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THE EFFECT OF SPRAYING WITH HUMIC ACID AND NANO NITROGEN ON SOME VEGETATIVE AND CHEMICAL CHARACTERISTICS OF POMEGRANATE SEEDLINGS PUNICA GRANATUML SHAHRABAN CLASS

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Abstract

This study was conducted during the 2023–2024 growing season at the experimental field associated with the College of Agriculture and Marshes in Dhi Qar Governorate. The primary aim was to examine the effects of foliar application of humic acid and nano nitrogen on selected vegetative and chemical traits of pomegranate seedlings of the Shahraban variety. Humic acid was applied at three levels (0, 2, and 4 $ml.L^{-1}$), while nano nitrogen was sprayed at concentrations of 0, 150, and 300 $mg.L^{-1}$. The experiment followed a factorial design based on a randomized complete block design (RCBD) with three replicates, using three seedlings per experimental unit. Statistical analysis revealed that treatment with 4 $ml.L^{-1}$ humic acid resulted in superior stem length, recording 72.89 cm, and higher potassium content at 1.802%. The application at 2 $ml.L^{-1}$ significantly enhanced other parameters, including the average diameter of the main stem (7.119 mm), dry weight of the green mass (38.13 g), dry weight of the root mass (22.66 g), nitrogen content (2.312%), protein percentage (14.45%), and phosphorus content (0.230%). Regarding the second factor, nano nitrogen, treatment at a concentration of 300 $mg.L^{-1}$ exhibited notable improvements in stem length, phosphorus percentage, and potassium percentage, with values recorded as 78.84 cm, 0.269%, and 1.873%, respectively. Likewise, the application of 150 $mg.L^{-1}$ nano nitrogen outperformed in enhancing the main stem diameter (7.513 mm), dry weight of the vegetative portion (38.09 g), root dry weight (23.15 g), nitrogen content (2.382%), and protein percentage (14.88%). Moreover, analysis indicated significant interactions between the factors across most measured traits, with varying degrees of improvement depending on the respective treatment concentrations. However, one parameter—unspecified in the text—did not exhibit statistically significant differences due to these interactions. potassium, where the interaction between the two study factors was not significant for this trait.

Keywords: Foliar nutrition- Humic acid -Nano nitrogen - Shahban pomegranate.

Introduction

Pomegranate belongs to Pomegranate belongs to the pomegranate family and its scientific name isPunica QranatumL . It is one of the most important deciduous fruit crops that are widespread its trees can withstand high temperatures in the summer compared to and in temperate regions other deciduous fruit treesPagliarulo . et al., 2016 (Holland at el,2009 Pomegranate is grown commercially in Spain, India, Cyprus, Saudi Arabia and Iraq. Many sources also indicate that Central Asia, Iran and Iraq are the original homeland of pomegranateStover andMercure 2007 , andMatthaiou Pomegranate has a high nutritional value due to its good content of .(2014 , vitamins, especially vitaminsB2, B1, C. ,And a number of pigments, fats, proteins, fibers , sugars) and mineral salts such as potassium, iron, copper, and some organic acidsNikdel Hassan ,.et al : 2016 And others, 2012(The number of fruitful pomegranate trees in Iraq reached 6,495,705 . trees, and the total production was estimated at 241,671 tons, and the average production per tree was 37.20 kg/ tree, as Diyala Governorate ranked first in terms of production, estimated at tons, or 54.94% of the total production of Iraq, followed by Salah al-Din and Karbala 132,767 Governorates (Central Agricultural Statistical Organization 2020). There are many varieties of .pomegranate in Iraq, including the Shahraban variety , which is grown in Diyala Governorate ,This variety is characterized by good productivity and its fruits are flat, large, 4.35 mm thick weighing 446 grams, and its peel color is yellow-pink (Al-Mayahy , 2018). Paying attention to feeding seedlings and performing various service and fertilization operations at the beginning of their growth gives them good vegetative growth early, which is positively reflected in the total production, as foliar feeding is considered one of the effective and beneficial methods for plant growth, as it uses small amounts of the nutrient element and secures the plant's need for nutrients) during critical and sensitive stages that the roots are unable to provideMartin Humic .(2002 , acid is a complex organic humic compound and has a high ability to control the acidity of the soil against changes that occur as a result of the use ofchemical fertilizers, as discussed by Leonard (2008), play a significant role in enhancing plant growth and improving the bioavailability of essential nutrients. Their mode of action involves increasing the permeability of cell membranes, which facilitates the absorption of water and nutrients, thereby promoting the efficient transport of minerals within the plant system. An important property of humic acid, a component often associated with such fertilizers, lies in its ability to activate plant enzymes. Specifically, the guanine group in humic acid serves as a nitrogen receptor, while oxygen functions as a stimulant and a chemical mediator in oxidation-reduction processes, as highlighted by Al-Hamdani (2012). The influence of such mechanisms underscores their critical role in agricultural practices. acid are similar to the effects of hormones (auxins) on the plant, as it helps regulate plant growth and) stimulates cell division , and plays a role in increasing root density and increasing its cells Canellas et al., 2012). Nitrogen is considered one of the essential nutrients that plants need in large quantities, and its importance lies in the fact that it is the main component of amino acids and also enters into the composition of some important molecules such as purines and pyrimidines And ,the profins And the cytochromes are essential for the processes of respiration and photosynthesis and since the nitrogen added to the soil in the form of fertilizers undergoes many transformations that lead to its loss, such as volatilization in the form of ammonia or fixation within clay minerals or the opposite of nitrification (Ali, 2012 and Al-Mawsili, 2019). Therefore, it was It is used as a spray on the green group, and modern technologies have been used to increase the efficiency of fertilizers. Nitrogenation and one of these techniques is the use of nano-fertilizers, which are characterized by their high surface area, in addition to reducing pollution and environmental risks) that occur when using other mineral fertilizersSingh .et al 2021(.

The study aims to encourage the cultivation and propagation of this variety in Dhi Qar Governorate, in addition to building a strong structure and improving the vegetative growth of Shahraban pomegranate seedlings using humic acid and nano nitrogen spraying and reducing environmental pollution resulting from the excessive use of chemical fertilizers by using organic .and nano fertilizers

:Materials and methods of work

: Conducting the experiment -1

- This study was conducted in the valley of the College of Agriculture and Marshlands University of Thi Qar for the agricultural season 2023-2024. The current study was conducted on one-year-old pomegranate seedlings of Shahraban variety , almost uniform in length and size. The seedlings were brought from one of the orchards of Diyala Governorate at the beginning of February. After that, the seedlings were transferred to suitable-sized anvils (containing 10 kg) and a culture medium consisting of a mixture was used. And with a ratio of 1:3, the laboratory analysis results were: Before starting the experiment . As follows

:Table (1) Soil components used in the agricultural medium

Unity	Value	The attribute
	7.4	PH
$ds.m^{-1}$	2.26	EC
The attribute		
%	78	Sand
%	10	Clay
%	12	Silent
Weave Loary sand		
$mg\ kg^{-1}$	24.77	Nitrogen
$mg\ kg^{-1}$	7.94	Phosphorus
$mg\ kg^{-1}$	142.01	Potassium

:Study factors -2

The experiment included two factors, the first factor being humic acid . The questioner Rasha in ,three concentrations 0 , 2, 4) ml. L^{-1} At a rate of three sprays, with 20 days between each spray on the date of 20/3 - 10/4 -1/5 and three levels)H1,H2,H3 The second factor is spraying nitrogen (. fertilizer - Nano in three concentrations (0 150 and 300 mg /L - ^{1} at the following times: 15/3 and at three levels: N1 4/25 - 4/5, N2, N3 .

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:Table (2) shows the symbols of the factorial coefficients in the experiment

Symbols	Treatment	T
H1N1	Comparison treatment	1
H2	ml humic acid 2	2
H3	ml humic acid 4	3
N2	150 nano nitrogen amalgam	4
N3	Nano nitrogen amalgam300	5
H2N2	ml humic acid + 150 mg nano nitrogen 2	6
H2N3	ml humic acid + 300 nano nitrogen 2	7
H3N2	ml Humic Acid + 150 mg Nano Nitrogen 4	8
H3N3	ml Humic Acid + 300 mg Nano Nitrogen 4	9

: Experimental design -3

The current research conducted a factorial experiment within a randomized complete block design)RCBD that included two factors: the first factor was liquid humic acid sprayed on the leaves (.at three concentrations, and the second factor was nano nitrogen fertilizer Also spray on the ,leaves in three concentrations The treatments were distributed into three replicates and the experimental unit included three seedlings. Thus, the number of seedlings became 81 (3*3*3*3) and the results were analyzed statistically. Using theGenstat program , the differences between) the arithmetic means were compared according to the least significant differenceLSD test and (. at a probability level of 0.05 (Al-Rawi and Khalaf Allah, 2000)

: The studied characteristics -4

(Rate of increase in height Plant (poison) . Plant $^{-1}$ 1-4

The height of the seedlings was measured at the beginning of the experiment with a measuring tape from the soil surface to the highest peak of the main stem, at a rate of three seedlings for each experimental unit. The process was repeated at the end of the experiment, and by subtracting the . two values, the rate of increase in the height of the seedlings was obtained

.Rate of increase in main stem diameter: (mm. Seedling $^{-1}$) - 2 -4

were measured at the beginning of the experiment and also at the end of the experiment, and the difference between the two readings was calculated for the amount of increase using theVernia .meter for each experimental unit

(Average dry weight of the vegetative group (g. seedling) $^{-1}$ -3 -4

green mass of each sample was calculated using a sensitive balance after drying the green mass .in an electric oven at a temperature of 70% until the weight stabilized

: Average dry weight of the root system (gm. seedling - ^{1}) -4-4

The seedlings were carefully uprooted at the end of the experiment after being well watered the day before to preserve the largest possible root mass. The dry weight of the root mass was calculated using a sensitive balance after drying the root mass in an electric oven at a temperature .of 70% until the weight stabilized

.The percentage of nitrogen in the leaves - 5-4

The Kjeldahl method was employed to determine the nitrogen content in the samples, as outlined

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by Van Dijk et al. (2000). To begin, approximately 0.2 grams of the sample was weighed and placed into a flask. Subsequently, 5 milliliters of concentrated sulfuric acid were added to the sample, followed by an appropriate quantity of a catalytic mixture composed of potassium sulfate and copper sulfate. The digestion process was initiated by heating the contents until complete digestion occurred, indicated by the mixture becoming a clear liquid with a pale blue coloration. The digested solution was then fully transferred to the distillation flask of the Kjeldahl apparatus. This flask contained a concentrated sodium hydroxide solution (40%) and was connected to a condensing distillation unit. The distillation process was carried out by heating the flask until approximately 25 milliliters of distilled liquid were collected in a recipient flask. The collected distillate was subsequently titrated against a standard 0.1 M hydrochloric acid solution. A blank solution (control) was also prepared under identical conditions as a reference. The nitrogen content in each sample was calculated using the following formula: Nitrogen percentage = \[(Volume of hydrochloric acid consumed × Normality × 0.014) / (Weight of sample)] × 100 This procedure provided an accurate quantification of nitrogen within the analyzed samples.6 -4 Percentage of : total protein in leaves

The protein content in the leaves was determined by analyzing their nitrogen levels. The protein percentage was calculated using the nitrogen percentage, following this formula:

Protein percentage in leaves = Nitrogen percentage in leaves ×

:The percentage of phosphorus in the leaves 7-4

The phosphorus content was estimated by ammonium molybdate and ascorbic acid method using .a spectrophotometer

Spectrophotometer ata) wavelength of 620 nm according to the approved methodOlsen and Sommers .(1982 ,

. Percentage of potassium in the leaves 8-4

) Potassium was measured according to the method given byAddis and Wodaje). A (2017) Photoeletric Flame Photometer modelBWB was used .to measure potassium in the sample

Results and discussion:

rate of increase in height The seedling 1 . (cm. seedling $^{-1}$)

Table 3 highlights the significant impact of applying humic acid on the seedling height of pomegranate seedlings (Shahraban variety). The H3 treatment, using a concentration of 4 ml.L^{-1}, achieved the highest average height of 72.89 cm, followed by the H2 treatment with 2 ml.L^{-1}, which resulted in an average of 66.96 cm. Conversely, the control treatment (H1), with no humic acid application, recorded the lowest average height at 62.47 cm. Similarly, the use of nano nitrogen fertilizer also showed significant differences in plant height. The N3 treatment, applied at a concentration of 300 mg.L^{-1}, recorded the highest value at 78.84 cm, followed by N2 with 69.79 cm. The control treatment (without nano nitrogen) exhibited the lowest average at 53.68 cm. The interaction between the two studied factors demonstrated a pronounced effect as well. The combined treatment H3N3 resulted in the highest plant height average at 82.64 cm, while the control treatment recorded the lowest average value of 46.22 cm. Table 3 illustrates these findings, summarizing the influence of humic acid application, nano nitrogen fertilization, and their combined interactions on the increment rate in the height of pomegranate seedlings.

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
53.68	62.45	52.38	46.22	N1
69.79	73.58	68.25	67.53	N2
78.84	82.64	80.24	73.65	N3
	72.89	66.96	62.47	Humic acid rate
LSD 0.05 H=2.057 N= 2.057 HN = 3 .56				

.(Rate of increase in main stem diameter: (mm) .Seedling $^{-1}$ - 2

The data presented in Table 4 indicates that spraying with humic acid significantly influenced the stem diameter. The N2 treatment, at a concentration of 2 ml/L, achieved the highest stem diameter of 7.119 mm, whereas the control treatment (H1N1) without any additive recorded the lowest average of 5.962 mm. Additionally, the application of nano nitrogen fertilizer exhibited a significant effect. The N2 treatment with a concentration of 150 mg/L yielded the highest average diameter of 7.513 mm, closely followed by the N3 treatment with an average of 7.317 mm. Conversely, the control treatment (N1) showed the lowest average diameter of 5.132 mm. Moreover, the interaction between humic acid and nano nitrogen fertilizer demonstrated a substantial impact. The H2N2 combination, involving 2 ml/L of humic acid and 150 mg/L of nano fertilizer, produced the highest stem diameter at 8.366 mm, while the untreated control had the lowest value of 4.283 mm. Table 4: Effect of spraying with humic acid, nano nitrogen fertilizer, and their interactions on the main stem diameter growth rate in pomegranate seedlings, Shahraban variety.

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
5.132	5.907	5.207	4.283	N1
7.513	7.879	8.366	6.293	N2
7.317	6.860	7.783	7.309	N3
	6.882	7.119	5.962	Humic acid rate
LSD 0.05 H=0.501 N=0.501 HN=0.869				

. (Average dry weight of the vegetative group (gm. seedling) $^{-1}$ -1

The data presented in Table 5 highlights the significant impact of humic acid on the dry weight of the vegetative group in pomegranate seedlings (Shahraban variety). Among the treatments, the application of humic acid at a concentration of 2 ml/L demonstrated the highest efficacy, yielding a dry weight of 38.13 g. This was followed by the treatment with a 4 ml/L concentration, which recorded a value of 36.05 g, whereas the H1N1 treatment without humic acid application showed the lowest value at 27.31 g. Regarding nitrogen, the nano nitrogen treatment (N2) at a concentration of 150 mg displayed superior results, also achieving a dry weight of 38.13 g. Furthermore, the interaction between humic acid and nano nitrogen revealed a noteworthy advantage. The combined H2N2 treatment achieved the highest dry weight value of 45.72 g, significantly outperforming the comparison treatment, which recorded the lowest value at 23.51 g. Table 5: Effect of spraying with humic acid, nano nitrogen, and their interactions on the dry

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weight rate of the vegetative group in Shahraban variety pomegranate seedlings.

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
26.35	29.22	26.31	23.51	N1
38.09	40.62	45.72	27.93	N2
37.06	38.32	42.37	30.48	N3
	36.05	38.13	27.31	Humic acid rate
LSD 0.05 H= 0.985 N= 0.985 HN= 1.706				

:Average dry weight of root system (g. seedling $^{-1}$) -2

Table 6 demonstrates that the application of humic acid significantly influenced the dry weight of the root system in pomegranate seedlings (Shahraban variety). Among the treatments, the application of humic acid at a concentration of 2 ml.L^{-1} resulted in the highest mean dry weight of 22.66 g, followed by the treatment with a concentration of 4 ml.L^{-1}. In contrast, the control treatment (H1) exhibited the lowest mean value, recording 18.58 g. Regarding nano nitrogen, the treatment with a concentration of 150 mg.L^{-1} yielded the highest mean dry weight compared to the control treatment, which exhibited the lowest mean value at 17.84 g. Moreover, significant interactions were observed between humic acid and nano nitrogen treatments. Specifically, the combined treatment (H2N3) recorded the highest mean value at 25.52 g. In comparison, the control treatment showed a marked reduction in dry weight, with the lowest recorded value of 15.58 g.
Table 6. Influence of humic acid, nano nitrogen, and their interactions on the dry weight of the root system in pomegranate seedlings (Shahraban variety).

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
17.84	20.22	17.71	15.58	N1
23.15	23.32	24.76	21.37	N2
22.55	23.47	25.52	18.67	N3
	22.55	22.66	18.58	Humic acid rate
LSD 0.05 H =0.858 N=0.858 HN=1.486				

.The percentage of nitrogen in the leaves - 5

I The data presented in Table 7 demonstrates the impact of humic acid application on the studied trait. The H2 treatment, with a concentration of 2 ml.L^{-1}, achieved the highest value of 2.312%, followed closely by the treatment at 4 ml.L^{-1}, which recorded 2.236%. In contrast, the control treatment (H1N1) without any addition showed the lowest average at 1.856%. Regarding the second factor, spraying with nano nitrogen proved to be significant as well, with the N2 treatment yielding the highest percentage at 2.382%. This was followed by the 300 mg.L^{-1} treatment, which recorded 2.241%, while the control treatment registered the lowest percentage at 1.791%. Furthermore, the interaction between the two factors also had a significant effect. The combined H3N2 treatment resulted in the highest percentage of 2.616%, whereas the H1N1 control treatment showed the lowest percentage at 1.606%. Table 7 outlines the effects of humic acid and nano nitrogen sprays, as well as their interactions, on the nitrogen content in the leaves of Shahraban pomegranate seedlings.

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
1.791	1.912	1.854	1.606	N1
2.382	2.616	2.614	1.917	N2
2.241	2.181	2.468	2.073	N3
	2.236	2.312	1.865	Humic acid rate
LSD 0.05 H=0.858 N=0.858 HN =1 .486				

6- :Percentage of total protein in leaves

The data in Table 8 demonstrates that the percentage of total protein was significantly influenced by spraying humic acid at a concentration of 2 ml/L, achieving the highest percentage of 14.45%. This was followed by treatment with a concentration of 4 ml/L, which yielded a percentage of 14.00%. In contrast, the control treatment recorded a lower protein percentage of 11.66%. The results further indicate that spraying with nano nitrogen significantly enhanced this trait, with the highest increase observed at a concentration of 150 mg/L, reaching 14.88%. This was followed by treatment with 300 mg/L. The control group without fertilizer showed the lowest percentage, at 11.19%. Additionally, the interaction between the two studied factors exhibited a significant effect. The combination treatment with 4 ml/L of humic acid and 150 mg/L of nano nitrogen resulted in the highest protein percentage of 16.35%, compared to the control treatment, which recorded the lowest percentage of 10.04%. Table 8 outlines the effects of humic acid, nano nitrogen, and their interactions on the total protein percentage in the leaves of Shahraban variety pomegranate seedlings.

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
11.19	11.95	11.58	10.04	N1
14.88	16.35	16.33	11.97	N2
14.00	13.63	15.42	12.95	N3
	14.00	14.45	11.66	Humic acid rate
LSD 0.05 H=0.711 N= 0.711 HN= 1.231				

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:The percentage of phosphorus in the leaves 7-

Table 9 illustrates that the application of humic acid significantly influenced the phosphorus concentration in pomegranate seedling leaves. The treatment with a 2 $ml.L^{-1}$ concentration demonstrated the highest phosphorus percentage, closely followed by the 4 $ml.L^{-1}$ concentration, with values of 0.230% and 0.299%, respectively, showing no statistical difference between them. However, both treatments had a significant difference compared to the control group, which reported the lowest percentage of 0.176%. Additionally, the table indicates that spraying with nano nitrogen also produced a significant effect. The concentrations of 300 $mg.L^{-1}$ and 150 $mg.L^{-1}$ recorded the highest averages, with values of 0.269% and 0.202%, respectively. The combined interaction of humic acid and nano nitrogen demonstrated notable differences. The H3N3 treatment emerged as the most effective, achieving the highest phosphorus percentage of 0.306%, while the control group recorded the lowest percentage at 0.147%. Table 9 summarizes the effects of humic acid, nano nitrogen, and their interactions on phosphorus concentration in the leaves of Shahraban variety pomegranate seedlings.

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
0.165	0.178	0.169	0.147	N1
0.202	0.203	0.222	0.181	N2
0.269	0.306	0.300	0.200	N3
	0.229	0.230	0.176	Humic acid rate
LSD 0.05 H=0.023 N= 0.023 HN= 0.040				

.The percentage of potassium in the leaves - 8

The results presented in Table 10 demonstrate that spraying humic acid on the leaves significantly influenced potassium percentages, with the H3 treatment at a concentration of 4 $ml.L^{-1}$ showing the highest effectiveness, followed by the N3 treatment at 2 $ml.L^{-1}$. The recorded potassium percentages were 1.802% and 1.767%, respectively, compared to the control treatment without humic acid, which exhibited the lowest value of 1.647%. The highest percentage overall was observed at a concentration of 300 $mg.L^{-1}$, reaching 1.873%, followed by the 150 $mg.L^{-1}$ concentration at 1.790%. In contrast, the N1 control treatment showed a reduced percentage of 1.552%, while the interaction effect on this trait was not statistically significant.

Table (10) The effect of spraying with humic acid and nano nitrogen and their interactions on the percentage . Potassium in the leaves of pomegranate seedlings, Shahraban variety

Nano nitrogen rate	Humic acid concentrations			Nano nitrogen
	H3	H2	H1	
1.552	1.675	1.548	1.434	N1
1.790	1.814	1.843	1.713	N2
1.873	1.916	1.908	1.795	N3
	1.802	1.767	1.647	Humic acid rate
LSD 0.05 H=0.083 N=0.083 HN = N.S				

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:Discussion

The increases observed in Tables 3 and 4 can be attributed to the high nitrogen content in humic acid, which enhances carbohydrate storage within the plant by boosting the efficiency of photosynthesis and respiration. This process promotes increased cell division and vegetative growth, leading to taller and wider stems. Additionally, humic acid acts as a growth stimulant, comparable to compounds like auxins and gibberellins, which are known to encourage stem cell growth and elongation (Veran et al., 2010). It also plays a vital role in supplying essential nutrients to plants, improving the absorption of monovalent ions such as ammonium and potassium. This active ion uptake by the roots subsequently supports greater vegetative development, contributing to increased stem length and diameter. These findings align with studies conducted by Bhoyar et al. (2015) on mango seedlings, Al-Janabi (2017) on fig seedlings, Rajan et al. (2018), Hussein et al. (2019) on lemon, and Hakim (2023) on palm trees. The increases documented in Tables 5 and 6, relating to the dry weight of both the vegetative and root systems, can be attributed to humic acid's role in enhancing nutrient availability, as well as its contribution to providing organic compounds, amino acids, and facilitating vital biochemical reactions. By improving cell membrane permeability, humic acid promotes vegetative growth. Furthermore, an efficient photosynthesis process ensures the availability of essential nutrients for root development, resulting in stronger vegetative growth and subsequently higher dry weight in the plant's vegetative system. The observed increases may also stem from humic acid's direct and indirect influence on the availability of key nutrients like nitrogen, phosphorus, and potassium, which significantly enhance nutrient absorption (Katkat et al., 2009). These effects are reflected in the overall increase in plant biomass, including the dry weight of the root system. Such findings are consistent with studies by Judy (2013) on peach seedlings, Abdul Wahab and Al-Mashari (2017) on lemon seedlings, Abu Sirah on oranges, as well as Ghani and others....others (2018) on mango seedlings
In reference to the chemical properties outlined in Tables 7, 8, 9, and 10, humic acid is enriched with essential nutrients such as oxygen, nitrogen, and carbon. These components significantly enhance the efficiency of key metabolic processes in plants, including photosynthesis and respiration, which result in the production of substantial quantities of materials stored within the plant body (Ali et al., 2012). This, in turn, contributes to an increase in the nitrogen content. The rise in total protein levels can be attributed to the role of humic acid in promoting plant growth through the synthesis of organic and amino acids, with amino acids serving as the fundamental building blocks of proteins. Given that nitrogen constitutes a major component of the basic organic compounds in plants, including proteins, this explains the observed increase in protein content, aligning with findings reported by Genaidy et al. (2015), Al-Moussawi (2019), and Hamied (2018). With regard to mango seedlings, the observed increase in phosphorus percentage may be linked to humic acid's hormone-like activity, specifically its ability to inhibit the enzyme IAA oxidase. This inhibition enhances the activity of the indole-3-acetic acid (IAA) hormone, thereby stimulating plant growth. Alternatively, this increase might be attributed to humic acid's role in activating vital biochemical processes, thereby upregulating the synthesis of acids and enzymes responsible for phosphorus formation within plants. Additionally, humic acid plays a crucial role in enzymatic reactions that enhance cell membrane permeability. This improved permeability facilitates the transportation of nutrients from external environments into the cytoplasm, thereby improving the plant's overall nutritional status. Furthermore, humic acid exerts a stimulatory effect

on both vegetative and root systems, enhancing nutrient absorption through roots and leaves, which ultimately results in elevated potassium levels. The increase in potassium content could also stem from humic acid's composition as a nutrient-rich source directly applied to plant leaves. This observation is consistent with findings by Genaidy et al. (2015) on EL-Kheshin olive seedlings, Abd El-Hamied (2018) on mango seedlings, Al-Tamimi et al. (2017) on palm trees, and Hassan (2023) on olive seedlings. As for nano nitrogen , the increase in vegetative characteristics in Tables No. (3, 4, 5 and 6) is attributed to the role of Nano-manufactured nitrogen Spray on the papersThe interaction density on particle surfaces within the roots and leaves showed a noticeable increase, as these enhanced features facilitate the absorption of fertilizers produced using nanotechnology (Anonymous, 2010). Nitrogen plays a pivotal role in boosting the activity of meristematic zones by promoting auxins and enhancing the availability of essential materials required for photosynthesis, such as amino acids, nucleic acids, chlorophyll, and certain enzyme cofactors. This process accelerates cell division and elongation, resulting in overall plant growth. Consequently, there is a positive impact on the vegetative growth group, which manifests as an increase in seedling length and diameter, alongside augmented root size. These enhancements contribute to improved nutrient absorption efficiency, further promoting vegetative growth (Lling and Silberbush, 2002; Taiz and Zaiger, 2010). Such developments lead to a rise in the dry weight of the shoot and root systems, aligning with findings by Haggag (2018) on olive seedlings, Merza and Al-Jilihawi (2020) on lemon seedlings, and Honey (2021) on mandarin and grape seedlings. Similar results were observed with pear seedlings (2021) and in studies by Nikbakht (2021), who noted that nano-nitrogen spray on apple trees yielded comparable outcomes, as well as Lala et al. (2023). Nitrogen fabricated using nanotechnology demonstrates high bioavailability, proportional to its absorption rate. This nitrogen moves effectively between plant cells via plasma bonds approximately 50 nanometers in size, ensuring steady delivery of nutrients over extended periods. The sustained nutrient availability promotes active metabolic processes within the plant. This absorption efficiency translates to better vegetative growth, as seen in the increased concentrations of nitrogen, protein, phosphorus, and potassium in the current study. The higher protein levels can likely be attributed to the stimulation of vital physiological processes driven by nanotechnology, which enhances the production of acids and enzymes necessary for protein synthesis. Tables 7 through 10 illustrate these observations. These findings are consistent with the conclusions of Davarpanah et al. (2017) on pomegranate, Al-Rumaiydh et al. (2020) on pomegranate seedlings, Al-Asali (2021) on two varieties of mandarin seedlings, Rohi Vishekail et al. (2021) on olive trees, and Kli (2022) on the Ibrahimi apple variety.

Sources

Al-Janabi , Ali Saeed Attia. 2017. The effect of spraying with humic acid and seaweed extract Algazon. ,On some vegetative growth characteristics of fig seedlingsWhite Adriatic and Black .Diyala cultivars. Al-Furat Al-Awsat Journal of Agricultural Sciences. Volume (9), Issue (4)

Central apparatus For statistics . 2020. Fruit tree production estimates Summer. Directorate of .Agricultural Statistics in Iraq

Hassan , Mohammed Khamis. 2023. Response of Khastawi olive seedlings. Addition of potassium humate and foliar spraying with urea. Message Master's degree.College . Agriculture.University Anbar, Iraq

.**Hakim** , Hawa Ri Muhammad. 2023. The effect of humic acid and nanocompositeNPK in the growth of young trees of three Phoenix dactylifera L. cultivars. Master's thesis . College of . Agriculture. University of Kirkuk. Iraq

Al-Hamdani , Mona Hussein Sharif 2012. The effect of some organic compounds on the ,vegetative growth and quantitative and qualitative characteristics of olivesOlea europaeaL . . Ph.D. thesis. Faculty of Agriculture and Forestry. University of Mosul, Iraq

Al-Rawi , Khashe ' Mahmoud and Abdul Aziz Mohammed Khalaf Allah. 2000. Design and Analysis of Agricultural Experiments. Dar Al-Kutub Printing and Publishing Press. Ministry of . Higher Education and Scientific Research. University. Mosul, Iraq

Abdul Wahab , Nabil Ibrahim and Bassem Youssef Gamil Al-Mishari. 2017. The effect of spraying with humic acid. And cytokininCPPU in some growth parameters of navel orange and .local lemon . Diyala Journal of Agricultural Sciences 9(1):215-227

Mustafa , Essam Mohammed Jawad. 2021. The effect of soil fertilization with biostimulant and spraying with nano nitrogen on the growth of seedlings of two varieties of mandarin. Master's .thesis. College of Agriculture. University of Baghdad. Iraq

Al-Moussawi , Fatima Saad Hamid. 2019. The effect of spraying humic acid and seaweed extract on the growth of mango seedlingsMangifera indicaL . .Bull's Heart variety . Master's thesis .College of Agriculture. University of Baghdad, Iraq

Al-Mawsili , Muzaffar Ahmed Dawood, Wahida Ali Al-Badrani, Fateh Abdul Sayed Hassan, and .Saleh Mohammed Al-Rashidi. 2019. Plant Nutrition . Scientific Books House. Beirut, Lebanon

.**The watery one ,** Hassan Radhi2018. Study of genetic variation and the effect of some physiological treatments on the growth, yield and content of medically active compounds of .pomegranate. PhD thesis. College of Agriculture. University of Baghdad. Iraq

Abd El-Hamid , MM; MA, Wassel; AH, El-Sayed and MGM, Noaman.2015. Effect of spraying seaweed extract and silicon on fruiting of Alphonse mango trees. World Rural Observations. 7(4):44-50.

Al- Rumaiydh , Faiza K Falah H. Al- Miahy and Mahmud S. Ebd Alwahid.2020. The Effect of Nano NPK and Spraying by Salicylic acid on somem of thE Major and minor metabolism products of Pomegranate seedlings, cultivar Wonderful in Dhi-Qar Governorate.16(1) 2051-2055.

Bhoyar , R.K.; PSJoshi and AKSahoo.2015. Effect of Growth Promoting Substances on Pre-Bearing Mango Plantation. Trends in Biosciences. 8 (4): 1066-1068.

Canellas , L.P.; LB Dobbss ; AL Oliveira; J.G. Chagas; NO Aguiar; VM Rumjanek ; EH Novotny; FL Olivares; R. Spaccini and A. Piccolo. 2012. Chemical properties of humic matter as related to induction of plant lateral roots. European Journal of Soil Science, 63:315–324.

Davarpanah , S.; A. Tehranifar ; G. Davarynejad , M. Aran, J. Abadía and R. Khorassani.2017 . Effects of foliar Nano-nitrogen and urea fertilizers on the physical and chemical properties of pomegranate Punica granatum L. cv. Ardestani Fruits. Hortscience . 52(2):288–294.

El Kheshin , MA 2016. Enhancing vegetable growth of young mango transplants via GA3 and humic acid. Journal of Horticultural Science & Ornamental Plants 8(1): 11-18.

Genaidy , E.A. E. ; Merwad , MA; and Laila, FH 2015. Effect of algae, humic acid and waste organic material in culture media on growth performance of " Picual " olive seedlings. Int. J.ChemTech . Res., 8(11): 43-50 .

Ghani , F.; MR, Khan; N, Bostan; G,Nabi ; H, Muhammad ; A, Ali ; J, Amin and F, Rabi. 2018. Effect of humic acid and seed size on germination of mango (Mangifera indica L.) seed. Pure Appl. Biol., 7(1): 315-320.

Haggag, L.F .; Mustafa, NS ; Shaheen, M.F.M.; Genaidy , EAE; and Mahdy, HA 2014. Impact of NPK, humic acid and algae extract on growth of " Aggizi ".

Hamdy, I.M.; I.H.Saied and MSEH . Awad.2018. Effect of using humic acid and amino acids enriched with different nutrients as partial replacement of mineral nitrogen fertilizers in Zebda mango orchards. New York Science Journal. 11(7):62-71.

Hassan , Neveen A;Abeer A.EL- Halwagi and HA Sayed.2012.Phytochemicals, Antioxidant and Chemical promegranate Accessions Growing ingypt.World Applied Sciences Journal 16(8):1065-1073.

Hollarate ond D.Hatib K,Bar-Ya,akov 1.2009. The pomegranate:botany ,and sur-ticulture,breeding.Hortic Rev(Am Soc Hortic Sci)35:127-191.

Lala ,. T.Fadalah , G.Z. Al- Rikabi and Hadiah A. Atiyah.2023. Effect of adding Nano-NPK fertilizer and humic acid on some vegetable growth Characteristics and active components of Myrtle Myrtus communis L. J.Glob. Innov . Agric. Sci, 11(2):229-234

Leonard , AG 2008. Humic acid: 100% natural, many uses. Gold end Harvest organic. LLCTM.

Martin , P. 2002. Micro-nutrient deficiency in Asia and the Pacific. Borax Europe limited, UK, at, 2002. IFA. Regional conference for Asia and the pacific, Singapore, 18-20. **Matthaiou** , C. M. , N. Goutzourelas, D. Stagos, E. Sarafoglou, A. Jamurrtas, S. D. Koulocheri, S. A. Haroutounian, A. M. Tsatsakis, and D. Koureta. 2014. Pomegranate juice consumption in creases GSH level and reduces lipid and pro- tein oxidation in human blood.Food Chem.Toxiccol.73:1-6.

Nikbakht , M.; Solouki , M. and Aran, M. 2021. Effects of Foliar Application of Nano-Nitrogen and Urea Fertilizers on Quantity and Quality Properties of Bitter Apple (Citrullus colocynthis L.) Journal of Crops Improvement. Vol. 15(1): 155-168.

Nikdel , Kosar ; Esmaile Seifi;Hamed Father;Mehdi Sharifani and Khodayar Hemmati.2016.Physicochemical properties and antioxidant actioxidants acivities of five Iranian pomegranate cultivars (Punica granatum L.).in maturation stage.Acta agriculturae Slovenica,107-2,str.277-286 .

Olsen , S. R. and L. M. Sommers. 1982. Phosphorus in AL Page, (Ed). Methods of Soil Analysis. Part2. Chemical and Microbiological Properties 2nd edition , Amer. Soc. of Agron. Inc. Soil Scs . Sco . Am. Inc. Madision . Wis. USA

Pagliarulo .C.;De lito,V.;Picariello,G.;Colicchio,R.;Pastore,G,;Salvatore P.; Volpe.MGInhibitory effect of Pomegranate(Punica granatum L.)Polyphenol extracts on the bacterial growth and survival of clinical isolates of pathogenic Staphylococcus aureus and Escherichia coli.Food Chem.2016.190,824-831.

Rajan , R. K.; PC Mali; PM Haldankar ; PC Haldavanekar and PD Potphode.2018 . Effect of Humic acid on growth of Mango (Mangifera indica L.) nursery grafts Cv. Alphonso. Journal of Pharmacognosy and Phytochemistry, 7(6): 2778-2780.

Rohi Vishekaii , Z.; A. Soleimani; A. Hasani; M. Ghasemnezhad ; K. Rezaei and S. Kalanaky . 2021. Nano-Chelated Nitrogen Fertilizer as a New Replacement for Urea to Improve Olive Oil Quality. International Journal of Horticultural Science and Technology, 8, 191-2018 .

Singh , H.; A. Sharma; SK. Bhardwaj; SK. Arya; N. Bhardwaj and Khatri M. 2021. Recent advances in the applications of nano-agrochemicals for sustainable agricultural development. Review.Environ Sci Process Impacts.23(2):213-239.

Stover ,E . and E.W.Mercare.2007.the Pomegranate: a New Look at the fruit of paradise Hortsci.,42(5):1088-1092.

Taiz , L. and E. Zeiger. 2010. Plant physiology. Sinaure Assicates . Inc. Publishers. Sun elerland.

Van Dijk , D.; Houba, VJG (2000) Homogeneity and Stability of Material distributed within the Wageningen Evaluating 64 Programs for Analytical Laboratories Commun. Soil.Sci.Plant.Anal , 31 (11-14), 1745-1756 .

Wodaje Addis1 and Alemayehu Abebaw, (2017), Determination of heavy metal concentration in soils used for cultivation of Allium sativum L. (garlic) in East Gojjam Zone, Amhara Region, Ethiopia, Addis & Abebaw, Cogent Chemistry (2017), 3: 1419422 .

Lling , F. and M. Silberbush . 2002. Response of Mazie to foliar vs. Soil application of nitrogen–phosphorus–potassium fertilizers . 25(11):2333-2342.

Katkat , A. V. ; Gelick , H. ; Turan, M. A. and Asik, B. B. 2009. Effect of soil and foliar application of humic substances on dry weight and mineral nutrient of wheat under calcareous soil conditions. Australian Journal of Basic and Applied Sciences. 3 (2): 1266 – 1273.

Anonymous 2010. Humic and fulvic acids: The black gold of agriculture. http:// www. humintech . com/pdf/humic fulvic acids. pdf (Access date: 10.08. 2010) . 10 - Asif Sheh zad M; Maqsood . M; Altaf Bhatti . M; Ahmad . W; Rafiq .