Responses of Growth and Quality treats to Micro-Nano elements of two Varieties of Corn for two Seasons.

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Abstract

The research was Carry out the spring and autumn of 2022 in the village of Tulul Nasir / Al-Shura district (50 km south of Mosul) north of Iraq. The study included two varieties of maize (Dijlah) and (Al-Forat) and five treatments with micro-nano elements (Fe 9%, Zn 1% and Mn 1%), namely: spraying water and spraying plants with concentrations of 2 and 4 g. L^{-1} and spraying the soil with a concentration of 2.25 and 5.25 g. L^{-1} until complete wetness in the flowering stage. The split-plate system was used according to the randomized complete block design (R.C.B.D) with three replications as a factorial experiment. The following traits were measured: plant height (cm), leaf area (cm^2), leaf area index, test weight ($kg.hL^{-1}$), protein percentage, protein yield, oil percentage and oil yield. The study indicate that Dijlah variety was significantly superior in plant height (193.8 cm) and leaf area (5908.5 cm^2) and leaf area index (3.15), while the Al-Forat was significantly superior in the characteristics of test weight (73.15 $kg.hL^{-1}$), protein percentage (11.69%), protein yield (14.76), oil percentage (4.28%) and oil yield (5.41). It is noted from the results of spraying treatments with nano-microelements that a significant superiority was recorded for the treatment of soil spraying with a concentration of 2.25 g for the characteristics of plant height, leaf area and its index, protein percentage and its yield, and values (202.40 cm, 6483.6 cm^2, 3.46, 12.31% and 16.29 g) were recorded, respectively, while All treatments of spraying with nano scale microelements, whether on plants or soil, were superior compared to the comparison treatment in the characteristics of test weight, oil percentage, and oil yield. As for a factor season, a significant superiority is observed for the autumn in the characteristics of plant height (215.27 cm), leaf area (6181.3 cm^2), its index (3.29), protein yields (5.09), and oil (5.72), While significant superiority is noted for the spring season test weight and protein percentage with an average of (74.93 $kg.hL^{-1}$ and 11.96%), respectively. Most of the three interactions recorded significant differences for all studied traits, especially those of which nano fertilization is a part of it.

Keywords: Corn, micro-nanoelements, seasons.

Introduction

Corn (*Zea mays* L) occupies the third place in production after wheat and rice crops, as it is distinguished from other grain crops by its high content of carbohydrates (81%), protein (10.6%), oils (4.6%) and vitamins B1, B2, B3 (6). The cultivated area for the agricultural season (2018-2019) in the world amounted to 191.26 million hectares, and the production rate per hectare was 5.87 tons (21), and the global production rate reached 1122.17 million tons while in Iraq production and space are still limited, as the cultivated area reached 515,160 dunums, with a total production of about 473064 tons (14). Varieties differ from each other, and the reason for these differences is due to the variation in the genetic makeup of the cultivars. Environmental factors or the interaction between them (genetic structure + environmental factors) play an important role in showing these differences in most of the characteristics of growth and quality (9). (3) mentioned in their study to find out the effect of two varieties of corn (Bahooth 106 and Sarah), the superiority of the variety Bahooth

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106 in the characteristic of the test weight over the cultivar Sarah, and recorded a significant average of 79.63 and 79.22 kg. hL^{-1} for the sites of Mosul and Kalak, respectively. (20) when studied five genotypes of maize found significant differences between those genotypes in terms of percentage and protein yield, where the genotype was Dekalb-900M and gave the highest significant value in protein percentage of 12% and protein yield of 0.763 tons. (15) when studying several varieties of corn, namely (Al-Rabee, Al-Safa and Al-Nour), showed that there were significant variance among the varieties of corn, as the (Al-Nour) variety recorded the highest significant value for the percentage of oil and its yield, as the percentage of oil reached 4.43 % and the oil yield reached 0.26. $ton.ha^{-1}$. (12) concluded when studying three varieties of corn (Al-Maha, Sarah and Baghdad3) that Al-Maha recorded the highest average of the leaf area index characteristic of 3.60, while the Baghdad3 recorded the lowest value of 2.47. (19) who studies two varieties of corn crop (403SC and 53BAN) noted that 53BAN recorded the highest leaf area and plant height. (4) mentioned differences between the taxa he studiedSome research indicated the ability of using micro-nano fertilizers in fertilization as an alternative or supplement to conventional fertilizers that achieve many goals and advantages due to their use in small quantities and their high stability to variance conditions, which leads to its storage for long periods, and thus shows its importance because it is of a very small size, as it does not need large areas to store it, and it can also be used as a spray on the vegetative system, so the plant benefits from it directly and is absorbed by the plant rapidly, that is, it is quickly absorbed, which allows it to be used any times, depending on the needs of the plant. Nano fertilizers are environmentally friendly, as they are sprayed in small quantities on the leaves and soil (10). (16) observed in their study that spraying iron oxide nano particles with concentrations (0, 1, 2, 4, 6) gm. L^{-1} for maize plants, this led to the emergence of significant differences in the characteristics of plant height and leaf area compared to spraying with water. (17) studied the effect of foliar spraying with zinc (0, 0.5, 0.75, 1%) on the growth and yield of maize, the researchers noted that the spray treatment with a concentration of 1.0% recorded the highest plant height (174.99 cm) and test weight (284.19 gm. $pound^{-1}$). Regarding the influence of the growing seasons (spring and autumn), it is possible to record the differences of environmental factors according to the growing season, as this affects the growth and quality characteristics of the corn crop more, especially in the autumn season when the plant tends to increase the yield (grains) in contrast to the while spring season which vegetative growth increases at the expense of grain yield. (13) observed in an experiment conducted in Dohuk Governorate for the spring and autumn season and two kinds of yellow corn (Nawroz and Sangria), where the autumn season was superior to the spring pick in plant height as well as leaf area. (7) mentioned when studying three varieties of corn (Baghdad 3, Fajr 1, and Al-Maha), there are significant differences among the three varieties in terms of protein percentage and protein yield, where the variety (Fajr 1) gave the highest value for these two traits, amounting to 9.64% and 403 kg. ha^{-1} for spring season while 10.68%, and 595 kg. ha^{-1} for the autumn season. While (Baghdad 3) gave the lowest value for these two traits, amounting to 8.70%, 8.99%, and 225 kg. ha^{-1} and 316 kg. ha^{-1} and for both the spring and autumn respectively. (18) noted in his study to know the effect of seasons on two varieties of corn (local and imported), where the study showed the superiority of the local and imported variety in the autumn over the local variety of the spring in terms of plant height. (5) in his study of two varieties of corn (Masra and Rabi) indicated that the Rabi excelled in the test weight characteristic, as it recorded the highest significant value of 74.1 $kg.ha^{-1}$ for the spring harvest and 71.6 kg. hL^{-1} for the autumn harvest, while Massarah recorded the least significant value in the test weight of 71.7 kg. hL^{-1} spring season and 73.2 kg. HL^{-1} for the autumn. The study aims to find the best varieties in response to nano-fertilizers

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microelements, and the extent of the effect of these fertilizers on improving some growth and quality characteristics of the corn crop, especially in the regions of southern Mosul, which is considered one of the modern processes in that region.

Materials and Methods

The research was Carried out during the year 2022 (spring and autumn) in the village of Tulul Nasir / Al-Shura district which is 50 km south of Mosul. The study included ten factorial treatments resulting from the combination of two verities of maize crop (Dijlah and Al-Forat) and five treatments of spraying with micro-nano elements (Fe 9%, Zn 1% and Mn 1%). Zero (water spraying), spraying the plant concentration of 2 and 4 gm. L^{-1} and spraying the soil with a concentration of 2.25 and 5.25 g. L^{-1} until complete wetness at flowering stage. According to the factors of the study, the research was carried out using split plot according to the randomized complete block design (R.C.B.D) with three replications as a factorial experiment as reported by (8). The study land was plowed in the two orthogonal plows and the soil form. The seeds were sown manually in the spring and autumn on 15/4/2022 and 15/7/2022. The dimensions of the experimental unit were 2.5 *3 m with an area of 7.5 m^2. The experimental unit contained four furrows, and there were 10 plants in one furrow, 25 cm between one hole and another, and 75 cm between one furrow. Leaved 1 m between the experimental units. Nitrogen fertilizer urea (45-46N%) at a rate of 120 $kg.h^{-1}$ was added to all experimental units in two batches. (T.S.P) fertilizer 46% (P_2O_5) was added at a rate of 100 $kg.h^{-1}$ when preparing the study land. The field was watered when the plant needed it. Harvesting was carried out manually after the plant matured in the two study seasons on 1/8/2022 and 1/11/2022, the spring and the autumn, respectively. Table (1) shows the results of the analysis of the chemical and physical properties of the soil.

Table (1): Physical and chemical properties of the soil of the two experimental sites

Measurement type	Measurements	Measuring unit
Soil reactivity	8.4	---
electrical conductivity	0.30	Desi Siemens.cm^{-1}
organic matter	28.07	$g.kg^{-1}$
available nitrogen	0.039	$g.kg^{-1}$
available phosphorous	6.196	$mg.kg^{-1}$
available Potassium	6.00	mg.kg-1
Soil composition percentage		
Clay	189.5	$g.kg^{-1}$
Silt	325.0	$g.kg^{-1}$
Sand	485.5	$g.kg^{-1}$
Texture	Mixed	----------
(In the central laboratory of the College of Agriculture and Forestry / University of Mosul).		

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Growth and quality characteristics were studied at different stages of plant life and for ten random plants from the two furrows for each experimental unit, namely: Plant height (cm). Leaf area ($cm^2.plant^{-1}$): of all leaves of the plant was calculated according to the method mentioned by (11) by measuring the length and width of the leaf and multiplying it by 0.75. Leaf area index. Test weight ($kg.hL^{-1}$). Percentage of protein in seeds. Protein yield. Percentage of oil in the seeds The percentage of oil in the seeds was calculated and estimated by the saxolite device in the presence of Petroleum ether according to (1). Oil yield in seeds The data were analyzed statistically according to the system of factorial experiments with (R.C.B.D) using the computer and the SAS v9. program, and the Duncan multiple range test was used to compare the means of the coefficients as reported by (8).

Results and Discussion:

It is noted from table (2) that Dijlah variety was significantly superior in the characteristics of (plant height, leaf area, and leaf area index) and recorded values of (193.8 cm, 5908.5 cm^2 and 3.15), respectively, compared with Al-Forat variety which recorded the lowest significant average of (192.6 cm, 5818.7 cm^2 and 3.09), respectively this result can be attributed to the fact that Dijlah is more responsive to the available growth requirements and makes better use of them by accelerating vegetative growth, including increasing plant height, leaf area and leaf area index. This result was consistent with (4), (12) and (19). While the Al-Forat was significantly superior in the characteristics of test weight, protein percentage, its yield, and oil percentage and it is yield, reaching (73.15 $kg.hL^{-1}$, 11.69%, 14.76, 4.28% and 5.41), respectively compared with Dijlah which recorded the least significant value of 72.37 kg. hL^{-1}, 11.19%, 13.85%, 3.94% and 4.88) this may be due to the lack of superiority of this variety in vegetative traits, and therefore its superiority in qualitative traits, as it is difficult to obtain superiority in vegetative traits and quality at the same time, and this result is consistent with the results of (3) and (20).

As for the spraying treatments with nano-micro elements, it is noted that there are significant differences between the spraying treatments and for all the studied characteristics, as the soil spraying treatment with a concentration of 2.25 $gm.L^{-1}$ was significantly superior and recorded a value of (202.40 cm, 6483.6 cm^2, 3.46, 12.31%, and 16.29 gm) for the characteristics of plant height, leaf area and leaf area index and the percentage of protein and its yield, respectively, comparison treatment reached the lowest significant average for the above characteristics, reaching (178.61 cm, 4698.2 cm^2, 2.49, 10.20% and 10.95), respectively. Providing nutrients in good quantities to plants, and in turn, led to an increase in some characteristics of vegetative growth, and in turn was reflected in some specific characteristics, including the percentage of protein and its yield. This result was consistent with the findings of (16) and (17). As for spraying treatments with micro- nano particles For the characteristics of test weight, percentage of oil and its yield, the treatment of plant spraying with concentrations of 2 and 4 gm and soil spraying with concentrations of 2.25 and 5.25 $gm.L^{-1}$ was significantly superior to the comparison treatment, which recorded the lowest significant mean for all the traits. studied, where the test weight was 71.43 $kg.hL^{-1}$, percentage of oil was 3.55%, and the oil yield was 3.92. This may be due to the effect of the micro-nano elements on many vital and physiological processes within the plant for its development and growth, as well as photosynthesis, formation of chlorophyll, development of root cells in the plant, respiration, and water absorption and nutrients, as well as resistance to plant diseases, and microelements also enter into the synthesis of enzymes that participate in metabolic processes within the plant, or enter as assistant factors in nitrogen fixation and in the metabolism process. Findings with (2), (17) and (22). As for the seasons, the results of the averages in Table (2) indicate a significant

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superiority of the autumn in the characteristics of plant height, leaf area and its index, protein and oil yield. The least significant mean was (215.27 cm, 6181.3 cm^2, 3.29, 15.09 and 5.72) respectively, Compared to the spring season which recorded the lowest significant average, reaching (171.27 cm, 5545.9 cm^2, 2.95, 13.52 and 4.57), respectively. The reason may be due to the increase in plant height and leaf area and its index for this season reflected positively on most of the qualitative traits, and thus led to the improvement of these traits in a distinctive way. Results of the research agree with (7), (13) and (18) who found similar results. It is evident from the seasonal averages for the two characteristics of test weight and protein percentage. It is recorded that the spring had a significant superiority and recorded an average of 74.93 $kg.hL^{-1}$ and 11.96% compared to the autumn which recorded the lowest significant mean of (70.59 $kg.hL^{-1}$ and 10.92%) for both traits. The arrangement may be due to the high temperatures during the flowering period for this season and thus the decrease in the number of grains, this led to an increase in the test weight of these grains and was accompanied by an increase in the proportion of protein for this season. This result is line with the result of (5). While the seasons did not record significant differences in the percentage of oil, as the autumn recorded the highest average of 4.15% compared to the spring which recorded the lowest value of 4.06%.

Table (2): Effect of varieties, spraying treatments with Nano particles, and seasons on the studied traits.

	studied traits							
Varieties	plant height (cm)	Leaf area (cm^2)	Leaf area index	Test weight ($kg.hL^{-1}$)	Percentage of protein	protein yield	Percentage of oil	oil yield
Dijlah	193.89 a	5908.5 a	3.15a	72.37 b	11.19 b	13.85 b	3.94 b	4.88 b
Al-Forat	192.65 b	5818.7 b	3.09 b	73.15 a	11.69 a	14.76 a	4.28 a	5.41 a
Varieties rate	193.27	5863.6	3.12	72.76	11.44	14.30	4.11	5.14
Zero	178.61 e	4698.2 d	2.49 d	71.43 c	10.20 d	10.95 d	3.55 b	3.92 b
2	192.87 d	5918.1 c	3.15 c	73.89 a	11.24 c	13.88 c	4.35 a	5.52 a
4	195.25 c	6288.2 b	3.35 b	72.57 b	11.66 b c	15.09 b	4.15 a	5.40 a
2.25	202.40 a	6483.6 a	3.46 a	73.06 a b	12.31 a	16.29 a	4.28 a	5.52 a
5.25	197.20 b	5929.6 c	3.15 c	72.85 a b	11.79 b	15.32 b	4.21a	5.36 a
Rate of spraying treatments	193.26	5863.6	3.12	72.56	11.44	14.30	4.10	5.14
spring	171.27 b	5545.9 b	2.95 b	74.93 a	11.96 a	13.52 b	4.06 a	4,57 b
Autumn	215.27 a	6181.3 a	3.29 a	70.59 b	10.92 b	15.09 a	4.15 a	5.72 a
seasons rate	193.27	5863.6	3.12	72.76	11.44	14.30	4.10	5.14

Table (3) shows the triple overlap among the varieties, spraying treatments with nano-fertilizer, and seasons for the two characteristics of plant height (cm) and leaf

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area (cm^2). A significant superiority is observed for the overlap of the two varieties of corn, Al-Forat and Dijlah in the autumn when the soil was sprayed with a concentration of 2.25 gm. a value of plant height was recorded as 226.36 cm and 226.33 cm^2, respectively while the interaction between Al-Forat, the comparison treatment and spring recorded the lowest significant mean of 150.46 cm. While the triple interaction among the study factors for the leaf area characteristic in table (3) recorded a significant superiority between Al-Forat and soil spraying with a concentration of 2.25 gm, which did not differ significantly from spraying the plant with a concentration of 4 gm in the autumn. The overlapping of the spring season of the cultivar Dijlah and the same level of spraying also showed the same behavior with moral superiority. While the interaction of Al-Forat for the comparison treatment in the spring recorded the lowest average of 3940.0 cm^2.

Table (4), shows the interactions among the varieties. Spraying treatments with nano-microelements and seasons for leaf area index characterization showed that there was a significant superiority of the autumnal overlapping, Al-Forat, and the treatment of spraying plants with a concentration of 4 g, which did not differ significantly from spraying soil with a concentration of 2.25 g. Also, an overlap was recorded the spring of the variety Dijlah when spraying its plants with a concentration of 4 g of nano-microelements, the averages were (3.90 and 3.84) respectively, while the overlap of the spring of the variety Al-Forat and spring season recorded the lowest mean of 2.10. As for the triple overlap in table (4) the return of the test weight characteristic of the study factors, which are the varieties, spray treatments with micro-nano-elements and seasons, it is noted that the spring overlap of Al-Forat and the treatment of spraying plants with a concentration of 2 g recorded the highest significant value of 77.50 $kg.hL^{-1}$, which in turn did not differ significantly For the same interaction, but when spraying the soil with both concentrations of the nano-microelements while the interaction among the autumn and the two varieties Dijlah and Al-Forat and the comparison treatment recorded the lowest average of 69.26 and 69.30 $kg.hL^{-1}$.

Table (3): The effect of the triple overlap of factors for the two characteristics of plant height and leaf area.

Plant height (cm)						
Seasons	varieties	zero	2	4	2.25	5.25
spring	Dijlah	154.13 k	178,50 h	183.73 g	184.06 g	178.26 h
	AL-Forat	150.46 l	166.26 j	164,80 j	172.83 i	179.63 h
Autumn	Dijlah	198,20 f	211.26 e	211.16 e	226,33 a	213.23 e
	AL-Forat	211.66 e	215.46 d	221.33 b	226,36 a	217.66 c
Leaf area (cm2).						
Seasons	varieties	zero	2	4	2.25	5.25
Spring	Dijlah	4305.0 g	5856.7 e	7208.7 a	6562.3 b	5778.0 e
	AL-Forat	3940.0 h	5812.7 e	4265.7 g	5821.3 e	5908.7 d e
Autumn	Dijlah	5276.3 f	5828.2 e	6368.5 b c	6237.9 c	5663.4 e
	AL-Forat	5271.7 f	6175.2 cd	7310.1 a	7313.1 a	6368.6 b c

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Table (4): The effect of the triple overlap of factors for the two characteristics of leaf area index and test weight ($kg.hL^{-1}$).

Leaf area index						
Seasons	varieties	Zero	2	4	2.25	5.25
spring	Dijlah	2,29 f	3.12 d	3.84 a	3.50 b	3.08 d
	Al-Forat	2.10 g	3.10 d	2.27 f	3.10 d	3.15 d
autumn	Dijlah	2.83 e	3.10 d	3.40 b c	3.33 c	3,00 d
	Al-Forat	2.73 e	3.30 c	3.90 a	3.90 a	3.40 b c
Test weight ($kg.hL^{-1}$).						
Seasons	varieties	Zero	2	4	2.25	5.25
spring	Dijlah	72.66 c d	75.10 b	74.30 b c	74.03 b c	74.56 b c
	Al-Forat	74,50 b c	77,50 a	75.03 b	75.66 a b	75.96 a b
Autumn	Dijlah	69.26 e	71.43 d e	70.46 d e	71.40 d e	70.53 d e
	Al-Forat	69.30 e	71.53 d e	70.50 d e	71.16 d e	70.36 d e

Table (5) refers to the triple overlap of the two varieties, spraying treatments with micro-nano elements, and seasons for the percentage of protein. It is noted that the highest average of overlap between the spring season of the Forat cultivar was recorded when its soil was sprayed with a concentration of 2.25 g and reached 12.96%, while the overlap was recorded between the cultivar Dijlah in the autumn and the comparison treatment had the lowest significant mean of 9.30%. As for the triple overlap in Table (5) between varieties, seasons, and spraying treatments with micro-nano elements for protein yield, it is clear that a significant value was recorded for the overlap of the Al-Forat in the autumn and the treatment of soil spraying with micro-nano elements at a conc. of 2.25 g, which amounted to 18.86, while the least significant average of the overlap between the two varieties, Dijlah and Al-Forat, and the comparison treatment in the autumn amounted to 9,60.

Table (6) shows the results of the triple overlap between the study factors for the percentage of oil, where the highest average was recorded for the Al-Forat when its plants were treated with a concentration of 4 g in the autumn, it recorded the highest significant value of 4.63%, while the overlap of Dijlah was recorded in the comparison treatment in the season lowest average of the protein percentage reached 3.33% in spring. As for the characteristic of the oil yield, table (6) shows the triple interaction among the two kinds and the spraying treatments with micro-nano elements and the seasons. The highest significant value was recorded at 6.96, while

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the overlap of Dijlah with the comparison treatment in the autumn recorded the lowest average at 3.56

Table (5): The effect of the triple overlap of factors for the two characteristics, protein percentage and protein yield.

The percentage of protein						
Seasons	varieties	Zero	2	4	2.25	5.25
spring	Dijlah	10.70 f-h	11.83 b-e	11.56 b-f	11.96 a-e	11.60 b-f
	Al-Forat	11.40 d-g	12.46 a-d	12.53 a-c	12.96 a	12.63 a b
autumn	Dijlah	9.30 j	10.30 h i	11.16 e-h	12.13 a –e	11.40 d-g
	Al-Forat	9.43 i j	10.36 g-i	11.40 d-g	11.40 a – e	11.53 c –f
protein yield						
Seasons	varieties	Zero	2	4	2.25	5.25
spring	Dijlah	12.26 i	12.94 f-i	13.21 e-i	14.02 d –h	12.68 g –i
	Al-Forat	12.34 h i	14.02 d- h	14.54 d-f	14.50 d-f	14.73 d e
autumn	Dijlah	9.60 j	14.10 d-g	15.36 c d	17,80 a b	16.53 b c
	Al-Forat	9.60 j	14.46 d-f	17.26 a b	18.86 a	17.33 a b

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Table (6): The effect of the triple overlap factors for the two characteristics of oil percentage and oil yield.

The percentage of oil						
Seasons	varieties	Zero	2	4	2.25	5.25
spring	Dijlah	3.33 g	4.03 b-e	3.76 c-g	4.00 b-e	3.96 b-f
	Al-Forat	3.76 c-g	4.36 a b	4,50 a b	4,43 a b	4.46 a b
autumn	Dijlah	3.46 f g	4,40 a b	3.70 d-g	4,50 a b	4.23 a-c
	Al-Forat	3.63 e-g	4.60 a	4,63 a	4.20 a-d	4.20 a-d
oil yield						
Seasons	varieties	Zero	2	4	2.25	5.25
spring	Dijlah	4.06 f-h	4.60 c-f	4.30 e-g	4.13 f-h	4.30 e-g
	Al-Forat	4.40 d - f	5.03 c- e	5.23 c	4.90 c-e	4.73 c-f
autumn	Dijlah	3.56 h	6.03 b	5.10 c d	6,60 a b	6.13 b
	Al-Forat	3.66 g h	6.43 a b	6.96 a	6.46 a b	6.30 a b

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