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Effect of spraying Nano Zn and adding organic fertilizer on some physical traits of the soil and the growth of wheat plant yield (Rumeli cultivar)

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Abstract

This experiment was conducted at the research station of the Department of Soil and Water Technologies-Al-Musaib Technical Institute- Al-Furat Al-Awsat Technical University in the winter season 2022-2023 to study the effect of nano-zinc spraying at three concentrations (200, 100, 0) mg. L⁻¹ and three levels of organic fertilization were used (12, 6, 0) tons.ha⁻¹. The experiment was applied in an experimental system according to the randomized complete block design (RCBD), and the averages were compared with the least significant difference test (L.S.D) at a significant level of 5%. The results showed that spraying nano-zinc led to a significant increase in leaf area, plant height, dry weight of vegetative growth, and total yield, and the highest value was achieved with zinc at a concentration of 200 mg. L⁻¹. Also, the addition of organic fertilizer was excelled on the treatment of organic fertilizer 12 tons.ha⁻¹. There was a significant increase in bulk density, moisture content, plasticity limit and fluidity, and the results of the experiment showed excelled of the interaction treatment between the zinc concentration of 200 mg. L⁻¹ and organic fertilizer treatment: 12 tons. ha⁻¹ highest averages in the studied traits.

Keywords: Chhani, consumption, fuel-wood, households, Lanchaan

Introduction

Organic fertilizers in all their forms are soil amendments that come from either animal or plant waste, as well as their content of nutrients, which are mineralized by soil biota and made to plants (FSSA, 2003; Lampkin, N.H 2000) ^[10, 13] Research conducted in the eighties and nineties of the last century indicated that there was a response to spraying micronutrients on plants, and this was attributed to a decrease in their readiness in the soil. Therefore, spraying such nutrients can provide most of the crop's requirements, especially in the critical growth stages, which the roots may not be able to provide. (Martin, 2002; Saleh, 2010; Al-Salmani *et al.*, 2011) ^[15, 5, 3] Zinc is one of the nutrients described as micronutrients and plays a major role in many physiological processes and is related to increasing the rate of fertility and set in flowers and seeds. It is part of the enzymes that regulate the rate of metabolic reactions involved in the development and growth of crop plants. Graham *et al.*, (2001) ^[11] and Hussain *et al.*, (2018) ^[12] Wheat is a cereal crop that goes to the Poaceae and considered the most crop that contributes to providing food and energy to the world's population. Mladenov *et al.*, (2012) ^[17]. Reports indicated that Iraq's need for wheat is about 5 million tons annually, while the amount of production for the 2009/2010 season is only about 2.5 million tons. The steady increase in population and agricultural expansion forces researchers to intensify their efforts to exploit the soil and improve its physical and chemical properties to obtain good productivity for cultivated crops, most studies concerned with the agricultural field at the present time confirm the use of amendments to reduce the problems that the soil suffers from, whether clay or sandy, in order to reach the best productivity of these soils. Wheat constitutes an important nutritional value represented by the good balance in its grains between proteins and carbohydrates, in addition to the fact that it needs Man in his food (Al-Younis, 1992; Tony, 2006) ^[4, 19] The study aimat to determine extent of response of growth and yield indicators of wheat crop Rumeli to different levels of nano-zinc spraying and organic fertilizer.

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Materials and method of work

A field experiment was carried out in the Department of Soil and Water Technologies / Al-Musaaib Technical Institute / Al-Furat Al-Awsat Technical University. Rumeli wheat variety was planted for the winter season 2022-2023.

1. Preparing and preparing the land for agriculture: The randomized complete block design (RCBD) was used, dividing the field into square-shaped plots with a side length of 1 x 2 m, and adding 40 kg.ha⁻¹ of dab fertilizer in one batch and 100 kg.ha⁻¹ of urea fertilizer in two batches.

2. Planting the crop: Wheat seeds were planted 10 cm apart and 3 cm deep, and zinc was sprayed (40 days after planting) during the vegetative growth stage.



3. Irrigating the crop: with irrigation, which includes irrigation of the plant immediately after planting the seeds, and in the event of rainfall in sufficient quantities, irrigation of the plant is given after two weeks.

4. Harvest date: 1/5/2023

Studied traits

Soil separations: Soil separations were estimated using the hydrometer method described in Black (1965a) to determine the texture type.

1. Moisture content: it followed the gravimetric method proposed by Gardner and used the metal cylinder core mentioned in Black, (1965a) [8].

$$100 \times \frac{Mm - Ms}{Ms} = m\%$$

Since

m_θ = mass moisture content (gm water gm dry soil)

Mm = mass of wet soil (g)

Ms = dry soil mass (g)

The bulk density was measured using a coresample metal cylinder with a height of 0.05 m and a diameter of 0.05 m (a1965) Black [8].

2. Liquidity and plasticity limit: measured with a liquidity device according to the Casagrande method (1932).



vegetative growth traits Five plants were taken at harvest and randomly from each experimental unit

1. Average plant height (cm): The plant height was measured from the soil surface to its top using a tape measure before harvesting five plants taken for study, and then the average was taken.

2. Dry weight of vegetative growth (g): Five plants were randomly selected to measure the dry weight of vegetative growth from each experimental unit from the area in contact with the soil without the roots, then dried in a ventilated room until relative dryness, after which were dried in an electric oven at a temperature of (70 °C) for a period of 24 hours until the weight is stable, then the dry weight of the plant is calculated.

3. Flag leaf area cm²: The average of five flag leaf plants in the experimental unit was measured according to the following equation: flag leaf area cm² = flag leaf length * width from the middle * 0.95.



4. Total yield (tons.ha⁻¹): Calculate from the number of ears, number of grains, and the weight of 1000 grains . m², then convert the yield tons.ha⁻¹.

5. The results were analyzed statistically and the averages were tested according to the least significant difference test at the level of 0.05.

Table 1: Some soil traits used in the study

units	values	traits	
	7.2	pH	
DS.m ⁻¹	3.37	Electrical conductivity (ECe)	
%	0.89	Organic matter	
Mg.m ⁻³	1.38	Bulk density	
g.kg ⁻¹	245.7	Calcium carbonate	
cm.h ⁻¹	4.5	Water conductivity	
%	28.5	Plasticity limit	
%	14.5	Liquidity limit	
%	14	Moisture content	
mg.kg ⁻¹	7.33	available nitrogen	
	0.35	available phosphorus	
	10.17	available potassium	
g.kg ⁻¹	285	sand	Soil separations
	455	silt	
	260	Clay	
loam Silty		Soil texture	

Results and Discussion

Bulk density (Mg m⁻³): Its noted from Table (2) there are significant differences between the study factors in the bulk density traits, where control treatment without adding organic fertilizer gave the highest values, amounting to 1.46 Mg. m⁻³, compared to the 12-ton.ha⁻¹ organic fertilizer treatment which gave the lowest values, amounting to 1.37 Mg. m⁻³, and achieved a decrease of 6.56%. The same table indicates that using control treatment without Nano-zinc

spraying, the highest values reached 1.45 Mg. m⁻³ compared to the 200 tons.ha⁻¹ Nano-Zn spraying treatment. which gave the lowest values, amounting to 1.38 Mg. m⁻³ and achieved a decrease of 5.07%. As for the interaction in the same table, which had a significant effect on the bulk density characteristic, control treatment gave the highest value, 1.49 Mg. m⁻³, compared to the treatment (12 tons. ha⁻¹200 + mg L⁻¹) which gave the lowest values of 1.34 Mg m⁻³ and achieved a decrease of 11.19%.

Table 2: Effect of Nano-Zn spraying, adding organic fertilizer, and their overlap in the average bulk density, Mg. m⁻³

	Bulk density (Mg. m ⁻³)			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
1.46	1.44	1.47	1.49	0
1.39	1.36	1.37	1.45	6
1.37	1.34	1.36	1.42	12
	1.38	1.4	1.45	average
Organic fertilizer0.006 Nano Zn ,0.006 interaction:0.003			L.S.D 0.05	

Soil moisture (%): Its noted from Table (3) there are significant differences between the study factors in the soil moisture, where the organic fertilizer treatment gave 12 ton.ha⁻¹ The highest values reached 14.63% compared to control treatment, which was 12.9%, and achieved an increase of 13.41%. The same table indicates that using the Nano-Zn spray treatment was 200 mg. L⁻¹, the highest

values reached 13.96% compared to control treatment, which was 11.83%, and achieved an increase of 18%. As for the interaction in the same table, it had a significant effect on the soil moisture characteristic, the treatment (12 tons.ha⁻¹ 200 + mg.L⁻¹) which gave the lowest values of 15.8% compared to control treatment, 11.1%, achieving an increase of 42.34%.

Table 3: Effect of Nano-Zn spraying, adding organic fertilizer and their overlap in average soil moisture %

	soil moisture %			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
11.4	11.8	11.3	11.1	0
12.9	14.3	12.9	11.5	6
14.63	15.8	15.2	12.9	12
	13.96	13.13	11.83	average
Organic fertilizer0.733 Nano Zn ,0.733 interaction: 1.125			L.S.D 0.05	

Plasticity limit (%): It's noted from Table (4) there are significant differences between the study factors in the character of the plasticity limit, as the organic fertilizer treatment gave 12 ton.ha⁻¹ The highest values reached 35.22% compared to control treatment, 31.03%, and achieved an increase of 13.50%. The same table indicates that using the Nano-Zn spray treatment was 200 mg. L⁻¹, the

highest values reached 34.65% compared to control treatment, 31.36%, and achieved an increase of 10.49%. As for the interaction in the same table, it had a significant effect on the soil moisture characteristic, the treatment (12 tons.ha⁻¹200 + mg.L⁻¹) which gave the lowest values of 37.07% compared to control treatment, 29.5%, and achieved an increase of 25.66%.

Table 4: Effect of Nano-Zn spraying, adding organic fertilizer, and their overlap in the average plasticity limit %

	plasticity limit %			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
31.03	32.47	31.12	29.5	0
32.77	34.49	32.76	31.06	6
35.22	37.01	35.11	33.54	12
	34.65	32.99	31.36	average
Organic fertilizer 1.652 Nano Zn ,1.652 interaction: 1.025			L.S.D 0.05	

Liquidity limit (%): It is noted from Table 5 there are significant differences between the study factors in the liquidity limit characteristic, as the organic fertilizer treatment gave 12 ton.ha⁻¹ The highest values reached 20.77% compared to control treatment, which was 16.54%, and achieved an increase of 25.57%. The same table indicates that using the Nano-Zn spray treatment was 200

mg. L⁻¹, the highest values reached 20.03% compared to control treatment, which was 17.04%, and achieved an increase of 17.54%. As for the interaction in the same table, it had a significant effect on the soil moisture characteristic, the treatment (12 tons.ha⁻¹200 + mg.L⁻¹) which gave the lowest values of 22.81% compared to control treatment of 15.11%, achieving an increase of 50.95%.

Table 5: Effect of Nano-Zn spraying and adding organic fertilizer and their overlap in the average liquidity limit %

	liquidity limit %			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
16.54	18.07	16.44	15.11	0
18.28	19.22	18.33	17.3	6
20.77	22.81	20.99	18.73	12
	20.03	18.85	17.04	average
Organic fertilizer1.441 Nano Zn ,1.441 interaction: 1.025			L.S.D 0.05	

Plant height (cm): Results in Table (6) show that there are significant differences between the study factors in plant height, as the Nano-Zn spray treatment gave 200 mg. L⁻¹, the highest value reached 87.33 cm, compared to control treatment, which was 74.3 cm, achieving an increase of 17.53%. The same table indicates that the use of the organic fertilizer treatment is 12 ton.ha⁻¹ led to a significant increase in the plant height characteristic and gave the highest values

of 86.43 cm compared to control treatment of 74.5 and achieved a significant increase of 16.01%. The results of the analysis for the same table showed that the interaction between the two factors had a significant effect on the plant height. The treatment (200 mg. L⁻¹ + 12 tons e⁻¹) gave the highest value of 93.1 cm and the lowest value of 68.3 cm, achieving an increase of 36.31 cm.

Table 6: Effect of Nano-Zn spraying, adding organic fertilizer, and their overlap in the average plant height, cm

	plant height, cm			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
74.5	81.7	73.5	68.3	0
80.2	87.2	79.3	74.1	6
86.43	93.1	85.7	80.5	12
	87.33	79.5	74.3	average
Organic fertilizer 5.22 Nano Zn ,5.22 interaction :9.11				L.S.D 0.05

Dry weight (gm. Plant⁻¹): It's noted from Table (7) that there are significant differences between the study factors in the dry weight characteristic, as the Nano-Zn spray treatment gave 200 mg. Liter⁻¹, the highest value reached 15.61 g, compared to control treatment, which was 13.27 g, achieving an increase of 17.63%. The same table indicates that the use of the organic fertilizer treatment is 12 ton.ha⁻¹ led to a significant increase in the dry weight characteristic

and gave the highest values amounting to 14.78 g compared to control treatment of 13.27 g and achieved an increase of 11.37%. As for the interaction in the same table, it had a significant effect on the dry weight. The treatment (200 mg. liter⁻¹) excelled. + 12 tons⁻¹) and gave the highest values of 15.91 g and the lowest values of 12.31 g, achieving an increase of 29.24%.

Table 7: Effect of Nano-Zn spraying, adding organic fertilizer and their overlap in the average dry weight (g)

	dry weight (g)			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
13.27	14.63	13.87	12.31	0
14.37	15.31	15.07	12.73	6
14.78	15.91	15.28	13.15	12
	15.61	14.74	12.72	average
Organic fertilizer 1.5 Nano Zn ,1.5 interaction : 2.1			L.S.D 0.05	

Flag leaf area (cm²): It's noted from Table (8) that there are significant differences between the study factors in the characteristic of flag leaf area, as the Nano-Zn spray treatment of 200 mg was given. L⁻¹, the highest value reached 43.33 cm² compared to control treatment, which was 32.81 cm², achieving an increase of 32.06%. The same table indicates that the use of the organic fertilizer treatment is 12 ton.ha⁻¹ led to a significant increase in the dry weight

characteristic and gave the highest values of 43.14 cm² compared to control treatment of 33.1 cm² and achieved an increase of 30.41%. As for the interaction in the same table, it had a significant effect on the area of the flag leaf. The treatment (200 mg. litre) outperformed 1 + 12 tons e⁻¹) gave the highest values of 48.83 cm² and the lowest values of 30.9 cm², achieving an increase of 58.02%.

Table 8: Effect of Nano-Zn spraying, adding organic fertilizer, and their overlap in the average flag leaf area, cm²

	flag leaf area, cm2			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
33.1	35.2	33.4	30.9	0
38.6	45.97	38.15	32.7	6
43.14	48.83	45.75	34.85	12
	43.33	39.1	32.81	average
Organic fertilizer 1.7 Nano Zn ,1.7 interaction: 2.3			L.S.D 0.05	

Total yield (tons.ha⁻¹): It's noted from Table (9) that there are significant differences between the study factors in the character of total yield, as the nano-zinc spray treatment gave 200 mg. L⁻¹ highest values reached 5.03 ton.ha⁻¹ compared to control treatment is 2.9 ton.ha⁻¹ An increase of 73.44% was achieved. The same table indicates that the use of organic fertilizer treatment is 12 ton.ha⁻¹ led to a significant increase in the total yield, as it gave the highest

values of 4.46 ton.ha⁻¹ compared to control treatment is 3.52 ton.ha⁻¹ achieved an increase of 26.70%. As for the interaction in the same table, it had a significant effect on the total yield. The treatment (200 mg.L⁻¹ + 12 tons.E⁻¹) excelled and gave the highest values, amounting to 5.48 ton.ha⁻¹ compared to control treatment: 2.8 ton.ha⁻¹ and achieved an increase of 95.71%.

Table 9: Effect of Nano-Zn spraying and adding organic fertilizer and their overlap in the average total yield in ton.ha⁻¹

	total yield (ton.ha ⁻¹)			Organic fertilizer tons.ha ⁻¹
	Nano Zinc (mg.L ⁻¹)			
average	200	100	0	
3.52	4.33	3.43	2.8	0
4.27	5.29	4.58	3	6
4.46	5.48	4.71	3.2	12
	5.03	4.24	2.9	average
Organic fertilizer 0.91 Nano Zn 0.91 interaction: 1.41			L.S.D 0.05	

The results in tables: (2, 3, 4, 5, 6, 7, 8, 9) gave positive results in the studied traits. The organic fertilizer added to the soil has a significant effect in increasing the average of some physical traits, vegetative growth, and the yield of wheat plants of the Rumeli variety. The organic fertilizer treatment exceeded the level of 12 ton.ha⁻¹ significantly in

terms of bulk density, soil moisture, plasticity limit, fluidity limit, plant height, flag leaf area, dry weight, and total yield. The reason for this is that organic matter plays an important role in improving some of the soil's physical characteristics, such as bulk density, and that increasing the soil's organic matter content is important. It is extremely important as it

increases the vitality of agricultural soil and is also an important means of increasing the readiness of macro- and micro-nutrients. Soil moisture is considered one of the factors that determine various vital processes and their organization within the plant. At the same time, moisture is the determining factor for the plant's absorption of nutrients from the soil. The role of organic fertilizer and the organic acids it contains in increasing the permeability of cell membranes and the transfer of nutrients into the plant, which contributes to increasing the size, elongation, and division of cells, which was reflected positively in increasing vegetative growth indicators. This is consistent with (Al-Hadithi and Abdel Hamza (2010) ^[2] and (Mohammed, (2010) 2003 ^[18] and (Akul, Salman Shabib, 2012) ^[6].

As for the treatment of nano-zinc spraying, 200 mg. L⁻¹ has a significant effect on an average increase in plant height, leaf area, dry weight, total yield, and some physical characteristics. The reason is due to the efficiency of using nanofertilizers, which are more soluble and faster in penetration and assimilation into plant tissues than regular fertilizers, which led to positive results (Lal and Liu, 2015) ^[14].

The intervention treatment (200 mg.L⁻¹ + 12 tons.ha⁻¹) had a significant effect on all the studied traits and gave the highest values. The reason for this is that the use of organic fertilizer and zinc has an important effect on the soil, including increasing soil production and fertility while reducing environmental damage. The use of nano-fertilizer technology is the most widespread and widely used due to its positive effect in improving plant growth in many countries of the world (Bindraban *et al.*, 2020) ^[9].

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