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Effect of nano-foliar spraying with G-power Ca organic fertilizer and spraying stages on some yield and seed quality characteristics of corn (*Zea mays* L.)

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Abstract

A field experiment was conducted in the spring of 2022 in one of the trial fields connected to Ibn Al-Bitar Vocational Preparatory School. This field was north of Karbala Governorate. We wanted to find out what happened to maize yield and seed quality when different amounts of G-power Ca were sprayed at different times. Randomized Complete Block Design (RCBD) was used with three replications and two factors. The first factor includes different concentrations of the nano fertilizer G-power Ca (0,2,4,6) ml L-1 L-1 for all. The second set of factors includes three different times for foliar spraying: 20 days after planting, 40 days after planting, and 60 days after planting. It was found that the foliar spray treatment with G-Power Calcium at a concentration of (6 ml L-1) was much better at increasing the number of rows per ear (row ear-1) and the number of grains in a row (grain row-1). It was also much better at increasing the weight of 500 grains (g), the concentration of nitrogen in the grains (%), and the percentage of protein in the grains (%). It also gave them the highest averages for all of these traits.

Keywords: Nano fertilizer, G-power Ca organic fertilizer, corn

Introduction

Corn belongs to the Poaceae family and is considered one of the important crops belonging to this family. Maize grains are considered an essential source of protein, sugar, oil, starch, and flour and are mainly used as forage for animals as they are included in the composition of poultry and livestock provender, Its stems are a source of biofuel [1]. The average production per unit area is still low in Iraq, as the cultivated area for the year 2016 amounted to a total of 76 thousand hectares, with an average production of 3.42-ton ha^{1} [2], and this is very little compared to the average yield of agriculturally developed countries. Due to the importance of this crop worldwide in general and Iraq in particular, it is necessary to study and search for all possible means

to increase the yield by conducting some operations and field practices that will increase the yield and improve the quality characteristics of seeds by increasing their content of various elements and materials such as protein and oil and foliar nutrition is considered one of the important processes in improving plant growth by supplying it with various added materials and nutrients necessary for growth and vital processes, which play a major role in determining the nature of growth and the amount of the final yield of the plant and foliar nutrition is also considered one of the effective and beneficial methods for plant growth, especially when the roots are insufficiently able to absorb the elements and substances important for plant growth, which affects the biological, manufacturing and physiological processes within the plant [3]. Different nano-fertilizers are used for this because they are new technologies and can be used in many ways, such as adding them to the soil to improve its properties and essential components or putting them on plants to help them grow faster and produce more. This is possible because nano-fertilizers have special properties and behaviors, such as small particles and a large surface area that allows them to easily penetrate, dissolve, and settle inside th One important nanofertilizer used in nutrition plants is G-power Ca, an organic one. It has been shown to be very good at improving production, quantity, and quality through foliar nutrition [9].The date of spraying fertilizers and nutrients is also an important factor in achieving the maximum possible benefit for the plant, as the plant passes through different stages of growth, and at each stage, the growth requirements and the plant's ability to absorb and metabolize differ [4]. Therefore, this study was proposed in order to find out:Knowing the effect of different concentrationsfor foliar spraying from G-power Ca nano fertilizer.Determining the best date for foliar spraying, which achieves the maximum effect on the yield characteristics of maize.

Knowing the effect of the interaction between foliar spraying and spraying dates on some yield and seed quality characteristics of Maize

Materials and Methods

A field experiment was carried out in one of the fields of Ibn Al-Bitar Vocational Preparatory School located in Al-Hussainiya District - north of Karbala Governorate in March 2022 AD. The soil was prepared for cultivation and the field was divided into experimental units with dimensions of (3 m x 4 m), the planting process was carried out in the first half of March, and fertilizers were added according to the fertilizer recommendations recommended by [5]. The experiment included two factors.The first included different concentrations of foliar spraying with the nano-organic fertilizer G-power Ca, the factor was prepared according to the required concentrations (0, 2, 4, 6) ml L^{-1}. The following symbols symbolize treatments:-

A1 = control treatment A2= (2) ml L^{-1} A3 = (4) ml L^{-1} A4= (6) ml L^{-1}

As for the second factor, it included three different dates for foliar spraying, which is spraying after (20 of planting, 40 after planting, and 60 after planting), and the following symbols symbolize the treatments:-

N1= Spraying 20 days after planting N2= Spraying 40 days after planting N3 = spraying 60 days after planting

Characteristics studied

1- The number of rows in the ear (row ear^{-1}):

The number of ear rows was manually counted of five ears after harvest and their average was calculated.

2- Number of grains per row (grain row^{-1}):

The number of grains in the row was counted manually after harvesting five ears, their average was calculated.

3- Weight of 500 grains (g):

After sorting the ears grains, their counted 500 grains manually and weighed them using a sensitive scale. Their average was calculated.

4- Percentage of oil in grains (%):

The percentage of oil in the grains was estimated according to the extraction method referred to [6]. According to the following equation:

Oil percentage = (weight of flask after extraction - weight before extraction / weight of sample) x 100

5- Nitrogen concentration in grains (%):

The nitrogen concentration in the digested plant samples was calculated using a Microkjeldahl device according to what was stated in [7].

6- Protein percentage in grains (%):

Protein content was estimated according to the following equation:-

Protein percentage = Nitrogen percentage x 6.25 [8].

Results and Discussion

Average number of rows (row ear^{-1})

The results in Table (1) showed that there were significant differences between the concentrations of nanofoliar sprays. Treatment A4 had the highest average for the number of rows, at 16.11 (row ear^{-1}), while treatment A1 had the lowest average, at 13.78 (row ear^{-1}). This could be because the concentrations of nano-foliar fertilization have a big impact on controlling the acting According to the same table, the times that were sprayed had significanton the number of rows in the ear, as treatment N3 had the best average of 15.58 (row ear^{-1}). It's possible that this difference is because of the right time to apply foliar fertilizers, which gave the plants most of the nutrients they needed at different stages of growth. This increased leaf area led to more dry matter building up and better growth. As a result, more pollen and eggs are laid, which leads to more rows in the ear [9]. The table makes it clear that there isn't a big difference between the methods when it comes to contact.

Table (1): The effect of nano foliar spraying and spraying date on the average number of rows in the ear (row ear^{-1})

Combinations	Spraying dates			Average foliar spray
	N1	N2	N3	
A1	13.00	13.33	15.00	**13.78**
A2	14.00	14.33	13.33	**13.89**
A3	14.67	15.33	16.67	**15.56**
A4	15.00	16.00	17.33	**16.11**
Average spraying dates	14.17	14.75	15.58	
L.S.D $_{0.05}$	Foliar spraying	Spraying dates	interaction(spray×dates)	
	1.14	0.98	N.S	

Average number of grains in the row (grain row^{-1})

There were significant between the nanofoliar spray concentrations shown in Table 2. Treatment A4 had the most grains in a row, with an average of 25.33 (grain row-1); treatment A1 had the lower grains, with an average of 23.33 (grain row-1). This might be because the added fertilizers made photosynthesis more efficient, which led to more leaf area. And the same table makes it clear that treatment N3 was better because it gave the best average of 25.33 (grains row-1). This superiority may be due to the fact that the appropriate time for spraying nano nutrients has an apparent physiological effect, as adding nutrients when the plant is at its most active is reflected positively through the activity of various biological reactions, directly or indirectly, As well as the activity of the enzymes responsible for the metabolic reactions carried out by the plant, which provides better stimulation for the growth and development of the ear and the availability of an optimal food supply on the one hand, and the role of this nutrient in raising the efficiency of the carbon metabolism process on the other hand, which encouraged better growth, which was clearly reflected in an increase in the number of grains in the ear. There aren't any big changes in the exchange [10].

Table (2): Effect of nano foliar spraying and spraying dates on the average number of grains per row (grain row^{-1})

Combinations	Spraying dates			Average foliar spray
	N1	N2	N3	
A1	22.67	23.33	23.67	23.33
A2	23.33	23.00	25.33	23.89
A3	23.67	25.00	25.67	24.78
A4	24.67	24.33	27.00	25.33
Average spraying dates	23.58	23.92	25.33	

L.S.D 0.05	Foliar spraying	Spraying dates	interaction(spray×dates)
	1.29	1.11	N.S

Average weight of 500 grains (g)

The results of Table (3) showed that there were significant differences between the concentrations of nanofoliar sprays, treatment A4 gave the highest average for the weight characteristic of 500 grains, amounting to 143.56 (g), while treatment A1 gave the lowest average, amounting to 138.67 (g). The reason for the increase may be attributed to the positive effect of the added elements that participate in the synthesis of many materials, such as proteins, carbohydrates, enzymes, hormones, and chlorophyll, which caused an increase in the accumulation of dry matter during the grain-filling stage, as well as an increase in the efficiency of transferring carbohydrates and proteins from the leaves (source) to the grains (downstream). The reason for the increase in grain weight is that grains are the last downstream of the products of the carbon assimilation process [11]. It is clear from the same table that the dates of foliar spraying with nanofertilizer significantly affected the weight characteristic of 500, as the N3 date was superior in giving the highest average amounting to 141.92 g, This superiority may be attributed to the fact that balanced nutrition is one of the important elements that give a heavier and fuller grain, especially when nutrients are sprayed in the critical stages of the plant's life (the period of grain formation and filling), given that leaf fertilizer contains many important compounds, including amino acids and organic materials, in addition to calcium and nitrogen, these materials are absorbed as a result of being sprayed on the leaves, so their concentration increases, growth improves, and the yield increases, and this is reflected in the rest of the characteristics associated with the yield, including increased grain weight [12]. As for the interaction, there are no significant differences.

Table (3): Effect of nanofoliar spraying and spraying dates on the average weight of 500 seeds (g).

Combinations	Spraying dates			Average foliar spray
	N1	N2	N3	
A1	135.33	142.33	138.33	138.67
A2	139.33	139.67	142.67	140.56
A3	140.00	139.33	140.67	140.00
A4	141.00	143.67	146.00	143.56
Average spraying dates	138.92	141.25	141.92	
L.S.D 0.05	Foliar spraying	Spraying dates	interaction(spray×dates)	
	2.64	2.29	N.S	

Percentage of oil in grains (%)

The results of Table (4) showed that there were significant differences between the concentrations of nanofoliar sprays, treatment A4 gave the highest average for the oil percentage characteristic in grains, amounting to 4.460 (%), while treatment A1 gave the lowest average, amounting to 3.706 (%).The reason for the superiority may be due to the composition and role of nano-foliar fertilization and its containment of various elements and materials, as these elements are considered the main component of plant tissue units, increasing the levels of adding these elements has supported the construction of tissues in the plant, which has a positive impact on improving growth by doubling the plant's ability to retain nutrients. It also accelerates their movement in the plant due to its ability to introduce nutrients faster and easier into the plant cell membranes and helps in better absorption of amino acids, as well as firming of fruits and improving quality because it contains amino acids that help with ripening and which are involved in the synthesis of enzymes and growth regulators in plants [13]. From the same table, it is clear that the nano-foliar spraying dates have a significant effect on the oil percentage, as it was found that the N3 spraying date gave the highest average, amounting to 4.380%. The reason for this superiority may be attributed to the fact that the N3 spraying time was more appropriate to respond to foliar fertilization, which plays an important role in improving and stimulating plant growth, and this is reflected in improving the qualitative characteristics and seed content of various materials by supplying the plant with the necessary elements for its growth [14]. As for the interaction, there are no significant differences between the treatments.

Table (4): Effect of nano foliar spraying and spraying dates on the percentage of oil in grains (%)

Combinations	Spraying dates			Average foliar spray
	N1	N2	N3	
A1	3.340	3.813	3.963	3.706
A2	3.443	3.420	4.467	3.777
A3	3.843	4.470	4.420	4.244
A4	4.243	4.467	4. 670	4.460
Average spraying dates	3.718	4.043	4.380	
L.S.D $_{0.05}$	Foliar spraying	Spraying dates	interaction(spray×dates)	
	0.274	0.237	N.S	

Nitrogen concentration in grains (%)

The results of Table (5) showed that there were significant differences between the concentrations of nanofoliar sprays, treatment A4 gave the highest average for the nitrogen concentration in grains, amounting to 1.541 (%), while treatment A1 gave the lowest average, amounting to 1.361 (%).The reason may be attributed to the G-power Calcium foliar spray fertilizer containing many important compounds, including amino

acids and calcium, in addition to a percentage of nitrogen, as these substances are absorbed as a result of the addition by the leaves, and thus their concentration increases within the leaves and grains, and this is consistent with which He pointed out the role of nano nitrogen in increasing the plant's nitrogen [12] content. From the same table, it is clear that the dates of foliar spraying significantly affected the nitrogen concentration in the grains, as the N3 treatment gave the highest average of 1.663%, the reason was estimated to be that the plant at this date had absorbed the maximum possible amount of nitrogen, which is considered one of the basic components involved in the formulation of the G-power Calcium fertilizer. As for the interaction, it is clear from the table that there is no significant interaction between the treatments.

Table (5): Effect of nano foliar spraying and spraying dates on nitrogen concentration in grains (%)

Combinations	Spraying dates			Average Average foliar spray
	N1	N2	N3	
A1	1.297	1.331	1.457	1.361
A2	1.360	1.397	1.514	1.423
A3	1.404	1.427	1.610	1.480
A4	1.437	1.523	1.664	1.541
Average Average spraying dates	1.374	1.419	1.663	
L.S.D 0.05	Foliar spraying	Spraying dates	interaction(spray×dates)	
	0.075	0.065	N.S	

Protein percentage in grains (%)

It is clear from (Table 6) that there are significant differences between the concentrations of nanofoliar sprays, treatment A4 gave the highest average for the protein percentage in grains, amounting to 9.632 (%), while treatment A1 gave the lowest average, amounting to 8.509 (%).The superiority in the percentage of protein in grains may be attributed to the superiority in the percentage of nitrogen, which was reflected in an increase in the protein concentration as a result of the existence of a correlation and direct relationship between the two characteristics, the reason may be due to the nanofoliar spray fertilizer containing nitrogen, which is involved in the synthesis of chlorophyll, nitrogenous bases, and the manufacture of amino acids, which are the basis for the formation of proteins [10]. The same table also shows that there are significant between the spraying times. the N3 spraying date was later than the others, which is why it had the highest average of 9.756%. The table also shows that there are no big differences between the interactions.

Table (5): Effect of nano foliar spraying and spraying dates on the protein percentage of grains (%)

Combinations	Spraying dates			Average foliar spray
	N1	N2	N3	
A1	8.107	8.317	9.103	8.509
A2	8.500	8.730	9.460	8.897
A3	8.773	8.917	10.063	9.251
A4	8.980	9.520	10.397	9.632
Average spraying dates	8.590	8.871	9.756	
L.S.D 0.05	Foliar spraying	Spraying dates	interaction(spray×dates)	
	0.472	0.197	N.S	

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