International Journal of Aquatic Science
ISSN: 2008-8019
Vol 14, Issue 01, 2023

Comparative Study between Kaolinite Metal and SuppeFertilizer Nanoparticles in Foliar Feeding, Water Stress of Wheat Crop

Abbas S.S. AL-Wotaify[1], HawraaMahdi[2]

[1,2]*Agriculture College, AL-Qasim Green University, Iraq*

Emails: [1]Abas.s@agre.uoqasim.edu.iq, [2]mhawraa306@gmil.com

Abstract: A field experiment was conducted in one of the soils exploited by farmers in Babylon province, with an area of 600 m2 for the wheat crop, according to the Randomized Complete Block Designs, and in the arrangement of split plots, Its experimental units included the no-spray treatments for the concentration of kaolinite solution (K0), the chelated nano fertilizer (S0), and the spray treatments for the concentration of the regular kaolinite solution (K1) and the nano (K2), with a comparison with the nano-chelated fertilizer (S1). Its cultivated experimental units were exposed to the usual irrigation, and to three levels of water stress with percentages of water depletion 30, 60 and 90% represented by the symbols B0, B1, B2 and B3. The spraying treatment with kaolinite nano solution was characterized by achieving the highest height of 98.31 cm after spraying the B0K2S0 treatment. compared to the usual irrigation treatments. With a height of 96.20 cm after spraying treatment B1K2S0 under the water depletion level 30%. Its height reached 94.07 cm after spraying B2K2S0 treatment under the influence of 60% water depletion level. interaction with the chelated nano fertilizer gave a height of 90.93 cm after spraying the treatment B3K2S0 under the water depletion level of 90%.The results achieved by the efficiency of spraying the kaolinite nano solution affected the weight of a thousand grains, and as a result, the treatment B0K2S0 recorded the highest weight of a thousand grains of 50.00 g, and the spraying treatments B1K2S0, B2K2S0 and B3K2S1 achieved values of 43.33, 41.00 and 42.67 g. grain^{-1}, respectively. In the dry matter of the grain, potassium recorded 12.43 cmmol kg^{-1} when treatment B0K1S0. The highest values of calcium, magnesium, phosphorous and sulfur were 1.52, 10.1, 3.66 and 9.62 cmol kg^{-1} at treatments B0K2S1, B1K1S0, B3K2S0 and B1K2S0, respectively. While the micronutrients were exported by iron with the highest values of 180 mg kg^{-1} at B0K0S0. Zinc achieved the highest value of 140 mg kg^{-1} when B2K2S1 treatment, No value was recorded in treatment B2K1S1, and copper had the highest value of 50.70 mg kg^{-1} in treatment B2K0S1, and it did not reflect any value in most of the treatments. As for manganese, it gave the highest value of 130 mg kg^{-1} in treatment B3K2S1, and it did not register a value in some treatments.

Keywords: Kaolinite Metal, SuppeFertilizer Nanoparticles, Foliar Feeding, Water Stress, Wheat Crop

1. INTRODUCTION

Types of clays are available in huge quantities in the Iraqi Western Desert, and in vast areas, including kaolinite clays with a riverine depositional environment (floodplains), The mineral kaolinite is the main component of it is hydrated aluminum silicate, as well as iron oxides and quartz with some ions included in the structural composition of these clays and accompanying it, such as potassium and other elements adsorbed on their surfaces in the geological formation environment, and the available reserves of it are up to 1200 million tons, classified into several types: white, colored and gray [1] Kaolinite is a clay mineral that consists of one layer of silicate tetrahedron bonding (SiO4) with one layer of octahedron (Al2OH6). Thus, its structural structure is surrounded on one of its sides by terminal hydroxyl atoms, which have a high chemical adsorption potential, and a distinctive adsorption property for some ions such as phosphorous and iron, Especially when its crystal edges are broken during the processes of deposition and grinding, compared to other clay minerals whose hydroxyl atoms become internal as a result of the nature of the bonding of the silicate layers around them, which possesses surface silica oxygen atoms that are characterized as a relatively weak electronic donor[2[In themselves, they are clays from a sedimentary environment rich in accompanying elements that can be considered a source of nourishment for the plant by spraying them on the plant leaves through the ease of dissolving them in water, which increases more at the nano-granular size, forming a solution containing the ions of the dissolved elements released from their surfaces. It is a structural component. As well as its role in maintaining the relative humidity of the vegetative system, and its potassium content is high if it is from an environment rich in feldspar minerals and mica. The availability of potassium and some elements plays a role in alleviating the severity of water stress, which is one of the most important causes of loss in the productive quantity of the crop, exceeding the loss resulting from other environmental influences, because irrigation has priorities in the stages of growth and the components of the crop [3]. The fine grain size of clay minerals can be within the nanoscale range between 10-100 nanometers and makes them a non-toxic, inexpensive adsorbent material that is used in many fields, whether industrial, agricultural, engineering and environmental, and it is environmentally friendly because it is characterized by safety Health and food security [4] , [5] Since Iraq is located within a geographical area with scarce rainfall and is governed by unstable conditions in terms of abundance of arable water and various human uses, Especially after the severe decrease in the quantities of water and the current water revenues of the Tigris and Euphrates rivers, which are much lower than their natural rates, as a result of the unclear water strategies and policies with the riparian countries [6] It is necessary to find ways to achieve food security with techniques that provide at least moisture and available elements for the plant, according to which it can exercise its physiological and vital effectiveness, and not be preoccupied with resisting water stress, which is defined as the phenomenon of a water deficit in the root zone, and reducing the absorption of the plant to it when a certain period of time, It is considered one of the most important types of abiotic environmental stresses affecting the reduction of plant yield due to the negative impact on vegetative growth indicators by stimulating the production of oxidative free radicals of plant cells, thus transforming into double stress resulting from the effect of water and oxidative stress [7], [8] In light of this, the new idea was directed toward achieving the following aims:

1.Spraying local and nano kaolinite clays as aqueous solutions on wheat plant leaves, and testing their ability to prepare nutrients, compared with spraying with chelated nano fertilizers.

2. Testing the susceptibility of these clays to the possibility of relieving water stress according to levels of water depletion, compared to the usual irrigation of the wheat crop.

2. MATERIALS AND METHODS

Experience location and area landmarks

A field experiment was conducted during the winter season 2019-2020 in the field of a farmer, which belongs to the ancient city of Babylon, which is located 6 km from the centre of the Hilla city in the northeast direction. The area of the current study is part of the sedimentary plain in which the geomorphological processes are well-defined, which played an important role in the formation of its landforms [9] and the age of the geological formations on the surface of this region extends from the age of the Sumerians and Babylonians to the present time. It consists of river and wind sediments that human activity contributed to its formation following the exploitation of its land for agriculture and trade.

Preliminary Actions

A sample of Doikhla kaolinite mineral, whose composition is located in the Iraqi Western Desert, was prepared by the General Company for Geological Survey and Mining in Baghdad. And the crushed grain size is less than 75 µm with the mentioned company. The metal under the current study was diagnosed with an X-ray diffraction device at the College of Science - University of Baghdad through its basal distance of 7.31 Å, and by 83.8% in Figure 1. and grinding part of the sample of ordinary kaolinite represented by the symbol K1 by means of a nano-mill, The particle size of the metal was measured after grinding using the Particle Size Analyzes device in the laboratories of the College of Materials Engineering - University of Babylon, with a size of 70 nanometers for a kaolinite nanoparticle (K2) sample. The total content of the elements in the K kaolinite sample was estimated based on the number of nano-elements in the fertilizer package of the nano-super, represented by the symbol S1 by means of X-ray fluorescence (XRF) in the laboratories of the Ministry of Science and Technology - Baghdad. As shown in Table 1. Solutions of these samples were prepared at an average of 2 g l-1 according to the recommendations announced in the instructions leaflet for the package containing a group of nano-elements in the super nano fertilizer, as shown in Figure 2 for the super nano fertilizer package.

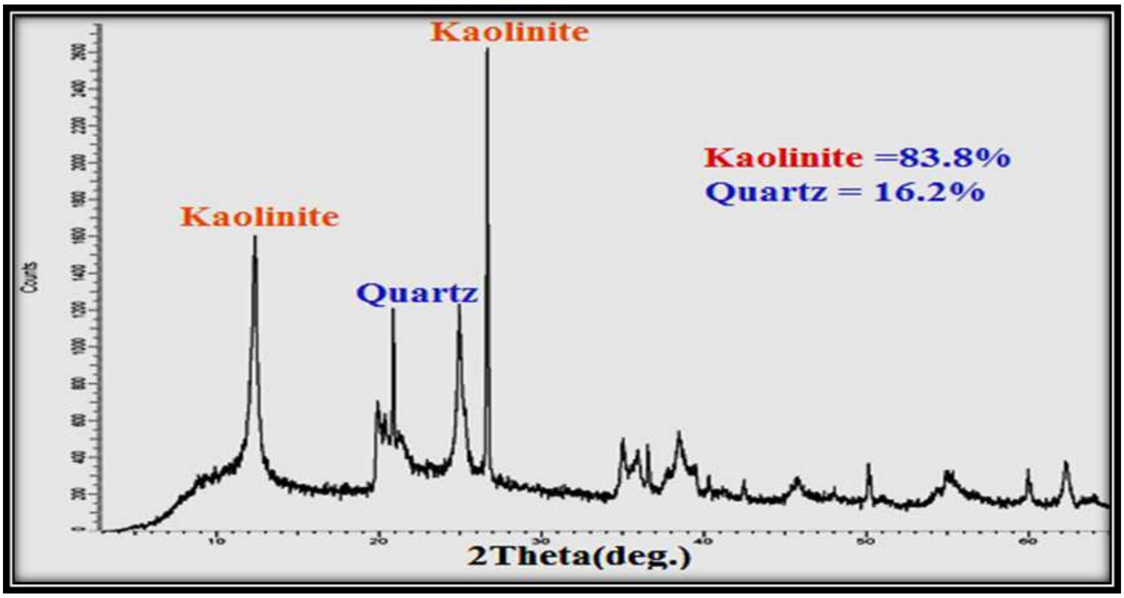

Figure 1. X-ray diffraction and kaolinite mineral percentage in a western desert sample.

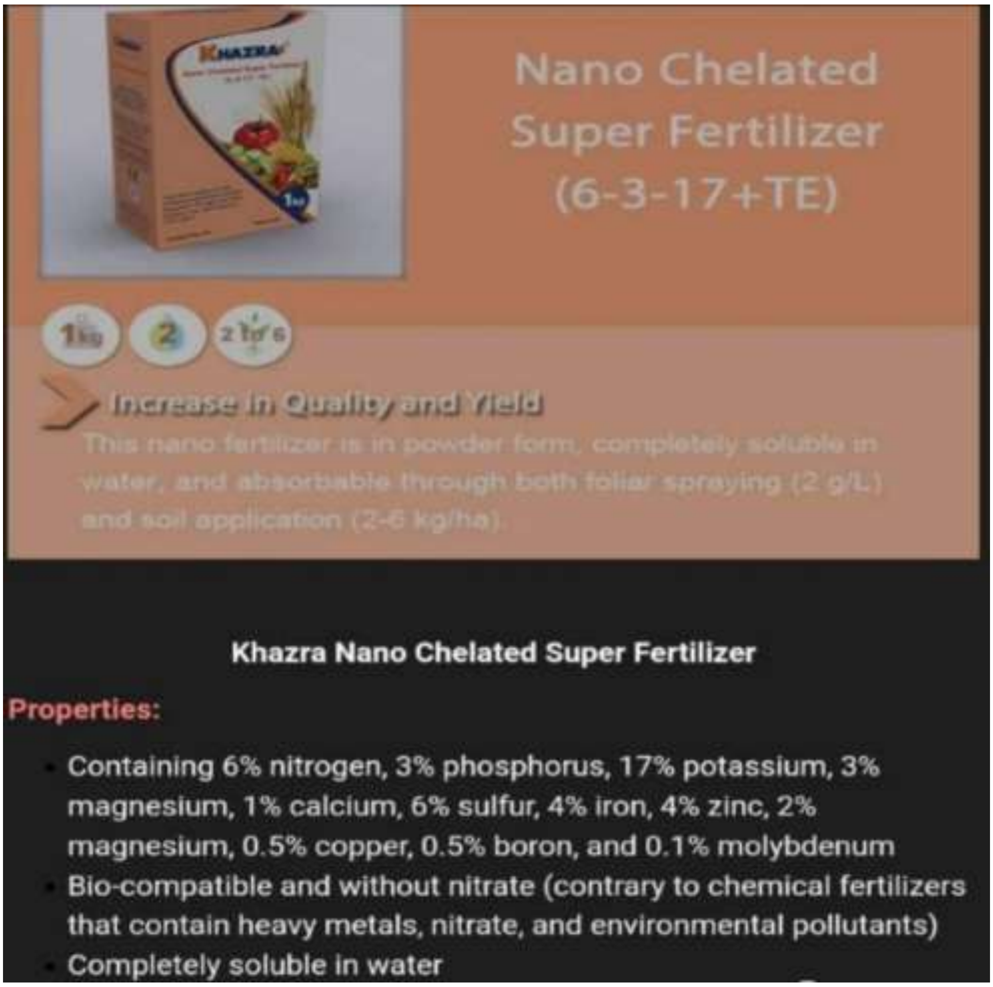

Figure 2. Explains the nutrients contained in the super nano compost box.

Table1. Elemental concentration in kaolinite mineral and super nano fertilizer.

total content of micro elements ($mg.kg^{-1}$)					total content of macro elements (comol kg-1)					sample
Mo	Mn	Cu	Zn	Fe	S	P	Mg	Ca	K	
0	0	0.02	0.04	49.74	1.43	0.54	2.75	7.9	3.76	**K_2**
1	20	5	40	0.71	1.87	0.96	1.23	0.25	4.34	**S_1**

Experimental treatments and statistical design

The experiment included studying the effect of three factors, the first factor - water stress and includes levels B0 regular irrigation, B1 water stress level 30%, B2 water stress level 60%, B3 water stress level 90%. The second factor - adding kaolinite mineral by spraying method K0 control treatment, K1 normal kaolinite, K2 nano kaolinite, the third factor - including spraying with super nano fertilizer S0 control sample, S1 adding super nano fertilizer.

Field procedures

The soil of the field was tillage with Moldboard plows perpendicular tillage to an area of 600 m2 with two dimensions 30 x 20 m, and the levelling and modification operations were coundected it. The field was divided into three replicates within the split-split plot arrangement, and by the design of randomized complete blocks. The field included four main units in each replicate, each of which has an area of 20 m2, and its dimensions are 4 × 5 m within one replicate. As for the distance between each line and another, it was 20 cm, with intervals between replicates of 2 m and between the treatments a distance of 1.5 m for the purpose of controlling the spraying of solutions of the treatments of regular and nano kaolinite and super nano fertilizer. IPA 99 wheat seeds were sown at the beginning of December of 2019, with a seed quantity of 120 kg ha-1.The cultivation was on lines, the distance between one line and another was 20 cm, as each experimental unit contained 6 lines. The field was irrigated with a water pump equipped with a meter to record the amount of water added to the field during regular irrigation, and the water depletion levels were 30, 60 and 90%.In light of this, the vegetative and fruitful total was treated with spray solutions at the two stages of branching and flowering with a number of additions according to the assessment of the water need at each added quantity of water to reach the mentioned water levels by measuring the moisture content at the field capacity of each level before and after the irrigation process and based on the described equation 1. By [10] the following:

$d = A(pw_2 - pw_1) * pb * D * \%w$ …..(1)

Since: d is the water depth of the water requirement, A is the area of the experimental unit, Pw2 is the weight at the field capacity, Pw1 is the initial volumetric humidity, ρb is the bulk density, D is the depth of the root zone and %W is the specific percentage of each of the levels of water stress.

Growth indicators and yield components

Plant height (cm) was measured as an average of ten plants in each experimental unit (cm), using a tape measure from the level of the soil surface to the end of the stalk of the main stem spike, according to what was mentioned by [11] the weight of 1000 grains (gm). The weight of a thousand grains was estimated (g) A thousand grains were taken from the yield of plants with an area of 1 m, and for each experimental unit, and weighed with a sensitive scale to represent the weight of a thousand grains, and returned to the crop. The seeds were ground after the end of the harvest season for the plant in the same area at each experimental unit and preserved well according to the method mentioned by [12] and presented at [13] and sent to the Research Center in the Department of Science and Technology - Baghdad, for the purpose of estimating its content of the mentioned elements In spraying treatments with an X-ray fluorescence device.

Statistical analysis

After obtaining the data of the field experiment, it was statistically analyzed according to the design of the complete random sectors within the arrangement of the split-split panels of the experimental units, and the averages were compared using the least significant difference (LSD) test at the level of significance .050 in a statistical program prepared by the computer Genstat [14]

3. RESULTS AND DISCUSSION

Plant height (plant cm^{-1})

Table 2 shows the results of the increased yield of wheat grown in the study soil at water depletion levels of 30, 60 and 90%, and for spraying treatments with normal and nano kaolinite solution. As well as spraying treatment with nano-chelating fertilizer. Whereas, treatment B1 for a depletion level of 30% gave the highest rate of 89.93 cm compared with treatment B2 for a depletion level of 60 and B3 for a 90% depletion level with a rate of 89.04 and 85.36 cm, respectively. Spraying with a solution of metallic kaolinite nano (K2) had a role in the rate of plant height was 93.49 cm compared with the treatment of spraying with a solution of metallic kaolinite (K1), as well as free of it (K0) at a rate of 89.02 and 85.28 cm, respectively. Then comes the solution of spraying with nano-chelating fertilizer (S1), which gave the highest average of 90.12 cm from the control sample (S0), in which the average height was 88.41 cm. The reasons for the high rate of the plant at the level of water depletion 30%, and its decrease at the level of 60 and 90%, may be attributed to the fact that the moisture content in the soil provided by the water depletion level of 30% is appropriate to the requirements of the physiological and biological processes that the plant practices, On the contrary, it decreases in the soil at the aforementioned levels, which causes a reduction in cell division of the stem and leaves, and their small size. In addition to the high level of water stress, it works to intercept and convert solar energy into chemical, and to produce the dry matter needed to complete the elongation process [15] As for the reasons for the superiority of spraying with a mineral solution of nano kaolinite in the rate of plant height compared to the two treatments of spraying with a solution of ordinary kaolinite and super nano fertilizer. It can be attributed to its fine nano-granular size that provides a high specific surface area and ion exchange capacity for its elemental content with the histological structure of vegetative organs. This is consistent with what was mentioned by [16] that nano nutrients are characterized by their small granular size with the presence of a large number of atoms on the outer surfaces that increase their chemical reactions, as well as their effective role in the packaging accuracy of the vegetative parts. In order to maintain the ionic and water balance inside the plant cell. Likewise with what was indicated by [17] that clay is considered a diffusing material that reduces the surface tension of the solution and facilitates the process of wetting the plant parts and the entry of nutrients through the stomata and plant tissues such as leaves. Then comes the chelating nano solution by affecting the high rate of plant heights, which enhances the role of nanoparticles in improving the vegetative growth indicators of the plant. As well as the content of the two treatments with kaolinite and nano-chelating fertilizers of nutrients and ready for absorption by the vegetative parts (Table 1), especially potassium, iron, copper, zinc and manganese, which play a positive role collectively in the activation of enzymes and division with the elongation of plant tissue cells [18] In light of this, it was mentioned [19] that nano-fertilizers consisting of iron, zinc and copper in certain concentrations contribute to an increase in plant height. It appears by observing the results of the interaction of the spraying treatment K2S0 in Table 4 that it exceeded the value of the plant height, which reached 94.25 cm, compared to the other two interaction treatments. Which enhances the role of nano kaolinite in vegetative growth indicators, and this was confirmed by the results of most vegetative growth indicators such as leaf area, chlorophyll index and spike length (Table 6, 7 and 8), as well as the results of the yield components in Tables 9 and 10. The value of the plant height for the mentioned interference treatment (K2S0) was consistent with the triple interference treatment B1K2S0 in which the highest height was 96.20 cm (Table 2). The level of water depletion is 30%, which provides suitable soil moisture for plant growth, and it can be close to what is provided by regular irrigation, and at a moisture tension that does not cause water stress. This is what was mentioned by [20] that the water depletion rate between 25-50% provides moisture tension that does not cause stress to the plant, and an amount of water available for plant growth and completion of its production requirements.

Table 2 The interaction effect of spraying treatments with normal, nano-mineral kaolinite solution and nano-chelating fertilizer on plant height at levels of water depletion.

average B x K	chelating fertilizer treatment (S)		Kaolinite treatment	water stress levels	interaction treatments
	S_1	S_0			
91.77	**93.78**	**89.77**	K_0	B_0	BxKxS
89.27	**90.19**	**88.34**	K_1		
97.15	**95.99**	**98.31**	K_2		
88.48	**90.21**	**86.74**	K_0	B_1	
86.86	**88.23**	**85.49**	K_1		
94.45	**92.69**	**96.20**	K_2		
88.59	**89.98**	**87.21**	K_0	B_2	
85.84	**85.43**	**86.25**	K_1		
92.70	**91.33**	**94.07**	K_2		
87.23	**90.19**	**84.27**	K_0	B_3	
79.17	**82.44**	**75.90**	K_1		
89.68	**90.93**	**88.43**	K_2		
89.26	**90.12**	**88.41**	S average		
$LSD_{0.05}$(BxK)= 4.05	$LSD_{0.05}$(S)=1.00		$LSD_{0.05}$(BxKxS)=4.63		

BxS				
B average	S_1	S_0		BxS
92.73	**93.32**	**92.14**	B_0	
89.93	**90.38**	**89.48**	B_1	
89.04	**88.91**	**89.17**	B_2	
85.36	**87.86**	**82.87**	B_3	
$LSD_{0.05}$ (B)=3.08	$LSD_{0.05}$ (BxS)=3.20			

KxS				
K average	S_1	S_0		KxS
89.02	**91.04**	**87.00**	K_0	
85.28	**86.57**	**84.00**	K_1	
93.49	**92.74**	**94.25**	K_2	
$LSD_{0.05}$ (K)=1.93	$LSD_{0.05}$ (KxS)=2.22			

The 1000 grain weight (g)

The results in Table 3 showed an effect of the treatments of the current study on the weight of 1000 grains, where the treatment K2S0 recorded a weight of 42.75 g, This was followed by treatment K2S1 with a weight of 39.75 g, and then treatment K0S1 and K1S1 with a weight of 38.75 and 35.50 g. While the weight recorded the lowest values when the control treatment K0S0 and K1S0 with weight 33.00 and 30.75 g, respectively. This confirms the distinctive role of the kaolinite mineral nano-metal despite the nano-elements in the chelated fertilizer, perhaps due to the strong adhesion of the mineral to the vegetative parts as a result of the availability of a high surface area due to its fine granular size, which gives a sufficient opportunity for the absorption of the elements, and the ability of its nanoparticles to be exported through foliar nutrition. As well as increasing its iron content, which contributes to building chlorophyll and storage proteins that accumulate in grain, calcium, which enters the formation of proteins and carbohydrates, and increases the size of chloroplasts. The final weight of the grain is determined by depending on the ability of the source to export the products of photosynthesis during the period of filling the grain, the ability of the grain to receive these products, as well as the strength of the grain's filling [21]. It also agreed with what was confirmed by [22] that the weight of a thousand grains had a positive correlation with the mentioned botanical indicators. While the interaction treatments of irrigation and chelating fertilizers (Table 3) showed the highest value of 39.00 g when treatment B3S1, Then came B0S1 with a weight of 38.56 and B0S0 with a weight of 38.00 g, and the spray treatments B1S0, B1S1, B2S0 and B2S1 recorded the lowest weights 33.78, 36.56, 35.22 and 37.89 g, respectively. The treatment of the water level excelled 90%, compared to the treatment of other levels, in violation of what was indicated by several researchers, including [23] and [24] that water stress during the stage of filling grain leads to a decrease in its weight, This increase in weight of a 1000 grains is probably due to the high level of water stress that encouraged the rate of supply of dry matter, and stimulated the storage sources represented by leaves and stems to push their products to the sink represented by grains. This was indicated by [25] that the increase in the weight of the grain is due to the rate of supply of dry matter from the source to the mouth of the plant during the unit time, which results in an increase in the degree of grain filling, and thus the weight of a thousand grains increases. This was confirmed by the average weight at the 60% depletion level treatment, which was the closest to the 90% treatment (36.56 and 37.00 g, respectively). In general, the weight of 1000 grains was close in values in all treatments, and it was consistent with what was mentioned by [26] that the levels of moderate (30%) and severe (10%) dehydration achieved homogeneous values in the weight of 1000 grains, What the spray treatments showed in their study to reduce the role of drought stress levels. The highest weight per thousand grains in Table (3) was reached when treatment B0K2S1 with a weight of 50.00 g. This was followed by treatment B0K0S1 with a weight of 44.33 g, and then came treatment B1K2S0 with a weight of 43.33 and 42.67, 41.00 g when treatment B3K2S1 and B2K2S0 respectively, Compared with other treatments, especially treatment B1K0S0, which recorded the lowest weights of 28.67 g, and treatment B1K1S0 with a weight of 29.33 g. It appears by observing the results that the values of the weight of 1000 grains at the irrigation levels all agreed with it [26]. This confirms the role of the nano-spray treatments, whether individually or in combination, in reducing the impact of water stresses on the weight of 1000 grains. This was reinforced by the values of the weight of one thousand grains at the level of 30% treatment without spraying, and other treatments of the normal kaolinite that gave the lowest values and what was mentioned [27] that the nano-element compounds have the ability to stimulate the vegetative cells in the processes of division and elongation through a direct effect on the areas of leaf formation and increase the number of its divisions. Thus, it increases the number of flowers and spikes, forming a dry substance, increasing the number and weight of grains, and thus increasing the yield of the effect of improving its components.

Table 3 Effect of interaction between spraying treatments with normal and nano kaolinite mineral solution and chelated nano fertilizer in 1000g. grain-1 at levels of water depletion.

average B x K	**chelating fertilizer treatment (S)**		**Kaolinite treatment**	**water stress levels**	**interaction treatments**
	S_1	**S_0**			
39.00	**44.33**	**33.67**	**K_0**	**B_0**	
31.83	**33.33**	**30.33**	**K_1**		
44.00	**38.00**	**50.00**	**K_2**		

32.33	**36.00**	**28.67**	**K_0**	**B_1**	**BxKxS**
31.83	**34.33**	**29.33**	**K_1**		
41.33	**39.33**	**43.33**	**K_2**		
34.50	**36.33**	**32.67**	**K_0**	**B_2**	
35.17	**38.33**	**32.00**	**K_1**		
40.00	**39.00**	**41.00**	**K_2**		
37.67	**38.33**	**37.00**	**K_0**	**B_3**	
33.67	**36.00**	**31.33**	**K_1**		
39.67	**42.67**	**36.67**	**K_2**		
36.75	**38.00**	**35.50**	**S average**		
$LSD_{0.05}$(BxK)=4.61	**$LSD_{0.05}$(S)=1.88**		**$LSD_{0.05}$(BxKxS)=6.32**		
BxS					
B average	**S_1**	**S_0**		**BxS**	
38.28	**38.56**	**38.00**	**B_0**		
35.17	**36.56**	**33.78**	**B_1**		
36.56	**37.89**	**35.22**	**B_2**		
37.00	**39.00**	**35.00**	**B_3**		
$LSD_{0.05}$ (B)=2.80	**$LSD_{0.05}$ (BxS)=3.56**				
KxS					
K average	**S_1**	**S_0**		**KxS**	
35.88	**38.75**	**33.00**	**K_0**		
33.12	**35.50**	**30.75**	**K_1**		
41.25	**39.75**	**42.75**	**K_2**		
$LSD_{0.05}$ (K)=2.47	**$LSD_{0.05}$ (KxS)=3.62**				

Total grain content of nutrients

Table 4 shows the total nutrient content in the dry matter of wheat grains, in which potassium ranged between 1.15-12.43 cmol kg^{-1}, and the lowest value was for treatment B0K1S0, and the highest for treatment B0K0S0 at regular irrigation and at the level of depletion 30% ranged between 10.33-12.43 cmol kg^{-1},and treatment B1K0S0 recorded the lowest value of 10.35 and 12.43 cmol kg^{-1} taken by treatment B1K1S1. Treatment B2K1S0 gave the lowest value of 10.35 and 12.43 cmol kg^{-1}, the highest value of potassium content recorded by treatment B2K2S1 at the 60% depletion level. For a 90% exhaustion level .Treatment B3K2S0 recorded the lowest value of 9.38 and 13.25 cmol kg^{-1} achieved by treatment B3K1S0, and the highest values for potassium, compared to regular irrigation treatments, and other water depletion levels, evidence that the plant employed potassium in confronting the water deficit, and the lack of investment in organizing the structural structure of the components of the fruit, as well as the nature of the structural composition of the ordinary kaolinite mineral, which has a low ion exchange capacity and a low specific surface area [28 .[These traits may provide difficulty and obstruction in the absorption of elements by the plant along with the state of thirsty, and the lack of water that enters an important factor in the manufacture of energy compounds, and transport processes within the plant tissues**.**

Table 4 Some macro and micro nutrients in the dry matter content of wheat grains**.**

total content of micro elements (mg.kg-1)					total content of macro elements (cmmol kg^{-1})					**treatments**
Mo	**Mn**	**Cu**	**Zn**	**Fe**	**S**	**P**	**Mg**	**Ca**	**K**	

0.00	120.00	0.00	110.00	180.00	4.56	9.38	3.16	1.52	12.43	**$B_0K_0S_0$**
0.00	67.96	0.00	70.33	150.00	4.78	8.25	3.00	1.32	1.23	**$B_0K_0S_1$**
0.00	0.00	0.00	69.73	160.00	4.46	8.80	3.04	1.52	1.15	**$B_0K_1S_0$**
0.00	0.00	47.48	120.00	95.65	4.81	9.83	3.12	1.30	12.43	**B_0K_1S1**
0.00	110.00	0.00	120.00	140.00	4.62	9.77	3.41	1.07	1.17	**$B_0K_2S_0$**
0.00	71.01	0.00	120.00	84.08	3.93	8.77	2.19	0.87	11.43	**$B_0K_2S_1$**
0.00	77.65	34.55	120.00	150.00	4.43	9.38	3.41	1.20	10.33	**$B_1K_0S_0$**
0.00	0.00	0.00	120.00	110.00	4.56	8.93	3.08	1.27	11.00	**$B_1K_0S_1$**
0.00	110.00	0.00	100.00	130.00	4.81	9.70	0.45	1.10	11.10	**$B_1K_1S_0$**
0.00	100.00	34.86	130.00	94.65	5.53	9.96	3.37	1.20	12.43	**$B_1K_1S_1$**
0.00	86.21	31.49	110.00	120.00	3.87	8.96	3.00	1.25	10.30	**$B_1K_2S_0$**
0.00	74.73	0.00	120.00	90.75	5.18	9.29	3.58	1.00	10.76	**$B_1K_2S_1$**
0.00	110.00	27.07	82.49	91.70	4.34	9.83	3.54	1.25	12.02	**$B_2K_0S_0$**
0.00	120.00	50.70	110.00	67.56	4.84	9.93	3.66	1.12	10.79	**$B_2K_0S_1$**
0.00	84.19	0.00	110.00	110	4.31	8.70	3.08	1.07	10.35	**$B_2K_1S_0$**
0.00	120.00	42.28	0.00	100.00	4.37	8.93	3.25	1.07	11.66	**$B_2K_1S_1$**
0.00	0.00	0.00	110.00	110.00	3.87	8.70	2.66	1.02	11.84	**$B_2K_2S_0$**
0.00	73.88	38.94	140.00	89.23	4.37	10.12	3.08	1.22	12.43	**$B_2K_2S_1$**
0.00	88.57	0.00	99.81	86.39	4.25	8.38	2.37	1.20	10.51	**$B_3K_0S_0$**
0.00	94.47	0.00	110.00	53.11	4.87	8.45	2.95	1.02	10.97	**$B_3K_0S_1$**
0.00	110.00	0.00	130.00	98.39	9.62	9.93	3.66	1.52	13.25	**B_3K_1S0**
0.00	83.00	0.00	110.00	120.00	5.06	9.03	2.70	1.07	11.58	**$B_3K_1S_1$**
0.00	92.88	49.97	65.63	110.00	5.25	8.16	3.54	0.85	9.38	**$B_3K_2S_0$**
0.00	130.00	37.99	91.43	120.00	4.31	9.35	3.25	1.20	10.64	**$B_3K_2S_1$**
* Nill	0.58	0.02	0.95	0.87	0.57	0.97	0.19	0.01	0.01	**LSD0.05**

It can be interpreted that other nutrients such as calcium, magnesium and sulfur recorded the highest values of 1.52, 3.66 and 9.62 cmol kg^{-1} when the treatments with normal kaolinite B0K1S0, B3K1S0 and B3K1S1 respectively ,With the exception of phosphorus, which achieved the highest values of 10.12 cmol kg-1 when treating the interaction of kaolinite and nano chelate fertilizer under the water depletion level 60% (B2K2S1), due to its availability in the samples of kaolinite and chelated fertilizer (Table 1), but a decrease was recorded in other water depletion levels, whether in Treatment of nano kaolinite alone or intertwined with nano chelated fertilizer, especially when treatment B3K2S0, with the lowest values of 8.16 cmol kg^{-1}, The justification can only be referred to the state of the plant and how it can be invested to employ this element in the exercise of its physiological and vital activities. The reasons can be due to the accuracy of the operator, as well as the environmental conditions and the prevailing factors that affected the spraying process. These and other reasons may apply to the transactions of experience that deviate from the rule imposed in the explanation of the reasons related to a being that does not disclose its causation. It is noted that the content of nutrients, especially the major ones, recorded a decrease in their content in the dry matter of the grain, and this could be due to the exploitation of the majority of nutrients by carrying out chemical and biological processes, in addition to their participation in the formation of proteins, carbohydrates, starch, and fats. As well as the activation of enzymes and plant hormones and the formation of energy compounds, some of which are used in the regulation of water stress.Potassium is involved in most metabolic reactions and regulation of osmotic effort. Calcium is included in the composition of the middle plate of the cell wall, and in the cell membranes to maintain their permeability and vital effectiveness. The table shows the grain concentration of micronutrients in which iron recorded the highest value of 180 mg kg^{-1} when the control treatment B0K0S0,This can be due to encouraging the plant's ability to absorb iron from the soil through root nutrition, and supplying the plant parts with it in the absence of the spraying treatments under study .Zinc achieved the highest value of 140 mg kg^{-1} in treatment B2K2S1, and no value was recorded in treatment B2K1S1, and copper had the highest value of 50.70 mg kg^{-1} in treatment B2K0S1, and it did not reflect any value in most of the treatments. As for manganese, it gave the highest value of 130 mg kg^{-1} in treatment B3K2S1, and it did not register a value in some treatments.This discrepancy in values when spraying treatments may be due to the treatments' content of these elements (Table 1), and to the conditions of water stress and the physiology of the wheat crop under the current study in how nutrients can be exploited for its benefit, and the mechanism practiced by the plant in absorbing nutrient solutions during and after operations spraying,As well as the nature and susceptibility of the processed material to feed. The plant needs to consume a large part of the nutrients, especially in the advanced stages of the vegetative and reproductive parts that require the availability of an appropriate moisture content for the plant to exercise its vital and physiological activities. It depends mainly on the process of photosynthesis, the formation of energy compounds and the activation of a number of plant enzymes, in addition to participating in alleviating water stress, and in chemical reactions such as oxidation, reduction and energy transfer, and others.

4. REFERENCES

[1] Al-Sahoki, Medhat Majeed, Ayoub Obaid Al-Falahi and Ali Fadam Al-Mohamadi (2009) Crop management for soil and breeding for drought tolerance, Iraqi Agricultural Science Journal, 40 (2):1-28.
[2] Churchman GJ , Gtes WP ,theng BKG,Yuan G ,2006.chapter 11.1 clays and clay minerals for pollution control in: fal za Berjaya BKGT .Gerhard L (eds)Develop men in clay science ,Vole El
[3] Sevier, Am stardom . pp. 625.675.
[4] Zhu and Njuguna, J, 2014. Nanolayerd silicates/clay: Uses and effect on health. Health and environmental safety of nanomaterials. Wood head publishing, Cambridge: 133-146.
[5] Al-Derfasi, Ali bin Abdullah and Salim, Mustafa Muhammad (2011) Advanced Plant Physiology, College of Science, Food and Agriculture, King Ibn Saud University, Kingdom of Saudi Arabia.
[6] Kandil, Ahmad Al-Najjar (2009). Cultivation of fodder and pasture plants in sandy and saline lands without irrigation and fertilization. The Third Conference on Marketing Applied Research and University Services, Mansoura University, 55-59.
[7] Al-Taher, Faisal Mahbes. (2005). The effect of foliar nutrition with iron, zinc and potassium on the growth and yield of wheat. L stivum ae Triticum Ph.D. thesis. Department of Field Crops Sciences - College of Agriculture - University of Baghdad.
[8] Al-Shammari, Qassem Yousef Shatit and Al-Hasnawi, Amir Hadi Jadoua (2016) The impact of geomorphic processes in shaping the surface appearances of the Earth in Babylon province using GIS, Journal of the College of Basic Education for Educational and Human Sciences, Issue (29): 456-481.
[9] Shabib, Yahya Jihad, inside Radi Nadwi, Ali acidi Diab. (2017). Emulsification of oil derivatives and their effect on the progression and decline curve of water on the soil

surface and the growth and productivity of corn Zea maysl using ribbon irrigation method, Dhi Qar University Journal of Agricultural Research, Volume 6 (1).Donaldson , E. 1996. Crop traits for water stress tolerance, Am. J. Altern . Agric. Greenbelt, M. D. Henry, A. Wallace Institute for Alternative Agriculture V. 11: 80-83. (Abs.).

[10] Jones, J. B. and Stey,W.J.A ,1973.Sampling, Handling and Analyzing plant tissue samples. In: Soil Testig and plat analysis ed. By walsh, L.M. and Beaton,J.D. Soil Sci. Soc. Of Am.,Madison,

[11] Wiscon: 248-268.

[12] Al-Sahhaf, Fadel Hussein. (1989). Applied plant nutrition. Ministry of Higher Education and Scientific Research, University of Baghdad. 260.

[13] Al-Rawi, humbled Mahmoud and Abdel Aziz Ibrahim Khalaf Allah.1980). Design and analysis of agricultural experiments. Ministry of Higher Education and Scientific Research. College of Agriculture and Forestry. University of Al Mosul.

[14] Al-Tabbal, J. A.; Kafawin, O. M. and Ayad, J. Y;.2006.Influence of water stress and plant growth regulators on yield and development of two durum wheat (Triticumturgidum l. var. durum) cultivars . Jordan J. of Agric. Sci., 2 (2): 28-37.

[15] Agrawal, S. and P. Rathore.2014. Nanotechnoloagy Prosand ConstoAgriculture: AReview. Int .J.Curr. Microbiol.App.Sci, 3(3):43-55.

[16] Al-Mawsili, Muzaffar Ahmad (1971) Al-Kamel in Fertilizers and Fertilization: Analysis of Soil, Plants and Water, Dar Al-Kutub Al-Ilmia for Printing, Beirut, Laban.

[17] Mohsen, Karim Hannoun, Asadi, Kazem Katami. (2016). Response of barley crop Hordeum vulgar el. For foliar feeding with iron, zinc and manganese. Al-Muthanna Agricultural Journal. Volume 4. Issue (2).

[18] Abdul-Amir, Hassan Khudair, Zaid Abdul-Zahra, Zahraa Saleh Toman, Ghofran Adai Burhan and Farah Hassan Habib (2016) Behavior of some nanomaterials in improving the growth of the onion plant Allium cepa and its effect on the fungus Aphanidermatum phthi. faculty of Agriculture . Al-Qadisiyah University.

[19] Al-Hafouzi, Saad El-Din Majid and Ahmed Saleh Khalaf. (2004). Effect of water tension levels and concentration of the ethiphon regulator on some growth characteristics, yield and components of barley. Iraqi Journal of Agricultural Sciences. Volume (5), Issue (3), pp. 39-26:

[20] Khakwani ,A,A.Dennett ,M.D. and Munir ,M,2011.Drought to lerance of. 21

[21] screeing wheat varieties by inducing water stress conditions .song klanakarin J.Sci. Technol., 33(2) : 135-142.

[22] Belheis, Iman (2014) A morphophysiological and biochemical study of durum wheat plants, Master's thesis, Faculty of Natural and Life Sciences, People's Democratic Republic of Algeria. Saeidi, M and M. Abdoli, 2015. Effect of drought stress during grain filling on yield and its components, gas exchange variables,and some physiological traits of wheat cultivars. J. Agr. Sci. Tech. 17:885-898.

[23] Ahmed, Shatha Abdel Hassan. and Hashem, Emad Khalil. (2017) The response of wheat yield and its components to ABA acid by the effect of water stress. Iraqi Journal of Agricultural Sciences -48(4): 941-956.

[24] Al-Awda, Ayman; Kayyal, Hamid and Khaiti, Mamoun (2004) The effect of radioactive agitation on the morphological characteristics and yield components of two cultivars Sham3 and Hourani of durum wheat, Damascus University Journal of Agricultural Sciences, Volume 20 (1): 127-142.

[25] Istabuli, T. Baum,M. Toucha,H ad Hamwieh,A .2020 .Evaluation of in morpho-physiological traits under drought stress conditions barley (Hordeum vulgare L.). Photosynthetica J. Vol. 58 (4):1059-1067.
[26] Buzea C, Pacheco I, Robbie K, 2000. Nano materials and nano particles: sources and toxicity. Biointer phases 2: mr 17 –Mr
[27] Mirbahar, A.A.; Markhand, G.S.; Mahar, A.R.; Abro, S. A. and. 28 Kanhar, N. A. 2009. Effect of water stress on yield and yield components of wheat (Triticum aestivum L.) varieties. Pak. J. Bot., 41(3): 1303-1310.