Al-Furat Journal of Innovations in Agricultural Sciences (FJIAS)

EFFECT OF DIFFERENT COMBINATIONS OF GROUND FERTILIZATION AND OPTIMUS PLUS NANO-FOLIAR ON SOME YIELD TRAITS AND OIL PERCENTAGE OF YELLOW CORN

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Received (05/09/2025), Received in revised form (15/10/2025)
Accepted (25/10/2025), Available online (31/12/2025)

FJIAS 2025, 1(4): 8-16

Abstract. A study was conducted in the experimental fields of Ibn Al-Bitar preparatory School in the north of Karbala for the spring season, with the aim of knowing the influence of spraying various concentrations of Optimus Plus nano-foliar and combinations of ground fertilization on the yield of the corn plant. The Randomized Complete Block Design (RCBD) was used with three replications, a factorial experiment, and two factors, the first (100% full mineral fertilizer recommendation). A mineral fertilizer recommendation of 50% with an organic recommendation of 50%, a recommendation of a mineral fertilizer of 50% with a recommendation of a micronutrients fertilizer 50%, a recommendation of a mineral fertilizer of 50%, an organic fertilizer of 25% and micronutrients 25%).The second factor included different concentrations of Optimus Plus, which are (0, 3, and 6 ml.L^{-1}). The results showed that Optimus Plus nano-foliar treatment the concentration (3 ml L^{-1}) and the fertilizer combination (recommended mineral fertilizer 50%, organic 25% and microelements 25%)was significantly excelled by recording it the highest averages for the traits of the rows number per cob, the biological yield, the yield of one plant, the percentage of oil and The grains number per row

Keyword: yellow corn ground fertilization, biological yield, Optimus Plus nano-foliar,

1.INTRODUCTION

Yellow corn(*Zea mays* L.) is considered one of the important crops belonging to Poaceae family, where it comes after rice and wheat in terms of economic importance due to its multiple uses [1].The average production per unit area is still low in Iraq, where the cultivated area for the year 2016 amounted to a total of 76000 hectares with 3.42 tons.ha^{-1} average production of [2] compared to the average yield of agriculturally advanced countries. Because of the importance of this crop worldwide in general and in Iraq in particular, it invites us to search seriously for all possible means to increase the yield, as well as many agricultural operations that come in the forefront of fertilization, especially since corn is one of the most responsive field crops to fertilizers [3]. The continuous adding of traditional chemical fertilizers and their excessive use to recover the lack of soil nutrients leads to increasing soil salinization and environmental pollution as well as the high costs of these fertilizers [4]. That is why it is necessary to think about using modern fertilizers as an alternative to traditional fertilizers and using them to provide nutrients for plant growth and increase productivity [5]. These fertilizers are very effective and environmentally friendly, which are called nano-fertilizers. On this basis, we will use nano fertilizer. Nanotechnology is the study of the basic principles of molecules and compounds, the size of which does not exceed 100 nanometers[6]. The use of nano-fertilizer is one of the most widely used and widely used molecules because of its positive effect on enhancing plant growth [7] . This study was applied with the aim of

1- Knowing the best combination of ground fertilization added to the soil to achieve the best growth and yield of corn plants

2- Knowing the best concentration of nano foliar spray fertilization (Optimus plus), which significantly affects the yield and growth of corn plant.

3- Knowing the influence of the interaction between ground fertilization and nano foliar spray on the growth and yield of corn.

Materials and methods

The field experiment was conducted in one of the field of Ibn Al-Bitar preparatory vocational school located in Al-Hussainiya district - Karbala province in March of the year 2020. The experimental land was prepared from tillage, smoothing, and leveling and the land of the experiment was divided into experiment units with dimensions (3 m x 4 m). The experiment unit area was 12 m^2 , each experiment unit included 5 rows with a length of 3 m, a distance between pit and another is 30 cm, and between row and another is 75 .cm, leaving a distance of between the experimental unit and another is 75 cm, and between a sector and another is 2 m, Nitrogenous fertilizers were added according to the fertilizer recommendations in the amount of 320 kg ha^{-1} urea fertilizer (46% N) and phosphate fertilizers at an amount of 200 kg ha^{-1} p DAP fertilizer (48%) (Iraqi Ministry of Agriculture, 2011).Potassium fertilizer was added according to the fertilizer recommendation K160 kg ha^{-1} NPK (5-3-45)[8,9]. The first batch of NPK and DAP fertilizer was added when planting and the first batch of urea fertilizer was added when germination and the second

batch was added from all Fertilizer after 45 days of germination and decomposed organic fertilizer was added when planting 10 tons ha^{-1} [10] and the microelements were added after a month of cultivation according to the manufacturer's recommendations .The combinations for the first factor were (a full mineral fertilizer recommendation 100%, a recommendation of a mineral fertilizer 50% with an organic fertilizer recommendation of 50%, a recommendation of a mineral fertilizer 50% with a recommendation of a micro- nutrients fertilizer 50%, a recommendation of a mineral fertilizer 50%, an organic fertilizer of 25% and microelements 25% It is denoted by the following symbols A1, A2, A3, A4 respectively.The second factor was prepared as a solution of nano-foliar fertilization (Optimas plas) according to the required concentrations (0, 3, 6) ml L^{-1}, the treatments were named as the following symbols
N0 = control treatment N2 = (3) ml.L^{-1}, N3 = (6) ml.L^{-1}
studied traits in the experiment:
1- Rows number per cob (row.cob^{-1}):
The rows number per cob was calculated manually for five cob after harvesting and their average was calculated
2- Number of grain per row (grain. row^{-1}):
The number of grains per row was calculated manually after harvest for five gerans and averaged.
3- Yield per plant (g):
The yield of one plant was calculated using a sensitive scale after the grains reached the appropriate moisture level by calculating the weights of the grains for five plants and taking their average.
4- Biological yield (tons.ha^{-1})
The calculation was made from the average weight of five plants after drying the sample until the weight was stable[11]
5- Oil percentage (%)
The percentage of oil in grain was estimated in the Graduate Studies Laboratory of the Department of Field Crops Sciences at the College of Agriculture, University of Karbala, by taking a sample of (5) g for each treatment, and through which the oil was calculated using Soxhlet and petroleum ether solvent and heating at a temperature of (60-60). 40 C) according to the extraction method referred to by[12] .
Oil percentage = (weight of the beaker after extraction - weight before extraction / weight of the sample) x 100

statistical analysis
The experiment was conducted according to Randomized Complete Block Design (RCBD) and the data were analyzed using the least significant difference (LSD) at the probability level of (0.05)

Results and Discussion

1- Average number of rows (row.cob^{-1})
The results in Table (1) illustrated the significant differences between the ground fertilization treatments, where the treatment A4 recorded the highest average for the number of rows trait amounted to 15.57

(row.cob^{-1}).While treatment A2 gave 13.46 (row.cob^{-1}), an increase of 16.67%.The reason for this increase may be due to the fact that the added fertilizers provided most of the nutrients during the growth stages, especially the major nutrients N-P-K. These elements contribute to increasing the leaf area, which leads to increasing the accumulation of dry matter and improved growth and it works to increase pollination and fertilization, thus increasing rows number per cob[14]. It is evident from the same table that the spraying concentrations had a significant influence on the rows number per cob, where the treatment N2 excelled in giving the highest average of 15.05 (row.cob^{-1}).While treatment N0 (control treatment) gave the lowest average of 13.46 (row.cob^{-1}), with an increase of 9.95%. The reason for the excelled may be due to the fact that the concentrations of nano-foliar fertilization have an important effect in regulating the plant hormones work, which promotes the growth of the reproductive organs and increases the number of flowering plants, thus increasing their fertilization. Which is reflected in the increase in the sites of grain[15] As for the interaction of the data in Table (1), it shows that there is no significant effect between the treatments of ground fertilization and Optimus Plus nano-foliar.

Table (1) Effect of ground and nano fertilization (Optimus Plus) and their interaction on the average number of rows (row.cob^{-1})

ground fertilization treatments	Concentrations of Nano foliar spraying (ml.L^{-1}(			ground fertilization average
	N0	N1	N2	
A1	14.06	14.33	15.40	14.60
A2	13.00	13.06	14.43	13.46
A3	13.33	13.73	14.12	13.71
A4	14.66	15.66	16.40	15.57
spray concentrations average	13.76	14.20	15.05	
L.S.D (0.05(	Nano foliar spraying	ground fertilization		interaction N.S
	0.37	0.43		

2-Average of grains number per row (grain .row^{-1})

Table (2) shows that the presence of significant differences in the ground fertilization treatments, where treatment A4 achieved the highest average for the grains number per row, where it reached 30.44 (grain .row^{-1}), while the A3 treatment achieved the lowest average of 23.33 (grain of row^{-1}), with an increase average of 30.27%.The reason for this may be due to the influence of the added fertilizers in increasing the efficiency of the photosynthesis process, which led to an increase in the leaf area index and provided an appropriate opportunity to reduce the abortion in female flowers as a result of reducing the state of competition among them for the products of photosynthesis during the stages of flower bud growth and development, which increased Their number[15].It is evident from the same table that the spraying concentrations had a significant influence on the number of grains per row, where the N2 treatment was

expelled in recording the highest (28.50 and 25.33) grain .row^{-1}, while the concentration of the nano foliar spray N0 (control treatment) achieved the lowest An average of 25.75 (grain .row^{-1}) with an increase of 10.67%. This the treatment N2 excelled may be due to the fact that the nano-spraying concentration has a nutritional effect as it activates the movement of the transport of mineral and organic elements and regulates their flow to the estuaries as well as contributes to increasing its capacity. The nitrogen element works to regulate the action of hormones and then control the action of auxin in bringing about apical dominance in the ear, as cytokinin works to prevent the transfer of auxin from old to new grains, and then increasing the grains number per row[16]. The results of the interaction in Table (2) illustrated that there was no significant effect on the treatments of adding Optimus plus . nano-foliage fertilization

Table (2) influence of ground fertilization and nano-spraying (Optimus Plus) and their interaction on the average grains number per row (grain .row^{-1})

ground fertilization treatments	Concentrations of Nano foliar spraying (ml.L^{-1}(			ground fertilization average
	N0	N1	N2	
A1	27.33	28.00	28.70	28.00
A2	26.00	27.06	29.43	27.44
A3	21.67	23.67	24.67	23.33
A4	28.00	32.00	31.33	30.44
spray concentrations average	25.75	27.67	28.50	
L.S.D (0.05(	interaction	Nano foliar spraying	ground fertilization	
	N.S	1.67	1.93	

3- The average yield per plant (g).

Table (3) shows that the presence of significant differences in the ground fertilization treatments, where treatment A4 achieved the highest yield per plant, which amounted to 145.1 g, while treatment A3 gave the lowest average vegetation of 131.0 g, with an increase of 10.76%. The reason may be due to the role of the added nutrients in enhancing all growth traits such as leaf area, chlorophyll content, plant height and dry weight, which were positively reflected on the yield components: cob length, grain weight and number of grains per cob.The addition of ground fertilization helped to increase the efficiency of the carbonization process, stimulate closing and opening of stomata, delaying senescence , prolonging the period of filling the grains, and the efficiency of the process of transferring carbohydrates, proteins and oil to the grains, which increased the plant yield and this was reflected in the total yield [17] showed there is a positive correlation between the grains weight, the grains number, and the yield of the plant. It is clear that the

concentrations of the nano foliar spray significantly influenced on the trait of the yield of one plant, where the treatment N2 was excelled in giving the highest average of 141.6 g, while the concentration of treatment N0 (control treatment) recorded the lowest average of 132.3 g with an increase of 7.02%. The reason for the increase in this characteristic is that the absorption of nutrients present in the composition of the Optimus plus nano-foliage fertilizer through the leaves directly and quickly led to an increase in their concentrations in the leaves, which increased their weight by prolonging the period of grain filling, by delaying senescence and increasing the size of the food tissue In the grain (endosperm tissue).Increasing the efficiency in assembling the products of the carbonization process, as well as the effect of these elements in transporting manufactured materials to the places where they are stored in the grains As for the interaction, it is observed from the data in Table (3) that there is no significant influence between the treatments for ground fertilization and foliar spray

Table (3) The influence of ground fertilization and nano-spraying (Optimus Plus) and their interaction on the average yield of one plant (g)

ground fertilization treatments	Concentrations of Nano foliar spraying ($ml.L^{-1}$(			ground fertilization average
	N0	N1	N2	
A1	27.33	137.0	144.3	137.3
A2	26.00	131.3	138.0	132.6
A3	21.67	129.3	136.6	131.0
A4	28.00	144.6	147.6	145.1
spray concentrations average	25.75	135.5	141.6	
L.S.D (0.05(	interaction	Nano foliar spraying	ground fertilization	
	N.S	2.6	3.0	

4- Biological yield (tons.ha^{-1})

Table (4) shows that the presence of significant differences in the ground fertilization treatments, where the A4 treatment achieved the highest average of biological yield, reaching 19.70 (tons.ha^{-1}).Whereas, treatment A3 gave the lowest average of (18.40 tons.ha^{-1}), with an increase of 1.09%. This excelled in biological yield is due to its excelled in leaf area, leaves number, plant height in addition to its excelled in yield of grain and its components, and this is consistent with what he found[18].It is clear that the concentrations of nano spray significantly influence on the treatment N2 as it amounted to 19.77 (tons.ha^{-1}) while the concentration of spray (N0 gave control treatment) the lowest average amounted to (18.44 tons.ha^{-1}) with an increase rate of 6.72%.The excelled of the concentrations of the nano-foliar spray may be due to the increase in the weight of grain, which led to the availability of nutrients in a balanced

manner, which in turn increases the leaf area as well as the increase in photosynthesis that works on the manufacture of proteins and carbohydrates, and thus leads to an increase in the weight of the dry matter in the vegetative growth and the yield of grains, and all this increase increases the biological yield (Jaaz et al., 2018).As for the interaction, it is clear from Table (4) that there is no significant interaction between the treatments of ground fertilization and nano foliar spray.

Table (4) The influence of ground fertilization and nano-spraying (Optimus Plus) and their interaction on the biological yield (tons.ha^{-1})

ground fertilization treatments	Concentrations of Nano foliar spraying (ml.L^{-1}(			ground fertilization average
	N0	N1	N2	
A1	18.57	19.55	20.04	19.39
A2	18.19	19.45	19.99	19.20
A3	18.02	18.48	18.71	18,40
A4	18.98	19.54	20.54	19.70
spray concentrations average	18.44	19.30	19.77	

L.S.D (0.05(	interaction	Nano foliar spraying	ground fertilization
	N.S	0.46	0.53

5- Average grain oil content (%)

The results in Table (5) shows that the presence of significant differences in the ground fertilization treatments, where A4 treatment achieved the highest average of 4.420%, while treatment A3 achieved the lowest average of 3.554%, with an increase of 24.36%.The reason for the excelled in the percentage of oil is due to the elements added from the ground fertilization, and these elements are the main component of the plant tissue units, and the increased levels of adding these elements have led to support the construction of these tissues at the expense of the percentage of oil to grain and that increasing the grains number per plant resulting from the increase in fertilization levels may be a reason for the decrease in the oil percentage because there is a negative relationship between the grains number in the plant and the percentage of oil. From the same table, it is clear that the concentrations of the nano foliar spray had a significant influence on the percentage of oil, where it was found that the spraying concentration N2 achieved the highest average amounting to 4.248%.While the spray concentration N0 gave the lowest average of 3.677%, respectively, with an increase of 15.52%. The reason may be attributed to the excelled of the nano-spray concentration of the N2 treatment of the nano-fertilizer Optimus plus added, because it contains organic materials 30%, amino acids, total nitrogen 5% and organic nitrogen 3%, and that this

fertilizer activates and helps the plant to get rid of stress [19] It increases the photosynthesis process and the ability of the plant to retain nutrients and accelerates its movement in the plant for its ability to introduce nutrients faster and easier into the membranes of the plant cells and helps to better absorb amino acids as well as holding the fruits fixed and improving the quality in terms of size and shape and Color and taste because it contains amino acids that help ripening and enter into the synthesis of enzymes and growth regulators in plants, increases the size of roots and reduces water loss from plants through transpiration [20] As for the interaction of Table (5) between the treatments of ground fertilization and Optimus plus nano foliar spray, it was found that there was no significant effect between the treatments.

Table (5) The effect of ground fertilization and nano-spraying (Optimus Plus) and their interaction on the average grain content of oil (%)

ground fertilization treatments	Concentrations of Nano foliar spraying ($ml.L^{-1}$(			ground fertilization average
	N0	N1	N2	
A1	3.803	3.963	4.380	4.049
A2	3.405	3.513	4.060	3.659
A3	3.300	3.440	3.923	3.554
A4	4.203	4.427	4.630	4.420
spray concentrations average	3.677	3.836	4.248	
L.S.D (0.05(	interaction	Nano foliar spraying		ground fertilization 0.169
	N.S	0.147		

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