Effect of adding the chemical fertilizer NPK and humic acid on the growth and mineral percentage for seedlings of three grape cultivars (*Vitis vinifera* L.)

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ABSTRACT

This experiment 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 (2019) to study the effect of chemical fertilization for compound fertilizers (NPK) (20: 20: 20), with three concentrations which are (0, 125, 250 mg NPK.L^{-1}) and organic fertilization with humic acid (HA) in three concentrations (0, 10, 20 mg.L^{-1}) on three cultivars of grapes: Rashmio, Taif, and Halawani, and studying all the interactions between the studied factors. The results can be summarized as follows:

The chemical fertilization with compound fertilizers (NPK) especially at a concentration of (250 mg NPK.L^{-1}) achieved a significant increase in the percentage of nitrogen, phosphorous, and potassium in the petioles of the leaves, the concentration of chlorophyll and the percentage of protein in the leaves. Organic fertilization with humic acid, especially at a concentration of (20 mg.L^{-1}) led to a significant increase in the percentage of nitrogen, phosphorus, and potassium in the Petioles leaves of grape seedlings, the concentration of chlorophyll, and the percentage of protein in the leaves. The studied traits varied according to the cultivated cultivars, where the Halawani cultivar significantly excelled on the two cultivars (Rishmio and Taifi) in the percentage of nitrogen, phosphorus, and potassium in the petioles of the leaves and the percentage of protein, while the two cultivars were significantly excelled on to the Halawani cultivar in the concentration of chlorophyll in leaves. The interaction treatments between NPK levels, concentrations of humic acid, and the three cultivars of grape had a significant effect on the percentage of nitrogen, phosphorus, and potassium in the Petioles leaves , especially at the treatment (250 mg NPK.L^{-1} + 20 mg HA.L^{-1} for the Halawani cultivar) and the percentage of protein in the leaves.

تأثير إضافة السماد الكيميائي NPK وحامض الهيوميك في النمو والمحتوى المعدني لشتلات ثلاثة أصناف من العنب *Vitis vinifera* L.

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الخلاصة

نفذت هذه التجربة في مشتل قسم البستنة وهندسة الحدائق /كلية الزراعة والغابات في جامعة الموصل - العراق. أثناء موسم النمو 2019 لدراسة تأثير التسميد الكيميائي للسماد المركب NPK (20 : 20 : 20) وفي ثلاثة تراكيز وهي (صفر ، 125 ، 250) ملغمNPK .لتر$^{-1}$ والتسميد العضوي بحامض الهيوميك HA)) وبثلاثة تراكيز وهي (صفر ، 10 ، 20) ملغم.لتر$^{-1}$ على ثلاثة اصناف من العنب رشميو وطائفي وحلواني ودراسة كافة التداخلات بين العوامل المدروسة. ويمكن تلخيص النتائج بما يأتي: حقق التسميد الكيميائي بالسماد المركب NPK ولاسيما عند التركيز 250 ملغمNPK. لتر$^{-1}$ الى زيادة معنوية في نسبة النتروجين والفسفور والبوتاسيوم في أعناق الاوراق وتركيز الكلوروفيل ونسبة البروتين في الاوراق. أدى التسميد العضوي بحامض الهيوميك ولاسيما عند التركيز 20 ملغم HA.لتر$^{-1}$ الى زيادة معنوية في نسبة النتروجين والفسفور والبوتاسيوم في أعناق اوراق شتلات العنب وتركيز الكلوروفيل ونسبة البروتين في الاوراق. تباينت الصفات المدروسة حسب الاصناف المزروعة إذ تفوق الصنف حلواني معنوياً على الصنفين رشميو وطائفي في نسبة النتروجين والفسفور والبوتاسيوم في أعناق الاوراق ونسبة البروتين، في حين تفوق الصنفين معنوياً

رشميو وطائفي على الصنف حلواني في تركيز الكلوروفيل في الاوراق. أدت معاملات التداخل بين مستويات السماد المركب NPK وتراكيز حامض الهيوميك واصناف العنب الثلاثة تأثيراً معنوياً في نسبة النتروجين والفسفور والبوتاسيوم في أعناق الاوراق ولاسيما عند معاملة (250 ملغمNPK. لتر$^{-1}$ + 20 ملغمHA.لتر$^{-1}$ للصنف حلواني) ونسبة البروتين في الاوراق.

1. INTRODUCTION

Grapes (*Visit vinifera* L.) belong to the Vitaceae family, which includes 14 genera, about 700 species, and more than ten thousand cultivars in the world. It is considered one of the most widespread and consumed fruits in the world for its high nutritional value where its fruits contain simple sugars, vitamins, organic acids, mineral salts, proteins, Fats, and others (3). 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) (18, 4). Humic acid is considered one of the most important used organic fertilizers, and it is one of the organic acids that are 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 different proportions and works to increase the efficiency of the roots to absorb nutrients and water from the soil, retain nutrients and water, and stimulate micro-organisms in the soil. It also works to increase the strength of the growth of the root system and improving it by increasing the dry and fresh weight, increasing lateral branching of the roots, increasing the number of microorganisms in the soil and dissolving heavy soil particles, improving its physical, chemical and biological properties, does not leave a harmful effect to humans and it has a high solubility in water and increases Evolution of chlorophyll, amino acids and enzymes (19). Many researchers have confirmed the physiological role of NPK and humic acid in increasing the leaves content of mineral and chlorophyll (21), the leaves content of nitrogen, phosphorous, and potassium for the grapevines (Superior cultivar) (8), the leaves content of chlorophyll and stalk thickness for the grape cultivar (Flame Seedless (9), and the Leaves petioles content of NPK and the leaves content of chlorophyll. The study of cultivars, especially local ones, is considered one of the important productive matters due to their variation in most of the formal and productive traits, their ripening date, and their response to various agricultural factors and treatments. Therefore, the study aims to improve the mineral, chlorophyll, and carbohydrate content for seedlings of three cultivars of local table grapes, With studying variation in behavior, extent, and susceptibility of cultivars to respond to mineral and organic fertilization (NPK) to produce homogeneous seedlings of grapes with good quality.

2. 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 fr 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, Taifi, 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 $HA.L^{-1}$)

Three levels of compound chemical fertilizer (NPK) (20: 20: 20) dissolved in water were added to the soil with three concentrations (0, 125 and 250 mg $NPK.L^{-1}$), Fertilizers were added in the form of fertilizer dissolved with water at a rate of (150 $cm.ml^{-1}$) for each seedling in three batches, where the first batch of chemical fertilizer (NPK) was on April 15, 2019, and within one month between batches. Three levels of humic acid were added to the soil at three concentrations (0, 10, and 20 mg $HA.L^{-1}$). Fertilizer was added with rate of (150 ml) from each concentration to each seedling in three batches, and the first addition was on April 17, 2019, and in three batches between each batch and another is one month With studying all possible interactions between the factors under study. Fully Expanded Leaves were collected from the seedlings of all the experimental units, and with rate of 16 leaves from each experimental unit in mid-August. The samples were digested according to the methods mentioned in (16). After digestion, the samples were quantitatively transferred to 50 ml volumetric flasks and the volume was completed with 100 ml distilled water. The digested samples were placed in glass containers for using it in estimating the nutrients (nitrogen, phosphorous, and potassium (NPK)), according to the method mentioned by (11). The percentage of nitrogen (%) in the Petioles leaves was estimated by the Micro-Kjeldahl method according to the method mentioned by (12). The percentage of phosphorus in the Petioles leaves was estimated by the method of ammonium molybdate and ascorbic acid, and it was read by spectrophotometer (CECIL CE 3021) at the wavelength of 882 nm (22). The percentage of potassium in the Petioles leaves of grape seedlings was estimated by a Flame Photometer 410 (20). The protein percentage was estimated according to the following equation:

percentage of Protein = percentage of nitrogen x 6.25 (7).

3. RESULTS AND DISCUSSION

The percentage of nitrogen in the leaves petioles (%):

Table (2) indicates that the levels of the studied chemical fertilization (NPK) had a significant effect in increasing the concentration of the percentage of nitrogen in the leaves petioles of grape seedlings. It is observed that the highest values of nitrogen were at fertilizing with 250 mg NPK.L^{-1} which amounted to (1.064%) which significantly excelled on the two treatments (125 and zero mg NPK.L^{-1}). The chemical fertilization treatment (125 mg NPK.L^{-1}) has significantly excelled which amounted to (0.458 nitrogen) compared to the control treatment. While the control treatment recorded the lowest values for this trait amounted to (0.154% nitrogen). The results of the levels of humic acid especially at spraying treatment with a concentration of (20 and 10 mg humic acid.L^{-1}) showed an increase in the percentage of nitrogen in the leaves petioles amounted to (0.651 and 0.532%), respectively. The same table showed that there are significant differences in the extent of the response of the cultivars to the traits of increasing the percentage of nitrogen in the leaves petioles, where the Halawani cultivar has significantly excelled the percentage of nitrogen in the leaves petioles amounted to (0.610 %) compared to the two cultivars (Rishmio and Taifi). The percentage of nitrogen in the leaves petioles for the taifi cultivar has excelled on the Rishmio cultivar which amounted to (0.542%), while the lowest values of the percentage of nitrogen in the leaves petioles for Rishmio cultivar which amounted to (0.523%). The results of the interaction, especially the triple interaction between the factors under study, indicate the significant effect of the percentage of nitrogen in the leaves petioles for grape seedlings with an increase in the concentrations of the interaction factors, especially at the interaction treatment (250 mg NPK.L^{-1} + 20 mg humic acid.L^{-1} for the Halawani cultivar), which achieved the highest values for the percentage of nitrogen in the leaves petioles amounted to (1.372%), while the lowest was observed in the control treatment which amounted to (0.098%).

The values with similar letters for each factor or their interactions individually did not differ significantly according to the Duncan multiple ranges test under the probability level of 5%.

The percentage of phosphorous in the leaves petioles (%):

Table (3) indicates that the levels of the studied chemical fertilization (NPK) had a significant effect in increasing the concentration of the percentage of phosphorous in the leaves petioles of grape seedlings with increase the levels of the compound fertilizer. It is observed that the highest values of phosphorous were at fertilizing treatment (250 mg NPK.L^{-1}) which amounted to (0.157%) which significantly excelled on the two treatments (125 and zero mg NPK.L^{-1}). The chemical fertilization treatment (125 mg NPK.L^{-1}) has significantly excelled which amounted to (0.056%) compared to the control treatment. While the control treatment recorded the lowest values for this trait amounted to (0.056%). The results of the levels of humic acid especially at spraying treatment with a concentration of (20 mg humic acid.L^{-1}) showed an increase in the percentage of phosphorous in the leaves petioles amounted to (0.119%) compared to the control treatment. The same table showed that there are significant differences in the extent of the response of the cultivars to the trait of increasing the percentage of phosphorous in the leaves petioles, where the Halawani cultivar has significantly excelled the percentage of phosphorous in the leaves petioles amounted to (0.144 %) compared to the two cultivars (Rishmio and Taifi). The percentage of phosphorous in the leaves petioles for the taifi cultivar has excelled on the Rishmio cultivar which amounted to (0.095%), while the lowest values of the percentage of phosphorous in the leaves petioles for Rishmio cultivar which amounted to (0.076%). The results of the interaction, especially the triple interaction between the factors under study, indicate the significant effect of the percentage of phosphorous in the leaves petioles for grape seedlings with an increase in the concentrations of the interaction factors, especially at the interaction treatment (250 mg NPK.L^{-1} + 20 mg humic acid.L^{-1} for the Halawani cultivar), which achieved the highest values for the percentage of phosphorous in the leaves petioles amounted to (0210%), while the lowest was observed in the control treatment which amounted to (0.029%).

Table 2: The effect of adding the chemical fertilizer NPK and humic acid and the interaction between them on the percentage of nitrogen in the Petioles leaves (%) for seedlings of three cultivars of grapes.

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**	0.098r	0.169 o	0.147h q	0.138f	0.154c
	10	0.109r	0.198o	0.149h q	0.152f	
	20	0.128r	0.245n	0.150h q	0.174e	
125	**0**	0.343m	0.399l	0.539j	0.427d	0.458b
	10	0.343m	0.394l	0.588i	0.442d	
	20	0.441k	0.392l	0.686h	0.506d	
250	**0**	0.931f	0.980e	0.833g	0.915c	1.064 a
	10	0.999e	0.982e	1.029d	1.003b	
	20	1.323b	1.127c	1.372a	1.274a	
Interaction between the compound fertilizer and cultivars	**0**	0.112g	0.204e	0.149f	Averages of Humic acid	
	125	0.376d	0.395d	0.604c		
	250	1.080a	1.030b	1.078a		
Interaction between Humic acid and cultivars	**0**	0.457f	0.516d	0.506d	0.493c	
	10	0.484e	0.525d	0.589c	0.532b	
	20	0.631b	0.588c	0.736a	0.651a	
Averages effect of cultivars		0.523c	0.542b	0.610a		

Table 3: The effect of adding the chemical fertilizer NPK and humic acid and the interaction between them on the percentage of phosphorous in the Petioles leaves (%) for seedlings of three cultivars of grapes.

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**	0.029s	0.039r	0.064o	0.044c	0.058 c
	10	0.041r	0.047q	0.078l	0.055c	
	20	0.058p	0.066n o	0.083l	0.069c	
125	**0**	0.062o p	0.073m	0.098i	0.077c	0.103 b
	10	0.067n o	0.089k	0.181d	0.112b	
	20	0.071m n	0.095i j	0.191c	0.119d	
250	**0**	0.091j k	0.140g	0.199b	0.143a b	0.157 a
	10	0.128h	0.148f	0.199b	0.158a	
	20	0.137g	0.162e	0.210a	0.169a	
Interaction between the compound fertilizer and cultivars	**0**	0.042i	0.050h	0.075f	Averages of Humic acid	
	125	0.066g	0.085e	0.156b		
	250	0.118d	0.150c	0.203a		
Interaction between Humic acid and cultivars	**0**	0.060i	0.084g	0.120c	0.088c	
	10	0.078h	0.094e	0.153b	0.108b	
	20	0.088f	0.107d	0.161a	0.119a	
Averages effect of cultivars		0.076c	0.095b	0.144a		

The values with similar letters for each factor or their interactions individually did not differ significantly according to the Duncan multiple ranges test under the probability level of 5%.

The percentage of potassium in the leaves petioles (%):

Table (4) indicates that the levels of the studied chemical fertilization (NPK) had a significant effect in increasing the concentration of the percentage of potassium in the leaves petioles. It is observed that the highest values of potassium were at fertilizing treatment (250 mg $NPK.L^{-1}$) which amounted to (1.369%) which significantly excelled on the two treatments (125 and zero mg $NPK.L^{-1}$). The chemical fertilization treatment (125 mg $NPK.L^{-1}$) has significantly excelled compared to the control treatment. While the control treatment recorded the lowest values for this trait amounted to (0.470%). The results of the levels of humic acid especially at spraying treatment with a concentration of (20 mg humic $acid.L^{-1}$) showed an increase in the percentage of potassium in the leaves petioles amounted to (1.016%) compared to the control treatment which gave the lowest values amounted to (0.767%). The same table showed that there are significant differences in the extent of the response of the cultivars to the trait of increasing the percentage of potassium in the leaves petioles, where the Halawani cultivar has significantly excelled the percentage of potassium in the leaves petioles amounted to (0.987 %) compared to the two cultivars (Rishmio and Taifi). The percentage of potassium in the leaves petioles for the taifi cultivar has excelled on the Rishmio cultivar which amounted to (0.912%), while the lowest values of the percentage of phosphorous in the leaves petioles for Rishmio cultivar which amounted to (0.752%). The results of the statistical analysis for the values of the interaction between the levels of the studied factors especially at the interaction treatment (250 mg NPK.L^{-1} + 20 mg humic acid.L^{-1} for the Halawani cultivar), which achieved the highest values for the percentage of potassium in the leaves petioles amounted to (1.975%), which significantly excelled on all treatments, while the lowest was observed in the control treatment which amounted to (0.387%). The reason for the increase in the percentage of nutrients nitrogen, phosphorus and potassium in the leaves petioles of grape seedlings is attributed to the fact that adding compound fertilizer (NPK) leads to an increase in the concentration of these elements in the soil solution, which leads to an increase in their availability of the roots and increase their absorption, thus increasing the concentration of these elements in the leaves petioles. These results agree with (18, 7). Adding the compound fertilizer in a soluble way led to increasing the efficiency of the fertilizer and increasing its absorption by the roots, thus increasing the concentration of macronutrients in the leaves. In addition to increasing vegetative growth by increasing the height of seedlings, the number, and area of leaves, and increasing the leaf area of the seedlings, thus increasing the vegetative and root growth through the addition of compound fertilizer, which requires an increase in the absorption of these elements to meet the need of the leaf and root system in growth, which led to an increase in the concentration of these elements in the leaves (1, 10, 6). The increase of the macronutrients NPK through the addition of humic acid is attributed to its role in improving soil composition, facilitating nutrients, and increasing the activity of microorganisms in the soil that improve the physical and chemical properties of the soil and increase the availability of nutrients from the roots (23). As well as increasing the nutritional content of the soil and improving the ability of the roots to absorb water and nutrients that provide growth requirements (2). Humic acid also increases the permeability of cellular membranes through its interaction with phospholipids, which act as an agent to transport nutrients through the membranes to the cell and increase the stimulation of root growth, thus increase the concentration of nutrients in the leaves (17, 23).

Concentration of Carbohydrate in the branches of grape seedlings (%):

Table (5) indicates that there are significant differences between the studied chemical fertilization treatments (NPK), where there was an increase in the branch content of carbohydrates for grape seedlings. It is observed that the highest values of Carbohydrate were at fertilizing treatment (250 mg NPK.L^{-1}) which amounted to (9.567%) which significantly excelled on the two treatments (125 and zero mg NPK.L^{-1}). The chemical fertilization treatment (125 mg NPK.L^{-1}) has significantly excelled compared to the control treatment. While the control treatment recorded the lowest values for this trait amounted to (7.380%). The results also show that there are significant differences between the levels of humic acid and the highest values for the concentration of carbohydrate in the branches were at the fertilization treatment (20 mg humic acid.L^{-1}) amounted to (9.035%), while the lowest values were at the control treatment, which amounted to (7.820%). As for the cultivars, it is observed that the cultivars are varied and affected clearly, where the Halawani cultivar has significantly excelled the Concentration of Carbohydrate in the branches amounted to (8.692 %) compared to the two cultivars (Rishmio and Taifi).

Table 4: The effect of adding the chemical fertilizer NPK and humic acid and the interaction between them on the percentage of potassium in the Petioles leaves (%) for seedlings of three cultivars of grapes.

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**	0.387n	0.425n	0.487l m n	0.433e	0.470 c
	10	0.425n	0.462 m n	0.501k –l	0.462d e	
	20	0.455m n	0.520k –l	0.598j -n	0.517d e	
125	**0**	0.685h - l	0.598j -i	0.661i - m	0.648d e	0.812 b
	10	1.000d e f	0.701h –k	0.825f -i	0.842c	
	20	0.771g h i	1.111d e	0.964e f g	0.984c	
250	**0**	0.875f gh	1.375c	1.412b c	1.220b	1.369 a
	10	1.000d e f	1.425b c	1.487b c	1.304b	
	20	1.178d	1.597b	1.975a	1.583a	
Interaction between the compound fertilizer and cultivars	**0**	0.422e	0.469e	0.521e	Averages of Humic acid	
	125	0.818d	0.803d	0.816d		
	250	1.017c	1.465b	1.624a		
Interaction between Humic acid and cultivars	**0**	0.649d	0.799c	0.853b c	0.767c	
	10	0.808c	0.862b c	0.937b	0.869b	
	20	0.801c	1.076a	1.171a	1.016a	
Averages effect of cultivars		0.752c	0.912b	0.987a		

The values with similar letters for each factor or their interactions individually did not differ significantly according to the Duncan multiple ranges test under the probability level of 5%.

The concentrations of carbohydrates increased in the branches of the Rishmio cultivar which amounted to (8.322%) compared to the taifi cultivar, which recorded the lowest values for the concentration of carbohydrates amounted to (8.230%). The results of the bi-interaction between the levels of compound fertilizer (NPK) and humic acid showed that there were significant differences in the concentration of carbohydrates in the branches, where the fertilization treatment (250 mg $NPK.L^{-1}$ 20 + $mg.L^{-1}$ humic acid) had the largest values for this trait which amounted to (10.563%), while the control treatment recorded the lowest values amounted to (7.196%). The results of the bi-interaction between the levels of chemical fertilization and the cultivars. The fertilization treatment (250 mg $NPK.L^{-1}$ and the Halawani cultivar achieved the highest concentration of the carbohydrate in the branches for the grape seedlings amounted to (10.263%), which significantly excelled on most of the treatments, while the lowest values were at fertilizing treatment (zero mg $NPK.L^{-1}$ and Rishmio cultivar) which amounted to (7.292%). it is observed from the data of the interaction between the levels of organic fertilization of humic acid and the cultivars that the highest the concentration of carbohydrates in the branches in the treatment of organic fertilization (20 mg of humic $acid.L^{-1}$) and the two cultivar (Halawani and Rishmio), which amounted to (9.261% and 9.190%), respectively, which significantly excelled on the rest of the treatments, while the interaction treatment between the control treatment (0 mg humic $acid.L^{-1}$) and the Rishmio cultivar recorded the lowest concentration of carbohydrate in the branches for Grape seedlings, which amounted to (7.613%). As for the triple interaction between the factors under study, the interaction treatment between the fertilization treatment (250 mg $NPK.L^{-1}$ + 20 $mg.L^{-1}$) and Halawani cultivar has significantly excelled in the concentration of carbohydrates in the branches of grape seedlings, which gave the highest values amounted to (11.230%), while the control treatment gave the lowest value amounted to (7.110%). The increase in carbohydrate concentrations in the branches of grape seedlings through the addition of NPK compound fertilizer, especially the high levels of it, is due to the increase in the concentrations of these elements in the leaves as shown in Tables (2, 3, 4) and the increase in the concentrations of chlorophyll in the leaves as shown in Table (6) as well as the increase in the leaf area of the seedlings that It increases the efficiency of the photosynthesis process and increases the accumulation of carbohydrates in the branches of the seedlings. The increase of carbohydrate substances in the branches of grape seedlings may be attributed to the addition of humic acid to the soil, which improves the physical and chemical properties of the soil composition in which the seedlings are planted, and then increases its fertility and the release of nutrients and their absorption by the roots, which in turn are transferred to other soil particles, which leads to an increase in the elements. Which leads to an increase in the nutrients in the leaves, increasing the leaf area, thus increasing the efficiency of the photosynthesis process and increasing its bio-products, the most important of which are carbohydrates and their accumulation in the branches of the seedling, which leads to an increase in carbohydrate concentrations in them. Table (5) shows the variation of the carbohydrate content in the branches of the three grape cultivars under study, which may be attributed to the variation in the strength of the cultivars among them through differences in the genetic factors that dominate the growth and size of leaves for each cultivar and the extent of their breadth and the genetic susceptibility of the main stem factors and its thickness resulting from the increase in the number and length of the Internodes, which is reflected in the content of the branches of carbohydrate materials. these results agree with (5, 1).

Table 5: The effect of adding the chemical fertilizer NPK and humic acid and the interaction between them on the branch content of carbohydrates for seedlings of three cultivars of grapes.

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**	7.230p q	7.110 q	7.250p q	7.196g	7.380c
	10	7.330o p	7.300 o p q	7.330o p	7.320g	
	20	7.800l m	7.466 n o	7.610m n	7.625f g	
125	**0**	7.600m n	7.710 l m	8.010k	7.773e f	8.297b
	10	8.410i j	7.890 k l	8.300j	8.200d e	
	20	9.110e f	8.700 h	8.943f g	8.917c	
250	**0**	8.010k	8.900 g	8.560h i	8.490c d	9.567 a
	10	8.750g h	9.200 e	11.000 b	9.650b	
	20	10.660c	9.800 d	11.230a	10.563a	
Interaction between the compound fertilizer and cultivars	**0**	7.453f	7.292 g	7.396f g	Averages of Humic acid	
	125	8.373d	8.100 e	8.417d		
	250	9.140c	9.300 b	10.263 a		
Interaction between Humic acid and cultivars	**0**	7.613f	7.906 e	7.940e	7.820c	
	10	8.163d	8.130 d	8.876b	8.390b	
	20	0.801c	1.076 a	1.171a	9.035a	
Averages effect of cultivars		8.322b	8.230 c	8.692a		

The values with similar letters for each factor or their interactions individually did not differ significantly according to the Duncan multiple ranges test under the probability level of 5%.

The percentage of protein in the leaves petioles (%):

Table (6) indicates that there are significant differences caused by the chemical fertilization treatment (NPK), where the fertilizing treatment (250 mg NPK.L^{-1}) gave the highest average percentage of protein which amounted to (6.649%). The chemical fertilization treatment (125 mg NPK.L^{-1}) has significantly excelled compared to the control treatment. While the control treatment recorded the lowest values for this trait amounted to (0.967%). The results of the levels of humic acid especially at spraying treatment with a concentration of (20 mg humic acid.L^{-1}) showed an increase in the percentage of protein in the leaves petioles amounted to (4.071%) compared to the control treatment which gave the lowest value amounted to (3.282 %). While the cultivars differed among themselves in their protein content, and the Halawani cultivar gave the highest values for the percentage of protein in the petioles, which amounted to (3.814%), which significantly excelled on the two grapes cultivars (Taif and Rishmio). The taifi cultivar also significantly excelled by giving it the highest percentage of protein in the leaves petioles, which amounted to (3.393%) on the Rishmio cultivar which gave the lowest percentage of protein in the leaves petioles amounted to (3.274%). The results of the interaction, especially the triple interaction between the studied factors, indicate that there are significant differences between the treatments, the interaction treatment between the chemical fertilization treatment (250 mg NPK.L^{-1} + 20 mg humic acid.L^{-1}) and the Halawani cultivar gave the highest values for the percentage of protein in the leaves petioles amounted to (8.575%). while the lowest values for the percentage of protein in the leaves petioles were at the control treatment for the Rishmio cultivar which amounted to (0.612%). the reason may be due to the increase in protein content is that the addition of compound fertilizer has led to an increase in soil fertility by providing macronutrients in the soil, especially increasing the concentration of the availability of nitrogen component in the soil, which leads to nitrogen absorption and increase in its content in the leaves, thus increasing the protein content in the leaves. The increase in the protein content is attributed to the addition of humic acid to the seedlings' soil, which improves the building of the soil and its role in providing nutrients in a balanced manner to the seedlings and increasing the hormonal activity within the tissues of the grape seedlings, which works to increase the nitrogen concentration in the leaves, thus increase the protein content in them. Table (6) also shows that there is a clear variation in the percentage of protein in the seedling leaves for the three grape cultivars, and the reason may be due to the variation in the strength of the cultivar and the activity of the roots to absorb nitrogen to meet the growth requirements for the cultivar. These results agree with (13).

Table 6: The effect of adding the chemical fertilizer NPK and humic acid and the interaction between them on the percentage of protein in the leaves petioles for seedlings of three cultivars of grapes.

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**	0.612s	1.056o p	0.918p q	0.862e	0.967 c
	10	0.618s	1.239o	0.932p q	0.951e	
	20	0.799p q	1.531n	0.937p q	1.089e	
125	**0**	2.145m	2.495l	3.369j	2.670d	2.865b
	10	2.145m	2.464l	3.624i	2.761d	
	20	2.757k	2.452l	4.286h	3.165d	
250	**0**	5.818f	6.124e	5.202g	5.715c	6.649a
	10	6.243d e	6.173e	6.431d	6.270b	
	20	8.264b	7.044c	8.575a	7.961a	
Interaction between the compound fertilizer and cultivars	**0**	0.697g	1.275e	0.929f	Averages of Humic acid	
	125	2.349d	2.470d	3.776c		
	250	6.775a	6.435b	6.736a		
Interaction between Humic acid and cultivars	**0**	7.613f	7.906e	7.940e	3.082c	
	10	8.163d	8.130d	8.876b	3.327b	
	20	0.801c	1.076a	1.171a	4.071a	
Averages effect of cultivars		3.274c	3.393b	3.814a		

The values with similar letters for each factor or their interactions individually did not differ significantly according to the Duncan multiple ranges test under the probability level of 5%.

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