) for factorial experiments, with three replications and five seedlings for each experimental unit. The results can be summarized as follows:Chemical fertilization resulted in NPK compound fertilizer, especially at a concentration of 250 mg NPK. L^{-1} resulted in a significant increase in the height of the main stem of the seedling, the average number of leaves, the area of one leaf , the leaf area of the seedlings, and the dry weight of the vegetative and root system.Organic fertilization with humic acid, especially at a concentration of 20 mg HA.L^{-1}, led to a significant increase in the height of the main stem of the seedling, the number of leaves, the area of one leaf, the leaf area of the seedlings, and the dry weight of the vegetative and root system.The studied traits varied according to the cultivated cultivars, where the Halwani cultivar was significantly excelled on the two cultivars Rashmio and Taifii in the height of the main stem, the area of one leaf, the leaf area of the seedling, and the dry weight of the vegetative growth.While the two cultivars Halawani and Taifii were excelled on the cultivar Rashmio in the number of leaves, and the cultivar Rashmio and Taifi was significantly excelled on the Taifii cultivar in the dry weight of root system.The bi and triple interactions between the levels of NPK compound fertilizer, humic acid concentrations, and the three grape cultivars had a significant effect, especially when treating (250 mg NPK.L^{-1} + 20 mg HA.L^{-1} for Halwani cultivar)in the length of the main stem of seedlings, the number of leaves for seedlings, the area of one leaf and the leaf area of seedlings.

تأثير التغذية المعدنية بالـ **NPK** والعضوية بحامض الهيوميك في النمو الخضري لشتلات ثلاثة أصناف من العنب ***Vitis vinifera* L.**

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الخلاصة

نفذت تجربة عاملية في مشتل قسم البستنة وهندسة الحدائق - كلية الزراعة والغابات في جامعة الموصل/العراق. أثناء موسم النمو 2019 لدراسة تأثير التسميد الكيميائي بالسماد المركب NPK (20 : 20 : 20) وبثلاثة تراكيز وهي (صفر ، 125 ، 250) ملغمNPK .لتر$^{-1}$ والتسميد العضوي بحامض الهيوميك Humic acid وبثلاثة تراكيز وهي (صفر ، 10 ، 20) HA ملغم.لتر$^{-1}$ في صفات النمو الخضري لثلاثة اصناف من العنب رشميو وطائفي وحلواني ودراسة كافة التداخلات بين العوامل المدروسة بإستخدام

تصميم القطاعات العشوائية الكاملة (R.C.B.D) للتجارب العاملية وبثلاثة مكررات وبخمسة شتلات لكل وحدة تجريبية ويمكن تلخيص النتائج بما يأتي:

أدى التسميد الكيميائي بالسماد المركب NPK ولاسيما عند التركيز 250 ملغمNPK . لتر$^{-1}$ الى زيادة معنوية في ارتفاع الساق الرئيسي للشتلة ومعدل عدد الاوراق ومساحة الورقة الواحدة والمساحة الورقية للشتلات والوزن الجاف للمجموع الخضري والجذري. أدى التسميد العضوي بحامض الهيوميك ولاسيما عند التركيز 20 ملغم HA.لتر$^{-1}$ الى زيادة معنوية في ارتفاع الساق الرئيسي للشتلة وعدد الاوراق ومساحة الورقة الواحدة والمساحة الورقية للشتلات والوزن الجاف للمجموع الخضري والجذري. تباينت الصفات المدروسة حسب الاصناف المزروعة إذ تفوق الصنف حلواني معنوياً على الصنفين رشميو وطائفي في ارتفاع الساق الرئيسي ومساحة الورقة الواحدة والمساحة الورقية للشتلة والوزن الجاف للمجموع الخضري ، في حين تفوق الصنفين حلواني وطائفي على الصنف رشميو في عدد الاوراق وتفوق الصنف رشميو وحلواني معنوياً على الصنف طائفي في صفة الوزن الجاف للمجموع الجذري.
أدت معاملات التداخلات الثنائية والثلاثية بين مستويات السماد المركب NPK وتراكيز حامض الهيوميك واصناف العنب الثلاثة تأثيراً معنوياً ولاسيما عند معاملة (250 ملغمNPK. لتر$^{-1}$ + 20 ملغمHA.لتر$^{-1}$ للصنف حلواني) في طول الساق الرئيسي للشتلات وعدد الاوراق للشتلات ومساحة الورقة الواحدة والمساحة الورقية للشتلات.

Introduction

Grape (*Visit vinifera* L.) belongs to the Vitaceae family, and it is one of the first plants cultivated by ancient humans, including the cultivation of grapes in Iraq, as early as the settlement of Mesopotamia Thus, grapes are among the oldest cultivated fruits.Grapes are one of the most widely consumed types of fruits in the world for their high nutritional value. Its fruits contain simple sugars, vitamins, organic acids, mineral salts, proteins, fats, and others (1). Nutrients play an "important" role in the growth and development of seedlings and fruit trees, especially the use of neutral fertilizers (NPK), which are included in the synthesis of many different biological compounds necessary for plant growth in order to continue to perform its various functions optimally, for nucleic acids (DNA, RNA, and tRNA, Ribosomal RNA), chlorophyll and protein, and it is involved in the synthesis of enzymes and some plant hormones responsible for the processes of cell division and growth, as well as in the synthesis of some vitamins, and it enters into the process of respiration and photosynthesis, as well as in the synthesis of phosphorous compounds with energy-rich bonds (ADP and ATP) and in the coenzymes (NAD and NADP) (2, 3).Humic acid is one of the most important organic fertilizers used. It is one of the organic acids produced naturally and one of the most important humic compounds resulting from the decomposition of organic matter. It contains in its composition carbon, hydrogen, nitrogen and oxygen in varying proportions and works to increase the efficiency of the roots to absorb nutrients and water from the soil and retain the elements nutrients, water and stimulating soil microorganisms,It works to increase and improve the strength of the root system growth through increasing the dry and fresh weight, increasing the lateral branches of the roots, increasing the number of micro-organisms in the soil and dissolving heavy soil granules, improving their physical, chemical and biological properties. Chlorophyll, amino acids and enzymes (4). Many researchers have confirmed the physiological role of NPK and humic acid in increasing the vegetative growth traits, such as (5) for one-year-old grape seedlings of Kamali cultivar and (6) for grape vines of excelled cultivar. And (7) on seedlings of grapes cultivar Summer Royal and (8) on vines of cultivar Flame Seedless. The study of cultivars, especially the local ones, is considered one of the important productive matters due to its variation in most formal and productive characteristics, the date of its maturity, and the extent of its response to various agricultural factors and treatments .The experiment aims to improve the vegetative and root growth of seedlings of three local table grape cultivars, with a study of the variance in the behavior,

extent, and susceptibility of the cultivars to NPK and organic mineral fertilization to produce seedlings of grapes of homogeneous growth and of good quality in terms of length and diameter.

MATERIALS AND METHODS

This study was conducted in the nursery of the Department of Horticulture and landscape gardening, College of Agriculture and Forestry, University of Mosul, Iraq during the agriculture season for the period from 2/15/2019 to 10/15/2019 on seedlings of three cultivars of local grapes at the age of one year, for the purpose of studying the variation in the growth behavior for the cultivars and their response to fertilization with three levels of NPK fertilizer and three levels of humic acid (HA) (Organic). in order to produce well-growing, homogeneous seedlings with good quality. Seedlings of the three cultivars were brought from one of the civil nurseries in the Dohuk province at the beginning of February, and the punching process was performed on it, with a rate of two buds per seedling, and its root group was buried directly to be planted in black nylon bags with a capacity of 10 kg river soil on 15/February/2019. Soil samples were taken before starting the experiment in order to assess some of the physical and chemical traits for the soil used in the experiment as shown in Table (1).

Table 1: Some physical and chemical traits for the soil of bags used in the study.

Soil separates			**Texture**	**Soil reaction (pH)**	**The electrical conductivity (mho's)**	**Organic matter (g.kg^{-1})**	**Calcium carbonate (g.kg^{-1})**
Sand	**Silt**	**Clay**					
485	305	210	Sandy loam	7.29	3.65	1.20	235
The concentration of some nutrients in the soil							
Nitrogen availability			Phosphorous availability			Potassium availability	
46.05			6.53			80.74	

*** The analysis was performed in the central laboratory for the College of Agriculture and Forestry, University of Mosul.**

The split plate system was used according to the Randomized Complete Block Design (RCBD), with three replicates and five seedlings for each experimental unit in one replicate, to study the effect of the following factors:

The first factor: cultivars: Rashmeo, Taifii, and Halwani

The second factor: Fertilizing seedlings with compound chemical fertilizer (NPK) (20:20:20 mg.Seedling-1) in three levels (0, 125, and 250 mg NPK.L^{-1})

The third factor: three levels of humic acid (0, 10 and 20 mg HA.L^{-1})

. The fertilizer was added in the amount of 150 ml of each concentration in three batches, and the first addition was on April 17, 2019 and in three batches between each batch and the other one month. With a study of all possible interactions between the factors under study. Vegetative growth measurements were taken in mid-October for all seedlings, and then the average was taken and included the following:

Height of the main stem (cm): using a tape measure and measured from the place of bud emergence from the pruned buds when planting seedlings to the top of the plant and for all seedlings.

The number of leaves formed on the seedling (leaf.seedling^{-1}). The number of leaves was counted on all seedlings.

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Leaf area ($cm^2.plant^{-1}$): The area of the leaf was estimated, by taking 16 leaves for each fully-grown plant from the third to sixth leaf from the top of the strongest growth on the main stem according to the following equation according to (9)

The leaf area of seedlings ($cm^2.seedling^{-1}$):

It was measured by multiplying the leaf area by the number of leaves to extract the leaf area of the seedling.

Vegetative dry weight (g): The Vegetative were separated from the seedlings, washed from the dust, and air dried for the whole experimental unit seedlings and weighed after drying in an electric oven (Oven) at a temperature of 70 ± 2 °C until the weight was stable.

Dry weight of the root system (g): The root system was separated from the cuttings of the seedlings, washed from the dust and air-dried for the whole experimental unit seedlings and weighed after drying in an electric oven (Oven) at a temperature of 70 ± 2 °C until the weight was stable. The data were statistically analyzed using the statistical program. (10) The averages were compared according to Duncan's polynomial test, at a probability level of 5%. (11).

Results and discussion :

Height of the main stem of grape seedlings (cm):

Table (2) shows that there are significant differences caused by the chemical fertilization (NPK) treatment, where the chemical fertilization treatment was excelled on 250 mg NPK. L^{-1} and gave the highest average of main stem height significantly and reached (60,972) cm. $seedlings^{-1}$, compared with the lowest Average height of main stem for chemical fertilization treatments 125 and zero mg NPK.L^{-1}, which were 57.06) and 50.60) cm $seedlings^{-1}$, respectively. Also, the chemical fertilization treatment with 125 mg NPK . L^{-1} was excelled and significantly compared to the control treatment. While the control treatment gave the lowest values for the height of the main stem, which was 50.60 cm. $seedlings^{-1}$. As for the levels of humic acid, we notice the spray treatment with a concentration of 20 mgL^{-1} of humic acid significantly excelled and it gave the highest values in the average for the height of the main stem, which amounted to 61.733 cm. $seedlings^{-1}$. While the cultivars differed among themselves and gave the cultivar Halawani (62.153) cm. $Seedling^{-1}$, which significantly excelled on the Taifii and Rashmio grape cultivars in the height of the main stem of the seedlings. The cultivar also excelled and gave the average height of the main stem reached (53.863) cm. $seedling^{-1}$. Significantly on the cultivar Reshmio, which gave the lowest average for the height of the main stem, which reached (52.631) cm. $seedling^{-1}$.The results of the interactions, especially the triple interaction between the factors under study, indicate that there are significant differences between the treatments, and the interaction treatment between the chemical fertilization treatment gave 250 mg NPK. L^{-1} + 20 mg humic acid. L^{-1} of the Halawani cultivar had the highest values in the height of the main stem, which amounted to (78,200) cm. seedling $^{-1}$, while the lowest height of the main stem was recorded when the control treatment was for the cultivar Rashmio, which amounted to (43.933) cm. seedling $^{-1}$. The reason for the increase in the height of grape seedlings is that the addition of NPK compound fertilizer leads to an increase in soil fertility by increasing the amount of macro elements available in the soil, which leads to increased absorption, which increases the efficiency of the process of photosynthesis and carbohydrate formation and uses for growth and bio-building processes and improve the vegetative growth of seedlings Increasing plant height, as well as the vital role of macronutrients, especially nitrogen, in increasing the plant hormone IAA (2, 12, 13).

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As well as the variation in the height of seedlings of grape varieties, which may be attributed to the difference in genetic factors controlling growth through the size of the leaves and their breadth, and the genetic susceptibility of the cultivars in terms of giving the number of produced leaves and the length of the branch in the seedling, which results in a discrepancy in the rate of height of seedlings according to the cultivars.

Table (2): The effect of chemical fertilization (NPK) and humic acid individually and the interaction between them on the average height of the main stem (cm) for seedlings of three grape cultivars.

The Compound fertilizer (mg NPK.L^{-1})	Humic acid (mg.L^{-1})	Cultivars			Interaction between the compound fertilizer and humic acid	Averages of the compound fertilizer
		Halawani	Taifi	Rishmio		
0	**0**	43.933 L	46.133 lk	lk ي49.400	46.378 e	50.607 c
	10	50.067 i-k	49.400 lkj	53.067 f-j	50.844 de	
	20	51.800 g-j	54.867 e-j	57.130 h-e	54.599 dc	
125	**0**	45.550 lk	47.867 lkj	56.800 e-i	50.072 de	57.068 b
	10	51.133 h-k	53.217 f-j	71.450 bc	c b 58.600	
	20	53.533 f-j	60.600 d-e	73.467 a b	62.533 ab	
250	**0**	58.667 efg	51.550 h-k	59.333 e-f	56.517 bcd	60.972 a
	10	59.400 ef	54.733 e-j	60.867 e-d	58.333 bc	
	20	59.600 ef	66.400 cd	78.200 a	68.067 a	
Interaction between the compound fertilizer and cultivars	**0**	48.600 e	50.133 ed	53.088 dc	Averages of Humic acid	
	125	48.600 d	50.133 dc	53.088 cd		
	250	50.072 dc	53.894 c	67.239 a		
Interaction between Humic acid and cultivars	**0**	59.222 b	57.561 b	66.133 a	50.988 c	
	10	49.383 de	48.517 e	55.067 c	55.926 b	
	20	53.533 c	52.450 cd	61.794 b	61.733 a	
Averages effect of cultivars		52.631 b	53.863 b	62.153 a		

Values with similar letters for each factor or their interactions individually do not differ significantly" according to Duncan's polynomial test under the 5% probability level.

The reason for the effect of humic acid on the rise of grape seedlings is to encourage the absorption of nutrients by the seedlings and reduce the pH of the used soil, in addition to that, the formation of ions is mainly caused by the decomposition of organic soil matter (13).In

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addition to the role of humic acid in increasing the development of chlorophyll and the assembly of sugars, amino acids and enzymes, thus increasing the efficiency of the photosynthesis process and its similar role to the role of auxins in cell division and increasing the percentage of dry matter, and then increasing the growth of the vegetative system, which is positively reflected in the increase in the height of seedlings (14).As for the organic fertilization treatments, significant differences were obtained between them, especially when the fertilization was treated with a concentration of 20 mg humic acid. L^{-1} and the number of leaves was 50,726 leaves. $Seedling^{-1}$, compared to treatments 10 and zero mg of humic acid. L^{-1},The treatment of organic fertilization with 10 mg .$L^{-1}$of humic acid was also significantly excelled compared to the control treatment.While the number of leaves varied among the grape cultivars under study, the highest values were recorded in the number of leaves for the cultivar Halawani (47,908 leaves. $Seedling^{-1}$), which was significantly excelled in the number of leaves compared to the two grape cultivars Taifi and Rashmio. The number of leaves of the Taifi cultivar (46.001 leaves.$seedling^{-1}$) exceeded the number of leaves of the Rashmio grape variety, while the lowest values were recorded in the number of leaves (42.727 leaves. $Seedling^{-1}$) in the cultivar Rashmio. As for the study of the interactions, especially the triple interaction between the studied factors, we find that there are significant differences between the treatments. The fertilization treatment was excelled with 250 mg NPK. L^{-1}+ 20 mg humic acid. $L^{-1}$of the Halawani cultivar in the number of leaves and gave (72,043) leaves.$seedling^{-1}$, while the lowest values were observed in the control treatment of the Halawani cultivar , which amounted to (34.000) leaves.$seedling^{-1}$.Perhaps the reason for the increase in the number of leaves on seedlings is due to the increase in fertilization rates with NPK compound fertilizer and the improvement of the roots' ability to absorb water and nutritional mineral elements, an increase in the concentration of these elements in the leaves and an increase in the building of chlorophyll in the leaves of seedlings, which leads to raising the efficiency of the photosynthesis process and thus increasing the amount of carbohydrates produced and their use For the vegetative growth processes of seedlings, including increasing the number of leaves (15 and 16).

The area of one leaf (cm^2)

Table (4) indicates that there were significant differences between the levels of chemical fertilization (NPK) studied in the area of one leaf (cm^2) for grape seedlings. Treatments 125 and zero mg NPK.L^{-1}.Also, the chemical fertilization treatment with 125 mg NPK . L^{-1} was significantly excelled on the control treatments. While the control treatment recorded the lowest values of (28.122) cm^2 for this trait. The results of humic acid levels showed significant differences between the treatments, where the highest values were recorded when spraying with a concentration of 20 mg humic acid. L^{-1}, which gave an area of one leaf of (36.577) cm^2 compared to the control treatment, which gave an area of one leaf of (30.048) cm^2.cultivars varied in the area of one leaf, where the highest values were recorded for the Halawani cultivar (35,667) cm^2, which significantly excelled on the two grape cultivars Taifi and Rashmio. The cultivar Rashmio also excelled and gave an area of one leaf (31.738) cm^2 on the area of one leaf for the Taifi grape cultivar , while the lowest values were recorded for the area of one leaf and amounted to (30.525) cm^2 for the Taifi cultivar.As for the interactions between the studied factors, especially the triple interaction, we find that there are significant differences between the factors and the fertilization treatment was given with 250 mg NPK. L^{-1} + 20 mg humic acid. L^{-1} of the cultivar Rashmio had the highest values in the area of one leaf, which amounted to (49.800) cm^2, while the lowest values were

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recorded in the area of one leaf for the control treatment of the Taifi cultivar , which amounted to (24.007) cm^2.The increase in the leaf area may be due to the good mineral nutrition with the major elements NPK, which leads to increased cell division and expansion, which leads to the expansion of the leaf area (17 and 18).

Table (3): The effect of chemical fertilization (NPK) and humic acid individually and the interaction between them on the number of leaves (leaf. seedling^{-1}) for seedlings of three grape cultivars.

The Compound fertilizer (mg NPK.L^{-1})	Humic acid (mg.L^{-1})	Cultivars			Interaction between the compound fertilizer and humic acid	Averages of the compound fertilizer
		Halawani	Taifi	Rishmio		
0	0	36.600 ij	41.000 f-i	34.000 j	37.200 e	39.683 c
	10	38.467 hij	43.360 e-i	37.883 hij	39.903 de	
	20	38.600 g-j	43.800 e-i	43.433 e-i	41.944 cde	
125	0	37.800 hij	40.100 e-j	43.933 e-i	40.611 de	43.034 b
	10	38.500 hij	43.467 e-i	49.650 de	43.872 cd	
	20	39.800 h	44.200 e-i	49.860 de	44.620 cd	
250	0	46.733 ef	46.553 fe	44.800 e-h	46.029 bc	53.919 a
	10	48.673 et	46.100 egf	55.567 cd	50.113 b	
	20	59.367 bc	65.433 b	72.043 a	65.614 a	
Interaction between the compound fertilizer and cultivars	0	37.889 e	42.720 b	38.439 e	Averages of Humic acid	
	125	38.700 e	42.589 d	47.814 c		
	250	51.591 b	52.696 b	57.470 a		
Interaction between Humic acid and cultivars	0	40.378 e	42.551 de	40.911 e	41.280 c	
	10	41.880 e	44.309 cde	47.700 bc	44.630 b	
	20	45.922 cd	51.144 b	55.112 a	50.726 a	
Averages effect of cultivars		42.727 b	46.001 a	47.908 a		

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In addition to the role of the major nutrients NPK in increasing the outputs of the photosynthesis process by increasing the chlorophyll content in the leaves from which the seedlings benefit in their vital processes, including cell division and expansion and the construction of new meristematic tissues as well as the role of the major nutrients NPK in their participation in the synthesis of many plant hormones Including indole acetic acid IAA and its participation also in the synthesis of nucleic acids (DNA and RNA), various enzymes and vitamins (19) that may contribute to increased growth, which is reflected in the increase in the area of one leaf.The increase in the area of one leaf through fertilizing with humic acid is due to its vital role in increasing the facilitation of nutrients in the soil and increasing their concentration in the leaves, which is positively reflected in the increase in the outputs of the photosynthesis process in addition to the vital role of humic acid in regulating the levels of plant hormones and stimulating enzymes within plant tissues Which increases the ability of cells to divide and elongation and increase the area of the leaf (16 and 20).Cultivars differed clearly in the area of one leaf, which is due to the variation of genetic susceptibility between cultivars based on the genetic factors controlling the leaf size for each variety and its breadth, and this is consistent with (21 and 22).

Table (4): The effect of chemical fertilization (NPK) and humic acid individually and the interaction between them in the area of one leaf (cm^2) for seedlings of three grape cultivars.

The Compound fertilizer (mg NPK.L^{-1})	Humic acid (mg.L^{-1})	Cultivars			Interaction between the compound fertilizer and humic acid	Averages of the compound fertilizer
		Halawani	Taifi	Rishmio		
0	0	25.487 gh	24.007 h	31.223 b-g	26.906 d	28.122 c
	10	26.253 e-g	24.707 h	33.310 b-e	28.090 cd	
	20	26.680 eh	27.600 hc	33.83 bc	29.371 cd	
125	0	32.040 b-f	26.873 e-h	32.203 h-f	d c b 30.372	31.318 a
	10	31.800 b-g	27.100 b-h	33.600 b-c	d c b 30.833	
	20	32.073 b-f	31.880 b-g	34.300 b	32.751 bc	
250	0	33.440 b-e	31.863 b-g	33.297 b-e	32.867 bc	38.489 a
	10	28.070 b-h	32.497 b-g	44.407 a	34.991 b	
	20	49.800 a	48.200 a	44.830 a	47.610 a	
Interaction between the compound fertilizer and cultivars	0	26.140 d	25.438 d	32.789 c	Averages of Humic acid	
	125	31.971 c	28.618 d	33.368 c		
	250	37.103 b	37.520 b	40.844 a		
Interaction between Humic acid and cultivars	0	30.322 bc	27.581 c	32.241 b	30.048 b	
	10	28.708 c	28.101 c	37.106 a	31.304 b	
	20	36.184 a	35.893 a	37.654 a	36.577 a	
Averages effect of cultivars		31.738 b	30.525 b	35.667 a		

Values with similar letters for each factor or their interactions individually do not differ significantly" according to Duncan's polynomial test under the 5% probability level.

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Leaf area of grape seedlings (m^2..seedling^{-1}):

Table (5) shows that there were significant differences in the levels of chemical fertilization (NPK) studied, which significantly affected the increase in the leaf area of grape seedlings. It is noted that the largest values were recorded in the leaf area of the seedling, which amounted to 0.213 m^2.seedling^{-1} when fertilizing with 250 mg NPK.L $^{-1}$, which was significantly excelled on the two treatments 125 and 0 mg NPK.L^{-1}, and the chemical fertilization treatment with 125 mg NPK.L^{-1} was significantly excelled compared to the control treatment, while the control treatment recorded the lowest values for this trait (0.111) m^2.seedling^{-1}. As for the concentrations of humic acid, it is noted from the data in the same table that there are significant differences, especially when spraying with a concentration of 20 mg of humic acid. L^{-1}, which gave the highest leaf area of 0.193 m^2.seedling^{-1}, while the lowest values were recorded for the control treatment, which was 0.125 m^2.seedling^{-1}.The effect of cultivars had a clear effect on increasing the leaf area of seedlings, as the largest values were recorded in the leaf area of Halawani cultivar (0.175) m^2.seedling^{-1}, which significantly excelled on Taifi and Rasmio cultivars. The cultivar also excelled the cultivar in the leaf area of the seedling, which amounted to 0.145 m^2.seedling^{-1}, on the grape cultivar Reshmio, while the lowest values were recorded for the leaf area of (0.140) m^2.seedling^{-1} for the cultivar Reshmio. As for the interactions between the studied factors, especially the triple interaction, we find that there are significant differences between the factors, and the fertilization treatment was given with 250 mg NPK. L^{-1} + 20 mg humic acid. L^{-1} of the Halawani cultivar , the highest values in the leaf area of the seedling amounted to (0.322) m^2.seedling^{-1}, while the lowest values were recorded in the leaf area of seedlings for the control treatment of the cultivar Rashmio, which amounted to (0.093) m^2.seedling^{-1}.The increase in the leaf area of seedlings is due to the physiological effect of the macro nutrients NPK in increasing the number of leaves and the area of one leaf, where the good mineral nutrition of the major elements NPK leads to an increase in cell division and widening, which leads to the expansion of leaves and increase the strength of the growth of seedlings and thus increase the leaf area of the seedling and this agrees with (22 and 23).The increase in the leaf area of the seedlings through their response to humic acid fertilization is due to the increase in the number of leaves per seedling and the increase in the area of one leaf, which results from the increase in the concentrations of the basic mineral elements NPK and the increase in the biological representation of chlorophyll in the leaves, whose biological and physiological benefits were reflected in the increase in the leaf area of the seedling. In addition, humic acid improves the physical and chemical composition of the soil, thus increasing its fertility, releasing nutrients and absorbing them by the roots, which in turn are transmitted to the different parts of the plant, which leads to an increase in vegetative growth, including an increase in leaf area (24).

Dry weight of the vegetative (g dry weight. Seedling^{-1}):

The data in Table (6) indicate that mineral nutrition with NPK had a significant effect in increasing the dry weight of the vegetative total of grape seedlings, especially when treated with 250 mg NPK. L^{-1}, which amounted to (39.145 g dry weight. seedling^{-1}), which significantly excelled on the treatment. The control treatment, which recorded the lowest values for this trait, reached 33,283 g dry weight. seedling^{-1}.The addition of humic acid led to a significant increase in the dry weight of the vegetative, and the treatment was recorded at a concentration of 20 mg of humic acid. L^{-1} has the largest values in the average dry weight of the vegetative (41.547) g dry weight. seedling^{-1}compared with the lowest value, which was when the control treatment, which amounted to (30.940) g dry weight. seedling^{-1}. The data of the same table

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showed that the cultivars had a clear effect to obtain the largest values of dry weight of the vegetative total, which amounted to 39.973 (g) dry weight. Seedling^{-1} of the Halwani cultivar , which significantly excelled on the Taifii cultivar, which recorded the lowest values of dry weight of the vegetative growth , which reached (33.559) g dry weight. seedling$^{-1.}$

Table (5): The effect of chemical fertilization (NPK) and humic acid individually and the interaction between them on the leaf area (m^2.seedling^{-1} of three grape cultivars.

The Compound fertilizer (mg NPK.L^{-1})	Humic acid (mg.L^{-1})	Cultivars			Interaction between the compound fertilizer and humic acid	Averages of the compound fertilizer
		Halawani	Taifi	Rishmio		
0	0	0.093j	0.098 ij	0.106 g-j	0.099 e	0.111 c
	10	0.102 h i j	0.108 d-j	0.126 d-j	0.112 ed	
	20	0.102 h i j	0.121 e-j	0.147 c-g	0.123 edc	
125	0	0.122 H - Y	0.108 f-j	0.143 c-h	0.124 edc	0.135 b
	10	0.122 H - Y	0.119 e-j	0.167 cd	0.136 dc	
	20	0.128 J-J	0.141 c-i	0.170 c	0.146 c	
250	0	0.155 g Dh	0.148 c-g	0.149 c-g	0.151 bc	0.213 a
	10	0.137 c - i	0.150 c-f	0.245 b	0.177 b	
	20	0.296 a	0.315 a	0.322 a	0.311 a	
Interaction between the compound fertilizer and cultivars	0	0.099 e	e d 0.109	0.126 d	Averages of Humic acid	
	125	0.124 d	0.122 d	0.160 c		
	250	0.196 b	0.204 b	0.238 a		
Interaction between Humic acid and cultivars	0	0.120 c	0.118 c	0.132 c	0.125 c	
	10	0.120 c	0.125 c	0.179 b	0.142 b	
	20	0.175 b	0.195 b	0.213 a	0.193 a	
Averages effect of cultivars		0.140 b	0.145 b	0.175 a		

Values with similar letters for each factor or their interactions individually do not differ significantly" according to Duncan's polynomial test under the 5% probability level.

The results of the bi-interaction, especially the triple interaction between the factors under study, indicate the significant effect on the dry weight of the vegetative growth of grape seedlings with an increase in the concentrations of the interaction factors, especially when fertilizing with 250 mg NPK. L^{-1} + 20 mg humic acid. L^{-1} of the cultivar Halwani, which achieved the largest values in the dry weight of the vegetative growth and reached 51.967) g dry weight. Seedling^{-1} and the value of this trait decreased and reached the lowest in the control treatment for the Taifii cultivar, which averaged (21.877) g dry weight. seedling$^{-1.}$The increase in the dry weight of the vegetative complex through fertilizing with NPK compound may be due to the physiological and vital roles of the many macro nutrients in the plant, especially their entry into the formation of protoplasm and multiple vital components, as well as the energy-carrying compounds of phosphorous element such as ADP and ATP and the increase

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in the activity of some enzymes to reach their maximum activity In the biological processes inside the plant (25 and 2), which were ultimately reflected in the length, thickness, number of leaves and leaf area of the seedling, which led to an increase in the dry weight of the vegetative growth .The increase in the dry weight of the vegetative growth through the addition of humic acid may be due to an increase in the efficiency of the photosynthesis process, which leads to an increase in the length of the main stem (Table 2) and an increase in the number of leaves and leaf area of seedlings, which leads to an increase in the vegetative growth of grape seedlings.Table (6) notes that there is a clear discrepancy between the grape cultivars in the dry weight of the vegetative total, which comes as a result of the variation in the lengths of the stems of the cultivated cultivars and the variation in the number of leaves and the leaf area of seedlings according to the cultivar and agrees with (26).

Table (6): The effect of chemical fertilization (NPK) and humic acid individually and the interaction between them on the dry weight of the vegetative (g dry weight. seedling^{-1}) for seedlings of three grape cultivars.

The Compound fertilizer (mg NPK.L^{-1})	Humic acid (mg.L^{-1})	Cultivars			Interaction between the compound fertilizer and humic acid	Averages of the compound fertilizer
		Halawani	Taifi	Rishmio		
0	0	23.363 h	21.877 h	34.677 efg	26.639 e	33.283 b
	10	37.813 def	23.100 h	38.557 def	d c 33.157	
	20	9.403 cde	35.043 efg	45.713 abc	40.053 ab	
125	0	29.933 g	29.750 g	35.010 efg	e d 31.564	36.409 ab
	10	35.683 d-g	36.390 d-g	39.810 b-e	cd b 37.294	
	20	46.597 ab	37.587 def	36.920 d-g	40.368 ab	
250	0	31.200 fg	36.543d-g	36.110 d-g	cd b 34.618	39.145 a
	10	35.640 d-j	39.153 cde	40.997 b-e	38.597 abc	
	20	38.110def	42.583 bcd	51.967 a	44.220 a	
Interaction between the compound fertilizer and cultivars	0	33.527 c	26.673 d	39.649 ab	Averages of Humic acid	
	125	37.404 cb	34.576 c	37.247 bc		
	250	34.983 c	39.427 bc	43.024 a		
Interaction between Humic acid and cultivars	0	28.166 g	29.390 fg	35.266 dc	30.940 c	
	10	36.379 cde	32.881 ef	39.788 bc	36.349 b	
	20	41.370 ab	38.404 bcd	44.867 a	41.547 a	
Averages effect of cultivars		35.305 b	33.559 b	39.973 a		

Values with similar letters for each factor or their interactions individually do not differ significantly" according to Duncan's polynomial test under the 5% probability level.

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dry weight of the root system(g dry weight. seedling^{-1}):

Table (7) shows that there are significant differences in the dry weight of the root system of grape seedlings, where the largest values were recorded when fertilizing with 250 mg.L^{-1}, which amounted to 48,094)) g dry weight. Seedling^{-1}, which was significantly excelled on the control treatment, recorded the lowest values in the dry weight of the root system, which reached (41.437) g dry weight. seedling^{-1}.As for the treatment of fertilization with humic acid, the results are noted that it excelled the treatment of fertilization with humic acid with 20 humic acid. L^{-1} in the dry weight of the total root, which had the highest values and amounted to (48.112) g dry weight. seedlings^{-1} compared to the lowest value, which was when fertilizing with humic acid was treated with 10 humic acid. L^{-1} and amounted to 40.073)) g dry weight. Seedlings^{-1} This excelled was not significant with the control treatment.cultivars varied in the increase in the dry weight of the root system, where the largest values were recorded for the cultivar Rashmio (46.278) g dry weight. Seedling-1, which excelled the Taifiigrape cultivar , which recorded the lowest values in the dry weight of the root system, which amounted to (41.319) g dry weight. seedling^{-1}. The data showed in the bi-interaction coefficients between the levels of compound fertilizer (NPK) and humic acid to a clear increase in the dry weight of the root system of grape seedlings.Fertilization treatment with 250 mg NPK achieved. L^{-1} 20 + mg. L^{-1} humic acid has the largest value for this trait (58.272) g dry weight. seedlings^{-1}, while the fertilization treatment with 125 mg NPK was recorded. L^{-1} 20 + mg. L^{-1} humic acid lowest values (38.216) g dry weight. seedling^{-1}.

The results of the interactions, especially the triple interaction between the factors under study, indicate the significant effect on the percentage of dry weight of the root system of grape seedlings with an increase in the concentrations of the interaction factors, especially when the fertilization was treated with 250 mg NPK. L^{-1} + 20 mg humic acid. L^{-1} for the cultivar, which achieved the largest values in the dry weight of the root system and reached (68.800) gm of dry weight. seedlings^{-1}, while the lowest was observed in the control treatment for the cultivar, as it reached (30.227) g dry weight. seedling^{-1}.The positive effect of NPK fertilization may be due to an increase in the vegetative growth of seedlings and an increase in leaf area (Table 6), which leads to an increase in the efficiency of the photosynthesis process and its vital products, which was reflected on the overall growth of seedlings, including an increase in the growth of the root system of grape seedlings. The reason for this may be due to the fact that the addition of humic acid to the soil led to an increase in the concentration of nutrients by the plant, especially NPK, and an increase in the strength of root group growth and improvement (27), in addition to its role as a medium for transferring nutrients from the soil to the plant, which may lead to an increase in the lateral branching of the roots (28).As well as its similar role to the role of auxins in increasing cell division, elongating roots, increasing its branches and the number of root hairs (29) and this is positively reflected in the increase in the dry weight of the roots. The number, lengths, and dry weight of the rootstock varied from one cultivar to another.

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Table (7): The effect of chemical fertilization (NPK) and humic acid individually and the interaction between them on the dry weight of the root system (gm dry weight. seedling^{-1}) for seedlings of three grape cultivars.

The Compound fertilizer (mg NPK.L^{-1})	Humic acid (mg.L^{-1})	Cultivars			Interaction between the compound fertilizer and humic acid	Averages of the compound fertilizer
		Halawani	Taifi	Rishmio		
0	0	36.967 i-k	30.377 l	36.743i-k	34.696 d	41.437 c
	10	ij c 38.920	30.227 l	56.150 bcd	41.766 c d	
	20	41.887 ghi	50.327 def	51.337 de	c b 47.850	
125	0	51.460 de	43.197 gh	61.437 b	52.031 ab	43.435 b
	10	44.550 fgh	29.830 l	45.797 efg	d c 40.059	
	20	50.887 dh	31.410 lk	32.350 lk	38.216 d	
250	0	53.057 d	53.787 cd	36.003 i-l	47.616 bc	48.094 a
	10	39.457 hij	33.923 jkl	41.807 gih	38.216 d	
	20	59.320 bc	68.800 a	46.697 efg	58.272 a	
Interaction between the compound fertilizer and cultivars	0	39.258 de	36.977 ef	48.077 bc	Averages of Humic acid	
	125	48.966 abc	34.812 f	46.528 c		
	250	50.611 ab	52.170 a	41.502d		
Interaction between Humic acid and cultivars	0	47.161 cd	42.453 ed	44.728 cd	44.780 b	
	10	40.976 d	31.327 e	47.918 abc	40.073 c	
	20	50.698 a	50.179 ab	43.461 ed	48.112 a	
Averages effect of cultivars		46.278 a	41.319 b	45.368 a		

Values with similar letters for each factor or their interactions individually do not differ significantly" according to Duncan's polynomial test under the 5% probability level.

References:

1 - Al-Saeedi, Ibrahim Hassan Muhammad. (2014). Grape classification. Al-Wadah Publishing House, and Ashtar for Cultural Investments, Amman, the Hashemite Kingdom of Jordan.

2-Mengle, K. & E. A. Kirkby; H. Kosegavten and T. Apple (2001). Principles of plant nutrition Kluwer Academic publishers.

3 - Al-Sarwani, Ayman Ali. (2008). Integrated management of grape gardens. Arab House for Publishing and Distribution. Cairo. The Egyptian Arabic Republic.

4-Phelpstek (2002). http://www.com/clints/humic acid.html. structure, properties, and soil application, Page 373 – 380.

5- Hammoud, Etidal Shaker, Muhammad Tarkhan Abu al-Mikh, Hana Ahmad

ISSN 2072-3875

Hashem (2013). The effect of N fertilizer. P and foliar spraying with Vigamine on growth indicators and chemical content of leaves of grape seedlings (Cultivar Kamali). Karbala University Scientific Journal - 11 (3): 165 - 170.

6-Shaheen, M. A., Sahar, M. Abdaelwahad, F. M. El-Morsy and A. S. S. Ahmed. (2013). Effect of organic and Bio-fertilization as a partial Substitute for NPK Mineral fertilizer on Vegetative growth, leaf mineral content, yield and fruit quality of Superior seedless Grapevine, Journal of horticultural Scince and Ornamental plants 5 (3) : 151 – 159, 2013 Issn 2079 – 2158.

7- Abdel Rahim, Zainab Hamed, Raja Abdel Hadi Kazem (2017). Effect of two organic nutrients and NPK on some vegetative and root growth characteristics of Summer Royal grape seedlings. Hagglet Iraqi agricultural sciences. (5) 48: 1176 - 1183.

-8Ahmed,F.F.;A.H.M.Abdealaa;S.M.A. El-Masry and A.H.R. Ahmed(2017). Effect of Humic and Volvic acid, Em and Amino Accid on Berries Colouration, Yield and Quality of Flame Seedless Grapes.Assut J. Arric. Sci., 48 (2): 88-103.

- 9Dvomic, V.(1965). Lucrari practice d'Ampelografia Ed. Didactica si pedagogica, Bucresti, Romania.

10-SAS. 2003. Statical analysis system. SAS Institute Inc., Cary, Nc. USA.

11 - Al-Rawi, Khasha Mahmoud and Abdul Aziz Muhammad Khalaf Allah, 1980). Design and analysis of agricultural experiments. Ministry of Higher Education and Scientific Research / University of Mosul.

12-Hopkins, W.G. & N. P. A. Hüner (2004). Introduction of plant physiology. 3rd Edition. John Wiley & Sons, Inc. U.S.A.

13 - Al-Imam, Nabil Muhammad Amin Abdullah and Haitham Thamer Abdul-Jabbar Al-Abbasi (2020). Effect of NPK, humic acid and gibberellin compound fertilizer on vegetative and root growth and mineral content of Eriobtrya japonica Lindl cultivation.

14-Turkmen, O.; S. Demir, S. Sensoy and A. Duursun. (2005). Effects of Arbuscular mycorrhizal fungus and humic acid on the seedling development and nutrient content of pepper grown under saline soil conditions. J. Bio. Sci., 5 (5).: 568 – 574.

-15Khaled, H. and A. F. Hassan. (2011). Effect of different levels of humic acids on the nutrient content, plant growth, and soil properties under conditions of salinity. Soil and Water Res., 7 (1) : 21 – 29.

16- Blackt, Raad Taha Muhammad Ali, Abbas Mohsen Salman Al-Hamidawi (2015). Effect of humic and fulvic humic organic acids and irrigation water quality on some vegetative growth indicators of date palm trees (Phoenix dactylifera L.) young Barhi cultivar. Kufa Journal of Agricultural Sciences. 7(1): 22-40.

17 – Al-Imam, Nabil Muhammad Amin Abdullah and Jassim Muhammad Khalaf Al-Ishaqi (2009). Effect of NPK compound fertilizer and spraying with iron and gibberellic acid on the growth and yield of pomegranate cultivar Punica granatum L. on knots, growth and some fruiting properties. Rafidain Journal of Agriculture 37 (2): 25-37.

-18 Abd El-Razek, E. ; D. Treutter,; M. M. S. Elshammaa,; A. A. Fouad and N. Abdel-Hamid. (2011). Effect of nitrogen and potassium Fertilization on productivity and fruit quality of ‹ Crimson seedless' grape. Agric. Biol. J. N. Am., 2 (2) : 330 – 340.

-19Singh, A. (2003). Fruit physiology and production. Kalyani publishers, Ludhianna, Scince 125 : 1144 – 45.

-20Bama S., K.G.; Somasundaram; S.S. Porpavai ; K.G. Selvakumari and Jayaraj . T. T. 2008. Maintenance of to high salinity . Annu. Rev. Plant physiol., 51 ; 464 – 497.

- 21Galet, P. (1971). Precis d' ampelographie pratlque. Imprimerie Dehan, Montpellier.

22 - Al-Imam, Nabil Muhammad Amin (1998). Effect of spraying with iron, zinc and compound fertilizer (NPK) on the growth and yield of two grape cultivars Halwani Lebanon and Kamali. PhD thesis. College of Agriculture and Forestry - University of Mosul. Iraq.

23Carbonneau, A. (1976). Analyse de la croissance des feuilles du sarment de vigne; estimation de sa surface foliaire par echantillonnage. Connaissance vigne, vin 10 (2) : 141–159.

24- Taha, Al-Shahat Muhammad Ramadan (2007). Bio-organic fertilizers. Faculty of Agriculture, Ain Shams University, Arab Thought House, Egypt.

25- El-Shazly, Saeed Abdel-Aty (1999). Technology of fertilization and irrigation of fruit trees in desert lands. Academic Library, Cairo, Arab Republic of Egypt.

26- Mezrag, Ahmed C. (2005). Comparison of growth kinetics and mineral composition of leaves for some local grape cultivars (Vitis vinifera L. . PhD thesis, Mentouri University, Constantine, People's Democratic Republic of Algeria.

27-Tatini, M. ; P. Bertoni, A. Landi and Traversi, M. L. (1991). Effect of humic acids on growth and biomass portioning of container-growth olive plants. Acta Hort. 294: 75 – 80.

-28Hartwigson, I. A. and M. R. Evans. (2000). Humic acid, seed and substrate treatments promoto seedling root development. Hort Science, 35 (7) : 1231 – 1233.

29-Passeghello D., Nicolini G., Nardi S.,(2002). Hormone-like activities of humic substances in different forest ecosystems. New phytol 155: 393-402.

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