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Effect of spraying with zinc nanoparticles, Humic acid, and adding the mineral fertilizer on the growth of pear seedlings (Hollywood cultivar)

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Abstract

The study was conducted at the Al-Hindiya Gardening Station (Karbala province), To study the effect of spraying 3 levels of nano zinc (0, 2, 4 g.L^{-1}) and two levels of humic acid solution (2, 4 ml.L^{-1}) and adding urea mineral fertilizer at two levels (5, 10 g.seedlings $^{-1}$) in the growth of pear seedlings, Hollywood cultivar grafted on apricot seedlings. The experiment was conducted according to completely randomized designs with three replicates, and the results were as follows: The treatment of zinc at a concentration of (2 ml.L^{-1}) was significantly higher in all vegetative growth traits that included seedlings length, stem diameter, number of leaves, leaf area, dry material of the plant and leaf content of chlorophyll and zinc and gave the highest averages of 84.20 cm, 7.62 mm, 40.70 leaf.seedling^{-1}, 23.67 2 cm^2, 42.28 g, 30.27 spad, 9.71 mg.100 g^{-1}, respectively, by comparison treatment, Where, the treatment with a humic acid concentration of 4 ml. Liters -1 was excelled on the above traits and gave the highest averages amounted to 78.17 cm, 7.04 mm, 41.73 leaf.seedling^{-1}, 23.64 cm ^{2}, 43.53 g, 29.17 spad, 9.34 mg.100 g^{-1} in respectively compared to the treatment of 2 ml.L^{-1}, the treatment of adding urea mineral fertilizer at the level of (10 gm.seedling^{-1}) was significantly excelled by giving the highest values of all studied vegetative traits amounted to 77.89 cm, 7.18 mm, 39.87 leaf.seedling^{-1}, 22.45 cm ^{2}, 42.19 g, 28.64 spad, 9.39 mg. 100 g $^{-1}$ respectively Keywords: term, term, term

Keyword : nano zink , humic acid , pear , seedling.

1. Introduction

Plum is a deciduous fruit that follows the genus (Prunus.sp), and belongs to the Rosaceae family, which is different in its climatic requirements and suitable soil. Pear cultivation has spread to large areas of the world, including the European pear group Prunusdomestica and its native origin in West Asia, the Japanese pear group Prunussalicina and its native China and the American pear group Prunus americana that originated in the American [1]. Pear fruits are consumed either freshly, dried or canned, and the nutritional value of the fruits is clear through what contains 100 g of fruit meat on water 86.6%, 0.150 g protein, 0.03 g fat, 13.34 g carbohydrates, and also contain vitamins (A and C) and some mineral elements (K, P , Ca) (Al-[2]. Pear production in Iraq is estimated at 11,558 tons, and Saladin province ranked first in the production of the Albalo cultivar, and Karbala province ranked first in terms of production for the Gage cultivar, and the average productivity of one tree was 43.1 kg [3]. Foliar feeding is among the basic and necessary factors for plant growth and development, especially in the early stages of seedling life, and despite the presence of Macro and Micronutrients in the soil in large quantities, the available quantities of them for the plant are almost not compatible with the rate necessary for the natural growth of the plant, As some nutrients, especially micronutrients in some lands, are exposed to washing, fixing, and adsorption processes that limit their movement and readiness for the plant, and this often leads to the failure of the root system to obtain such elements from the soil. Especially in the case of the basic soil prevailing in the country, and then the symptoms of a deficiency of these elements appear on the resulting seedlings, so they resort to spraying these elements on the vegetative system to improve the growth of the [4]. Zinc is one of the essential nutrients for plant growth, where it is included in building carbohydrates and proteins and activates a number of enzymes present in the chloroplast, which regulates the pH and thus it works to protect proteins from changing their nature, and the starch enzyme necessary for the manufacture of starch, as well as its important

role in building the plant hormone Indole acetic acid necessary for growth, elongation and division of plant cells and this element's readiness are influenced by the content of limestone in the soil and the high degree of its interaction [5]. [6] used four levels of chelated zinc sprayed on the leaves of peach seedlings are (0, 10, 20, 30 $mg.L^{-1}$) led to a significant increase in the concentration of nitrogen, potassium and zinc elements in the plant leaves and the leaf content of chlorophyll, carbohydrates and leaf area The length and diameter of the stem seedling, as well as the increase in the number of branches and the dry weight of the vegetative and root system[7] indicated that the use of fertilizer elements zinc and boron spray on the vegetative part of the pomegranate trees led to a significant increase in yield and quality, so the number of fruits in the trees increased, as well as the percentage of solids dissolved in the fruits and the acidity of their juice, increased, as well as increasing the concentration of the elements in the plant leaves [8], explained that the use of zinc oxide nanoparticles with a granular size (80 nm) and adding them to the soil with urea and water and in different weight ratios has reduced the acidity of the soil and maintained the degree of stability of the soil temperature and reduce the required urea amount thus the addition reduces the harmful effect Urea on agricultural production. The addition of humic acid, which is one of the compounds of humus and has several chemical properties, among which contributes to improving plant growth, directly or indirectly, because of its work as a biological catalyst and is a medium for transporting nutrients from the soil to the plant or from the leaves to the rest of the plant and has the ability to bind to claws With positive ions, it stimulates the release of oxidizing substances that include water-soluble substances such as beta-carotene as well as its nutrient components such as nitrogen and potassium [9]. [10], showed that the addition of high-potassium humic acid sprayed on pear seedlings at two levels (0, 2 $ml.L^{-1}$) resulted in a significant increase in the leaf content of chlorophyll and the relative water content and reduced water potential and proline and increased the area of the stomata in the leaves [11] also showed that spraying humic acid on the leaves of seedlings of Japanese pear at two levels (1, 2 $ml.L^{-1}$) and addition to the soil at average amounted to (5, 10 $ml.L^{-1}$) resulted in a significant increase in the average stem diameter, leaf area and number The leaves and branches and their dry weight, the stem content of carbohydrates, the leaf content of chlorophyll, nitrogen , phosphorous and potassium. Nitrogen enters into the synthesis of proteins and enzymes present in the plant and participates in the synthesis of some vitamins and organic alkalis and the synthesis of free amino acids [12]. [13] that adding 4 levels of urea fertilizer are (0, 10, 20, 30 kg. $dunam^{-1}$) to Pears seedlings this led to a significant increase in most vegetative traits of seedlings, including the length and diameter of the stem, the dry weight of the vegetative group, the dry weight of the root system and the leaf content of nitrogen and chlorophyll. The study aims to find out the extent of the Hollywood pear seedlings response to spraying with nano zinc , humic acid and the addition of mineral fertilizer (Urea) and the effect of this

2. Materials and methods

The study was conducted at the Al-Hindiya Gardening Station (Karbala province) belonged to the General Company for Horticulture and Forestry for the spring season 2018, to study the effect of spraying three levels of Nano zinc (0, 2, 4 $g.L^{-1}$) and two levels of humic acid with a concentration of (2, 4 $ml.L^{-1}$) and two levels of urea mineral fertilizer 46% nitrogen is (5, 10 $g.seedlings^{-1}$) in the growth of Pear seedlings of the Hollywood cultivar grafted on seedlings of apricot seedlings (age 9 months), average stem diameter of 6-5 mm and an average length of 45-50 cm and cultivation in plastic pots of 15 kg capacity, soil samples were randomly taken to estimate their physiochemical properties and according to the methods described [14] and mentioned in Table (1). The treatments were distributed randomly, and the seedlings were sprayed with the levels of nano zinc and humic acid on 1/4/2018, at the required levels and with four sprayings between one to another (15) days. The seedlings were sprayed using a manual sprayer (2 liters) and added with each concentration (1 cm) of cleaning material as a spreader for the purpose of increasing the surface tension of the water, i.e., facilitating the absorption of plant tissue into the additive [2].and the spraying process took place in the morning until the wetness of the seedlings, as well as the control treatment, was sprayed with distilled water only, and the spraying was done after watering the field one day before, as watering before spraying works to reduce the concentration of the soluble in the leaf cells due to the entry of water and the increase of its swelling and thus opening the stomata, which increases the penetration spray solution ions into leaves cells [15]. With the addition of urea mineral fertilizer in two batches, the first at the first and second spray two weeks after the first. A factorial experiment was conducted in completely randomized designs with three replicates, the total number of seedlings was 180 seedlings (5 seedlings per treatment), and the results were analyzed according to [16], and the averages were compared using the least significant difference test at the level of 5%.

Table 1. some physical and chemical traits of study soil.

Traits	Values	Units
Soil Texture	clay loam	
pH	7.6	
Ec	3.08	$dsm.m^{-1}$
Organic matter	14.8	$g.kg^{-1}$
Bulk density	1.51	$g.cm^{-3}$
Calcium carbonate	236.7	
Clay	370	$g.kg^{-1}$
Silt	359	
Sand	271	
Total nitrogen	13.1	
phosphorous availability	6.7	$mg.kg^{-1}$
potassium availability	23.8	
zinc availability	8.7	

3. The studied traits

The measurements of the vegetative growth traits were taken after the end of the growing season on 25/7/2018, as follows: -

The average length of the main vegetative branch (cm): Measure the length of the main vegetative branch by using the metric measurement tape from the area where the taste was originally connected to the top of the branch and take the average length of the vegetative branch for each seedling and then according to the average for each treatment.
The average diameter of the main vegetative branch (mm): The diameter was measured by the vernier and at a height (2-3 cm) from the Contact area for each seedling. The average was taken, then the average was extracted for each treatment.

The leaves number (leaf.seedlings^{-1}): The number of leaves per each seedling was calculated for the experimental unit and then extracted the average number of leaves per treatments.

The leaf area average (cm^2): The leaf area was measured by a (Digital Planimeter) device, where the leaf plant was printed on white paper, then the lens of the device was passed around the paper boundaries and the process was repeated three times. The rate is taken and the paper area is extracted for each treatment.
Chlorophyll leaf average : Chlorophyll meter CCM-200 Plus was estimated by taking a reading of 20 sheets per experimental unit, then the rate was measured and measured in SPAD UNIT units.
The average dry weight of the vegetative growth: It was calculated by taking the vegetative total of three seedlings from each treatment and measuring the fresh weight, then the samples were dried in an electric oven (Oven) at a temperature of 70 ° C. for 48 hours and measuring the dry weight.
Zinc in the leaves: Determine the leaf content of zinc according to the method mentioned [17] after drying the selected soft leaves and digesting them in a mixture of ammonium acetate and sodium oxalate using the spectrophotometer.

4. Results and discussion:

4.1. Effect of spraying nano zinc, humic acid, and adding urea on the seedling length average (cm)

Table 2.and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth for Pear seedlings, the treatment of spraying nano zinc at a concentration of 2 gm.L $^{-1}$ was significantly excelled and gave the highest average seedling length reached (84.20 cm) In comparison to the control treatment, which gave the lowest average (59.08 cm), As for the treatment of humic acid spray at a concentration of 4 ml.L^{-1}, it significantly excelled and gave the highest average amounted to (78.17 cm) compared to the treatment of 2 ml.L^{-1}, which gave the lowest average amounted to(71.80 cm). Whereas, the treatment of adding mineral fertilizer (urea) the concentration of 10 g.seedlings $^{-1}$ was excelled significantly and gave the highest average of (77.89 cm) compared to the treatment of 5 g. seedlings $^{-1}$ which gave the lowest average length of the seedlings stem reached (72.07 cm). As for the interaction treatments, the treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid) was significantly excelled and gave the highest average value for this trait amounted to (89.35 cm) and the treatment (2 g.L^{-1} nano zinc + 10 g.seedlings^{-1} urea fertilizer) significantly excelled and gave the highest average amounted to (88.57cm) and the treatment (4ml.L^{-1} humic acid + 10 g.seedlings^{-1}urea fertilizer) significantly excelled and gave the highest average amounted to (80.18cm), while it gave the triple interaction treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid + 10 g.seedlings^{-1} urea fertilizer)gave the highest average was (92.63 cm).

Table 2. Effect of nano zinc , humic acid spraying and urea adding on average seedling length (cm)

Humic acid(ml.L^{-1})	**Urea fertilizer(g. seedling^{-1})**	**Nano zinc(g.L^{-1})**			**average**
		0	2	4	
2	5	51.67	73.60	78.70	67.99
	10	59.50	84.50	82.83	75.61
4	5	60.47	86.07	81.93	76.16
	10	64.70	92.63	83.20	80.18
LSD			4.09		2.36
		Nano zinc × Humic acid			
2		55.58	79.05	80.77	71.80
4		62.58	89.35	82.57	78.17
LSD			2.89		1.67
		Nano zinc × Urea fertilizer			
5		56.07	79.83	80.32	72.07
10		62.10	88.57	83.02	77.89
LSD			2.89		1.67
average		59.08	84.20	81.67	
LSD			2.05		

4.2. The effect of spraying nano zinc , humic acid, and adding urea on the average stem diameter of the seedling (mm)

Table 3. and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth for pear seedlings. The treatment of spraying nano zinc at a concentration of 2 g.L^{-1} was significantly excelled and gave the highest average the main stem diameter of seedling amounted to (7.62 mm) compared to the control treatment, which gave the lowest average amounted to (6.40 mm). As for the treatment of humic acid spray 4 ml.L^{-1} it was significantly excelled and gave the highest average amounted to (7.04 mm) compared to the control treatment of 2 ml.L^{-1}, which gave the lowest average (6.80 mm). Whereas, the treatment of adding mineral fertilizer (urea) at a concentration of 10 g.seedlings $^{-1}$ was significantly excelled and gave the highest average amounted to (7.18 mm) compared to the treatment of 5 g.seedlings $^{-1}$ which gave the lowest average amounted to(6.66 mm). As for the interaction factors, the treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid) was significantly excelled and gave the highest average for this trait (7.72 mm). G.seedlings -1 urea fertilizer) significantly and gave the highest average amounted to (8.52mm) and the treatment (4 ml.L^{-1} humic acid + 10 g.seedlings $^{-1}$ urea fertilizer) significantly excelled and gave the highest average value (7.42mm), while triple interaction treatment (2 g.seedlings $^{-1}$ nano zinc + 4 ml.L^{-1} humic acid + 10 g.seedlings $^{-1}$ urea fertilizer) which gave the highest average amounted to (8.93 cm).

Table 3. Effect of nano zinc , humic acid spraying and urea adding on average stem diameter (cm)

Humic acid(ml.L^{-1})	Urea fertilizer(g. seedling^{-1})	Nano zinc(g.L^{-1})			average
		0	2	4	
2	5	5.85	6.93	7.19	6.66
	10	6.85	8.11	5.85	6.94
4	5	6.62	6.51	6.85	6.66
	10	6.27	8.93	7.05	7.42
LSD			0.53		0.30
		Nano zinc × Humic acid			
2		6.35	7.52	6.52	6.80
4		6.45	7.72	6.95	7.04
LSD			0.37		0.22
		Nano zinc × Urea fertilizer			
5		6.24	6.72	7.02	6.66
10		6.56	8.52	6.45	7.18
LSD			0.37		0.22
average		6.40	7.62	6.74	
LSD			0.26		

4.3. The effect of spraying nano zinc , humic acid, and urea adding on the average number of leaves per seedling

Table 4. and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth for pear seedlings. The nano zinc treatment spray at a concentration of 2 g.L^{-1} was significantly excelled and gave the highest average number of seedlings leaves amounted to(40.70 Leaf.seedling^{-1}) compared to the control treatment, which gave the lowest average amounted to (32.93 Leaf.seedling^{-1}), No significant differences emerged between them and the treatment at a concentration of 4 g.L $^{-1}$. As for the treatment of humic acid spray at a concentration of 4 ml.L^{-1}it was significantly excelled and gave the highest average amounted to(41.73 Leaf.seedling^{-1}) compared to the treatment of 2 ml.L^{-1}, which gave the lowest average amounted to (33.85 Leaf.seedling^{-1}). Whereas, the treatment of adding mineral fertilizer (urea) was excelled to the concentration of 10 g.seedlings^{-1} significantly and gave the highest average amounted to (39.87 Leaf.seedling^{-1}) compared to the treatment of 5 g.seedlings^{-1} which gave the lowest average amounted to (35.71 Leaf.seedling^{-1}). As for the interaction factors, the treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid) was significantly excelled and gave the highest average value for this trait amounted to (46.32 Leaf.seedling^{-1}) and the treatment (2 g.L^{-1} nano zinc + 10 g.seedlings^{-1} urea fertilizer) significantly excelled and gave the highest mean average amounted to (43.08 Leaf.seedling^{-1}) and treatment (4 ml.L^{-1} humic acid + 10 g.seedlings^{-1} urea fertilizer) significantly excelled and gave the highest average value (44.78 Leaf.seedling^{-1}), while triple interaction treatment of (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid + 10 g.seedlings^{-1} urea fertilizer).it gave The highest average amounted to (50.60 Leaf.seedling^{-1}).

Table 4. Effect of nano zinc , humic acid spraying and urea adding on the average number of leaves (leaf.seedling^{-1})

Humic acid(ml.L^{-1})	**Urea fertilizer(g. seedling^{-1})**	**Nano zinc(g.L^{-1})**			**average**
		0	2	4	
2	5	29.57	34.60	34.03	32.73
	10	32.93	35.57	36.40	34.97
4	5	33.50	42.03	40.50	38.68
	10	35.70	50.60	48.03	44.78
LSD			2.59		1.50
		Nano zinc × Humic acid			
2		31.25	35.08	35.22	33.85
4		34.60	46.32	44.27	41.73
LSD			1.83		1.06
		Nano zinc × Urea fertilizer			
5		31.53	38.32	37.27	35.71
10		34.32	43.08	42.22	39.87
LSD			1.83		1.06
average		32.93	40.70	39.74	
LSD			1.30		

4.4. Effect of spraying nano zinc, humic acid, and urea adding to the average dry weight of the seedling (g)

Table 5. and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth for Pear seedlings. The nano zinc treatment spray at a concentration of 2 g.L^{-1} was significantly excelled and gave the highest average dry weight of the seedling amounted to(42.28 g) compared to the control treatment, which gave the lowest average amounted to (34.77 g), and no significant differences emerged between it and the treatment at a concentration of 4 g.L^{-1}. As for the treatment of humic acid spray at a concentration of 4 ml.L^{-1} it was significantly excelled and gave the highest average amounted to (43.53 g) compared to the treatment of 2 ml.L^{-1}, which gave the lowest average amounted to (35.98 g). Whereas, the treatment of adding mineral fertilizer (urea) a concentration of 10 g.seedlings $^{-1}$ was significantly excelled and gave the highest average amounted to (42.19 g) compared to the treatment of 5 g.seedlings^{-1} which gave the lowest average of (37.32 g). As for the interaction factors, the treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} Humic acid) was significantly excelled and gave the highest average for this characteristic of (47.47 g) and the treatment excelled (2 g.L^{-1} nano zinc + 10 g. seedlings $^{-1}$ urea fertilizer) significantly and gave the highest mean average (45.45 g) and treatment excelled (4 ml. L^{-1} humic acid + 10 g.seedlings $^{-1}$ urea fertilizer) significantly and gave the highest average amount (47.54 g), while treatment of triple interaction (2 g.L^{-1} nanoc zinc + 4 ml.L^{-1} humic acid + 10 g.seedlings^{-1} urea fertilizer) gave the highest average amounted to (53.83 g).

Table 5. Effect of nano zinc , humic acid spraying and urea adding on the average dry weight of the seedling (g)

Humic acid(ml.L^{-1})	Urea fertilizer(g. seedling^{-1})	Nano zinc(g.L^{-1})			average
		0	2	4	
2	5	31.83	37.13	36.40	35.12
	10	34.23	37.07	39.23	36.84
4	5	35.40	41.10	42.07	39.52
	10	37.60	53.83	51.20	47.54
LSD			2.82		1.63
		Nano zinc × Humic acid			
2		33.03	37.10	37.82	35.98
4		36.50	47.47	46.63	43.53
LSD			1.99		1.15
		Nano zinc × Urea fertilize			
5		33.62	39.12	39.23	37.32
10		35.92	45.45	45.22	42.19
LSD			1.99		1.15
average		34.77	42.28	42.23	
LSD			1.41		

4.5. Effect of spraying nanozinc, humic acid and urea adding on the average leaf content of chlorophyll(spad)

Table 6. and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth for pear seedlings. The nano zinc treatment spray at a concentration of 2 g.L^{-1} was significantly excelled and gave the highest average leaf content of chlorophyll amounted to(30.27 spad) compared to the control treatment, which gave the lowest average amounted to (24.77 spad). As for the treatment of humic acid spray at a concentration of 4 ml.L^{-1} it was significantly excelled and gave the highest average amounted to (29.17 spad) compared to the treatment of 2 ml.L^{-1} which gave the lowest average amounted to (25.85 spad). Whereas, the treatment of adding mineral fertilizer (urea) the concentration of 10 g. seedlings^{-1} was significantly excelled and gave the highest average amounted to (28.64 spad) compared to the treatment of 5 g.seedlings $^{-1}$ which gave the lowest average amounted to (26.38 spad). As for the interaction factors, the treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} Humic acid) was significantly excelled and gave the highest average for this trait (33.48 spad), and the treatment (2 g.L^{-1} nano zinc + 10 g.seedlings $^{-1}$ urea fertilizer) significantly excelled and gave the highest average amounted to (32.98 spad) and the treatment (4ml.L^{-1}humic acid + 10 g.seedlings $^{-1}$ urea fertilizer) significantly excelled and gave the highest average amounted to (30.76 spad), while triple interaction treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid + 10 g.seedlings $^{-1}$ urea fertilizer). The highest average amounted to (37.57 spad).

Table 6. Effect of nano zinc , humic acid spraying and urea adding on the average leaf content of chlorophyll(spad)

Humic acid(ml.L^{-1})	Urea fertilizer(g. seedling^{-1})	Nano zinc(g.L^{-1})			average
		0	2	4	
2	5	23.33	25.70	26.50	25.18
	10	23.90	28.40	27.27	26.52
4	5	24.73	29.40	28.63	27.59
	10	27.10	37.57	27.60	30.76
LSD			1.86		1.08
		Nano zinc × Humic acid			
2		23.62	27.05	26.88	25.85
4		25.92	33.48	28.12	29.17
LSD			1.32		0.76
		Nano zinc × Urea fertilizer			
5		24.03	27.55	27.57	26.38
10		25.50	32.98	27.43	28.64
LSD			1.32		0.76
average		24.77	30.27	27.50	
LSD			0.93		

4.6. Effect of spraying nano zinc , humic acid, and urea adding on the average leaf area cm2

Table (7) and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth for Pear seedlings. The treatment of spraying nano zinc at a concentration of 2 g.L^{-1} was significantly excelled and gave the highest average of leaf area reached (23.67 cm ^{2}) In comparison to the control treatment, which gave the lowest average amounted to (20.80 cm^{2}). As for the treatment of humic acid spray 4 ml.L^{-1}, it significantly excelled and gave the highest average amounted to (23.64 cm^{2}) compared to the treatment of 2 ml.L^{-1}, which gave the lowest average amounted to (20.30 cm^{2}). Whereas, the treatment of adding mineral fertilizer (urea)a concentration of 10 g. seedlings $^{-1}$ was significantly excelled and gave the highest average amounted to (22.45 cm^{2}) compared to the treatment of 5 g. seedlings $^{-1}$ which gave the lowest average amounted to (21.49 cm^{2}). As for the interaction treatments, the treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid) was significantly excelled and gave the highest average for this trait was (25.99 cm^{2}) and the treatment (2 g.L^{-1} nano zinc + 10 g.seedlings $^{-1}$ urea fertilizer) significantly excelled and gave the highest average amounted to (24.17 cm^{2}) and the treatment (4ml.L^{-1} humic acid + 10 g.seedlings^{-1}urea fertilizer) significantly excelled and gave the highest average value (23.72 cm^{2}), while the triple interaction treatment (2 g.L^{-1} nano zinc + 4 ml.L^{-1} humic acid + 10 g. seedlings $^{-1}$ urea fertilizer) gave the highest average amounted to (26.44 cm^{2}).

Table 7. Effect of nano zinc , humic acid spraying and urea adding on the average leaf area(cm^{2})

Humic acid(ml.L^{-1})	Urea fertilizer(g. seedling^{-1})	Nano zinc(g.L^{-1})			average
		0	2	4	
2	5	16.57	20.80	20.86	19.41
	10	21.23	21.90	20.42	21.18
4	5	22.26	25.53	22.89	23.56
	10	23.15	26.44	21.58	23.72
LSD			2.12		1.22
		Nano zinc × Humic acid			
2		18.90	21.35	20.64	20.30
4		22.71	25.99	22.24	23.64
LSD			1.50		0.87
		Nano zinc × Urea fertilizer			
5		19.42	23.17	21.88	21.49
10		22.19	24.17	21.00	22.45
LSD			1.50		0.87
average		20.80	23.67	21.44	
LSD			1.06		

4.7. Effect of spraying nano zinc, humic acid, and urea adding to the average leaf content of zinc

Table (8) and Appendix (1) indicates a significant difference between the levels of the study factors in the effect on some indicators of vegetative growth of pear seedlings. The treatment of nano zinc spraying at a concentration of 2 $g.L^{-1}$ was significantly excelled and gave the highest average leaf content of zinc was (9.71 mg.100 g^{-1}) , compared to the control treatment, which gave the lowest average amounted to (6.96 mg. 100 g^{-1}).As for the treatment of humic acid spray 4 ml $.L^{-1}$, it significantly excelled and gave the highest average amounted to (9.34 mg. 100 g^{-1}) compared to the treatment of 2 ml. L^{-1}, which gave the lowest average amounted to (7.88 mg. 100 g^{-1}).Where the treatment of the adding of mineral fertilizer (urea) the concentration of 10 g was excelled, As for the interaction factors, the treatment (2 $g.L^{-1}$ nano zinc + 4 $ml.L^{-1}$ humic acid) was significantly excelled and gave the highest average for this trait amounted to (10.90 mg. 100 g^{-1}) and the treatment excelled (2 $g.L^{-1}$ Nano zinc + 10 $g.seedling^{-1}$ urea fertilizer) was excelled and gave the highest average amounted to (10.80 mg. 100 g^{-1}) and treatment excelled (4 $ml.L^{-1}$ humic acid + 10 g. $seedling^{-1}$ urea fertilizer) was significantly and gave the highest average amounted to(10.39 mg. 100 g^{-1}), where, the triple interaction treatment (2 $g.L^{-1}$ nano zinc + 4 $ml.L^{-1}$ Humic acid + 10 $g.seedling^{-1}$urea fertilizer) gave the highest average amounted to (12.67 mg.100 g^{-1}).

Table 8. Effect of nano zinc , humic acid spraying and urea adding on the average leaf content of zinc(mg.100 g^{-1})

Humic acid($ml.L^{-1}$)	**Urea fertilizer(g. $seedling^{-1}$)**	**Nano zinc($g.L^{-1}$)**			**average**
		0	2	4	
2	5	6.28	8.10	7.75	7.38
	10	6.95	8.93	9.27	8.38
4	5	7.06	9.13	8.69	8.30
	10	7.53	12.67	10.98	10.39
LSD			0.73		0.42
		Nano zinc × Humic acid			
2		6.62	8.52	8.51	7.88
4		7.30	10.90	9.83	9.34
LSD			0.52		0.30
		Nano zinc × Urea fertilizer			
5		6.67	8.62	8.22	7.84
10		7.24	10.80	10.12	9.39
LSD			0.52		0.30
average		6.96	9.71	9.17	
LSD			0.37		

The results showed in tables (2-8) and appendix (1) a significant excelled for the treatment of spraying nano zinc at a concentration of 2 $g.L^{-1}$ compared to the treatment without spraying in increasing the vegetative growth indicators of the seedlings studied and the reason can be due to the role of zinc, it is involved in building Carbohydrates, proteins and activates a number of enzymes present in the chloroplast, which regulates the pH and thus it works to protect proteins from changing their nature, The starch enzyme necessary for the manufacture of starch, as well as its important role in building the plant hormone indole acetic acid, which is necessary for the growth, elongation and division of plant cells, and this element are affected by its availability with the content of lime in the soil and the high degree of [5], As for the excelled of the humic acid treatment at a concentration of 4 ml. L^{-1}, in addition to its components from the availability elements such as nitrogen, phosphorus, potassium and a portion of the micronutrients, they all contribute to or enter into the formation of amino acids, nucleic acids and enzymes that help in increasing vegetative growth, which is necessary to form a chlorophyll molecule that It is the basis of photosynthesis, which increases the percentage of manufactured materials and thus increases the rates of vegetative growth, such as the length and thickness of the seedlings and the increase in the number of leaves and their surface area [18]. . As for the treatment of urea fertilizer 10 gm. seedlings -1 it significantly excelled in increasing the averages of the studied indicators, it can be due to the participation of the nitrogen component in the composition of proteins and enzymes present in the plant and its contribution to the cell division process as well as its participation in the composition of some vitamins and organic alkalis and the synthesis of free amino acids Which all contribute to increasing the studied vegetative growth [12].

Appendix 1. Analysis of variance of studied traits

Source of variance	degrees of freedom	Seedlings length	Stem diameter	Leaf number	chlorophyll	Dry matter	Leaf area	Leaf content of Zinc
Blocks	2	6.668	0.191	1.744	1.177	1.202	6.186	1.062
Zinc	2	2295	4.771	215.7	90.75	224.3	27.17	25.53
Humic	1	364.8	0.523	558.5	99.33	513	100.7	19.26
Urea	1	305.1	2.413	156.3	45.79	213.6	8.41	21.64
Zinc * humic	2	55.09	0.087	49.7	22.63	39.32	7.42	2.23
Zinc * urea	2	27.4	4.279	4.331	24.64	14.98	9.976	2.236
Humic * urea	1	29.16	0.518	33.64	7.471	89.3	5.824	2.673
Triple	2	0.403	1.886	15.36	9.901	31.69	2.707	1.654
The error	22	5.768	0.096	2.319	1.199	2.745	1.549	0.186

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