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Effect of Mineral, Organic and Bio-Fertilizer on Growth and Yield of Sunflower

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Abstract. *A field experiment was conducted in Al-Mussaib/ Al-Taheria project during the summer of 2020. A factorial experiment carried out by three factors according to the randomized complete block design RCBD to study the effect of mineral, organic and bio-fertilizer on growth and yield of sunflower. The study included two levels of NPK mineral fertilizer (without fertilizer, mineral fertilizer half the fertilizer recommendation) and two levels of organic fertilizer (without organic fertilizer, and Organic fertilizer). Three methods of bio-fertilizerd addation by used as Bio Health (Control without fertilizer, bio-fertilizer of soaking the seeds, and injecting the soil with Bio Health), For the second level seeds were soaked and mixed well with the bio-fertilizer before planting, the third level the plants were injected with Bio Health. Seeds flame cultivar cultured in June 2020. Results of the experiment showed that there were significant differences between the means of the studied traits in the mineral's presence, organic and bio fertilizer process, and mineral fertilizer gave the best mean for all traits except for seed yield The organic fertilization was the significant, as it reached 179.83 cm, 3693.20 cm and 23.62 leaves. plant $^{-1}$, 23.93 cm and 64.74 g for plant height, leaf area, number of leaves, disc diameter and weight of 1000 grains compared to the control treatment, which amounted to 160.33 cm, 2315.20 cm and 18.37 leaves. plant $^{-1,}$ 19.53 cm and 56.88 g ,respectively. The interaction between mineral and organic fertilizer was significant in the means amounted to 190.50, 2.72 cm and 1.47 ton/ha for plant height and seed yield, respectively, and the triple interaction was significant for all plant traits.*

Keywords: *mineral fertilizer; bio-fertilizer; chimecal fertilizer; sunflower.*

1. INTRODUCTION

The sunflower *Helianthus annuus* L. is one of the most important oil crops in the world, and this importance has increased recently because of the shortage in the produced quantity of oils because of its use in human nutrition and its entry into many industrial products, and the production of fodder needed to feed animals, whether green fodder or silage. Besides its seeds containing a percentage of It is high in protein ranging from 20 to 30%, which made it used in poultry feeding, flower use for beekeeping. It based sunflower cultivation in the United States of America, Russia and Argentina, according to the report of the Food and Agriculture Organization [1]. The productivity in 2018 was about 0.9 thousand tons on an area of 250 hectares [2], and mineral fertilization is a major source to supply the plant with nutrients, including the play major role in the biological and physiological processes of the plants. Nitrogen nutrition has a clear effect on the growth of plants, as it regulation of plant hormones (auxins and cytokines), which increases the divisions of meristematic cells, which is positively reflected on the vegetative growth, and it is a component Essential for protoplasm and cell membranes and in the formation of nucleic acids, RNA and DNA, and energy compounds ATP, NADPH2 and NADH, while phosphorous is one of the important elements for plants and called the key to life, because of its important and direct role in vital processes

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such as the formation and division of living cells, Potassium has a role with putting energy in the plant through its contribution to the processes of transport, representation and storage, and it activates enzymes that contribute to the photosynthesis process and contributes to the formation of nucleic acids and proteins, ATP and photosynthesis process.
Organic matter has an effective role in improving and because of the low percentage of organic matter in the soils of dry and semi-arid climates, such as the Iraqi soil, with adding organic matter to the soil as it increases the vitality of agricultural soils. Led to improve the spread and penetration of roots [3]. As for the role of organic matter in the chemical properties, improve the soil cation exchange capacity and decreasing chelating material of nutrients in soil [4].Comparing to adding chemical fertilizers, the trend in sustainable farming systems aims to reduce the use of mineral fertilizers, whose continued addition to the soil leads to the deterioration of its fertility and pollutes the environment significantly. Therefore, the interest in adding organic fertilizers has increased in soil [5]. Benefit from modern and low-value technologies bio-fertilizers, which help to increase the availability of nutrients in the soil, which leads to an increase in the yield of agricultural crops and improves production [5]. Researchers are constantly seeking to find solutions to reach the best results through modern technologies, and among these technologies are bio-fertilizer, as they help to increase the readiness of nutrients for absorption by the plant and activate microorganisms in the soil, which leads to an increase in yield. Also, the use of bio-fertilizer is necessary for agricultural crops and improves the yield. Its quality and productivity and also reduces environmental pollution because it reduces the use of chemical fertilizers as it increases the plant's ability to absorb nutrients and water [6]. The study came to know The effect of mineral . organic and bio-fertilizer and there interactions on the growth and yield of sunflower plants.

2. MATERIALS AND METHODS

2.1. Experiment site

An experiment was carried out for the summer on June 1, 2020, in the Babylon province / Al-Mussaib project to study the efficiency of mineral: organic (sheep manure), cheamicl and bio-fertilizer and to know the best fertilizers and their effect on the growth and yield of sunflower crop.

2.2. Soil preparation operations

Table (1) shows some physical and chemical properties of the study soil before planting.

2.3. Experiment design and implementation

This study was done as a factorial experiment in a completely randomized block design (RCBD) with three replicates. Using one repeater included 12 treatments distributed randomly on the experimental panels. The number of experimental panels was 36 panels with dimensions of 3 x 4 m, leaving intervals between sectors 2 m and between the experimental units 1 m :

• Mineral fertilizer includes two levels (without mineral fertilization A1, half mineral fertilization of the recommendation A2) , where 46% urea fertilizer added with a rate of 37.5 kg/dunum, half the amount when preparing the soil and the second batch after 60 days from the first batch, and superphosphate fertilizer added as P_2O_5 at a rate of 50 kg/dunum as a source of phosphorous in one batch when preparing the soil. As for the potassium element, potassium sulfate K 43% used with at a rate of 25 kg/dunum, added in two batches, the first with the second date of adding nitrogen That is, 60 days after planting and the second batch before flowering.

• Organic fertilizer includes two levels (without adding B1 organic fertilizer, B2 organic fertilizer), which is decomposed sheep manure at a rate of 6 kg for each experimental unit. It added sheep manure before planting. The organic fertilizer prepared from sheep manure has high contents of organic from the

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anaerobic digestion process for 45 days. Aerobic fermentation is a method for processing sheep manure, and it is also suitable for the production of sheep manure of organic fertilizer manufacturing It, using natural microorganisms or inoculated microorganisms, and converts organic matter into organic matter, carbon dioxide, and water. It the beneficial to have little environmental pollution.

• Bio-fertilizer includes 3 treatments (without bio-fertilizer C1, bio-fertilizer (soaking seeds with bio-health) C2, soil injection with bio-health C3) The bio-fertilizer of (Bio Health) country of origin Germany. The second level where the seeds were soaked and mixed well with bio-fertilizer before Agriculture, the third level the plant roots, were injection with bio-health after germination .

Table 1. some physical and chemical properties of field soil samples

Traits		Unit	Value
pH			7.90
Ece		Ds m-1	4.6
Organic matter		g .kg^{-1}	0.85
Bulk density		µg m^{-3}	1.52
Gypsum		g kg^{-1}	0.85
Calcium Carbonate		g kg^{-1}	269
Nitrogen		g kg^{-1}	20.56
Phosphor			19.2
Potassium			158.6
Mean weight diameter (MWD)		Mm	0.43
Porosity		%	40.95
Soil aggregate stability		%	9.42
Water conductivity		cm. min^{-1}	7.85
Cation exchange capacity			19.4
Separators of soil	Sand	g kg^{-1}	254
	Silt		354
	Clay		392
The type of texture		Clay loam	

Table 2. Some chemical properties of sheep manure

Traits	Value and unite
pH	6.82
Electrical conductivity	4.6
Total Nitrogen	1.68%
Total phosphorous	0.62%
Total potassium	1.08%
Total Organic Carbon	31.83%
Organic matter	54.93%
C/N	18.94

The seeds of the Flame variety were planted on the field with a distance of 75 cm between one row and another and 25 cm between one plant and another. It holes that did not sprout re-planted after a week of germination. land of experiment whenever necessary.

2.4. Soil and plant samples

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It took soil samples from the field after harvesting, as well as for plant samples, by taking 10 plants from each unit randomly to make measurements on them and preparing them to take the required measurements.

2.5. Studied traits

1) Plant height (cm): The height of the plant was measured by measuring tape starting from the point of contact of the plant with the soil to the base of the flower disc.

2) Leaf area (cm^2. $plant^{-1}$): It measured this trait based on the following equation :-
leaf area = 0.95 x length x largest width .... (5)

3) Weight of 1000 grains (g)

4) Total seed yield (Tons/ha^{-1}): It was measured through the following equations:-
Yield per plant = number of discs x number of seeds in the disc x weight of the seed .... (6)
Total seed yield = yield per plant x plant density.........(7)

5) Head diameter (cm): using the tape measure from the disk flowers wide.

2.6. Statistical analysis

Data were analyzed using SPSS statistical analysis program according to the used design, and it compared the means with the least significant difference LSD at the level of 0.05 . [10] .

3. RESULTS AND DISCUSSION

3.1. RESULTS

Table. 3. Effect of mineral, organic and biological fertilization and their interactions on plant height (cm)

Mineral fertilization (A)	Organic fertilization (B)	Bio Fertilization (C)			Mean B×A
		C1	C2	C3	
A1	B1	142.00	155.66	159.00	152.22
	B2	161.66	170.00	173.66	168.44
A2	B1	168.00	177.00	182.66	175.88
	B2	159.66	193.33	198.33	183.77
L.S.D (0.05)		8.613			4.972
Mineral fertilization x bio fertilization					
Mineral fertilization (A)		Bio Fertilization (C)			mean A
		C1	C2	C3	
A1		151.83	162.83	166.33	160.33
A2		163.83	185.17	190.50	179.83
L.S.D (0.05)		6.090			3.516
Organic Fertilization x Bio Fertilization					
Organic fertilization (B)		Bio Fertilization (C)			
		C1	C2	C3	
B1		155.00	166.33	170.83	164.06
B2		160.67	181.67	186.00	176.11
L.S.D(0.05)		6.090			3.516
Mean C		157.83	174.00	178.42	
L.S.D (0.05)		4.306			

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Table 4. Effect of mineral, organic and biological fertilization and their interactions on leaf area (cm^2 plant^{-1})

Mineral fertilization (A)	Organic fertilization (B)	Bio Fertilization (C)			Mean B×A
		C1	C2	C3	
A1	B1	6 .1757	2242.6	2262.6	2087.67
	B2	2270.0	2246.3	2712.0	2542.78
A2	B1	2793.3	3678.0	3633.0	3368.11
	B2	3739.6	4137.3	4177.6	4018.22
L.S.D (0.05)		88.138			50.886
Mineral fertilization x bio fertilization					
Mineral fertilization (A)		Bio Fertilization (C)			mean A
		C1	C2	C3	
A1		2013.8	2444.5	2487.3	2315.20
A2		3266.5	3907.7	3905.3	3693.20
L.S.D (0.05)		62.323			35.982
Organic Fertilization x Bio Fertilization					
Organic fertilization (B)		Bio Fertilization (C)			
		C1	C2	C3	
B1		2275.50	2960.30	2947.8	2727.90
B2		3004.80	3391.80	3444.8	3280.50
L.S.D (0.05)		62.323			35.982
Mean (C)		2640.20	3176.10	3196.3	
L.S.D (0.05)		44.069			

Table 5. The effect of mineral, organic and biological fertilization and their interactions on the weight of 1000 grains (g)

Mineral fertilization (A)	Organic fertilization (B)	Bio Fertilization (C)			mean B×A
		C1	C2	C3	
A1	B1	44.23	56.53	57.06	52.61
	B2	57.50	62.56	63.43	61.16
A2	B1	59.56	63.23	63.80	62.20
	B2	64.43	68.16	69.26	67.28
L.S.D (0.05)		0.925			0.534
Mineral fertilization x bio fertilization					
Mineral fertilization (A)		Bio Fertilization (C)			mean A
		C1	C2	C3	
A1		50.86	59.55	60.25	56.88
A2		62.00	65.70	66.53	64.74
L.S.D(0.05)		0.654			0.377
Organic Fertilization x Bio Fertilization					
Organic fertilization (B)		Bio Fertilization (C)			
		C1	C2	C3	
B1		51.90	59.88	60.43	57.40
B2		60.96	65.36	66.35	64.22
L.S.D (0.05)		0.654			0.377
Mean C		56.43	62.62	63.39	
L.S.D (0.05)		0.462			

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Table 6. Effect of mineral, organic and biological fertilization and their interactions on seed yield (ton.ha-1)

Mineral fertilization (A)	Organic fertilization (B)	Bio Fertilization (C)			mean B×A
		C1	C2	C3	
A1	B1	0.94	1.31	1.33	1.19
	B2	1.20	2.42	2.53	2.05
A2	B1	1.83	2.03	2.12	1.99
	B2	2.45	2.76	2.91	2.71
L.S.D (0.05)		0.100			0.058
Mineral fertilization x bio fertilization					
mineral fertilization (A)		Bio Fertilization (C)			mean A
		C1	C2	C3	
A1		1.07	1.86	1.93	1.62
A2		2.14	2.40	2.51	2.35
L.S.D (0.05)		0.071			0.041
Organic Fertilization x Bio Fertilization					
Organic fertilization (B)		Bio Fertilization (C)			
		C1	C2	C3	
B1		1.38	1.67	1.73	1.59
B2		1.82	2.59	2.72	2.38
L.S.D (0.05)		0.071			0.041
Mean C		1.60	2.13	2.22	
L.S.D (0.05)		0.050			

Table 7. Effect of mineral, organic and biological fertilization and their interactions on disc diameter (cm)

Mineral fertilization (A)	Organic fertilization (B)	Bio Fertilization (C)			mean B×A
		C1	C2	C3	
A1	B1	16.13	19.2	20.06	18.46
	B2	20.20	20.80	20.83	20.61
A2	B1	20.76	22.53	22.76	22.02
	B2	24.10	25.33	28.10	25.84
L.S.D (0.05)		0.819			0.472
Mineral fertilization x bio fertilization					
Mineral fertilization (A)		Bio Fertilization (C)			mean A
		C1	C2	C3	
A1		18.16	20.00	20.45	19.53
A2		22.43	23.93	25.43	23.93
L.S.D(0.05)		0.579			0.334
Organic Fertilization x Bio Fertilization					
Organic fertilization (B)		Bio Fertilization (C)			
		C1	C2	C3	
B1		18.45	20.86	21.41	20.24
B2		22.15	23.06	24.46	23.22
L.S.D(0.05)		0.579			0.334
Mean C		20.30	21.96	22.94	
L.S.D (0.05)		0.409			

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Table 8. Analysis of variance between mean of squares for the studied traits

Sources of Variation	d.f	Plant height	Leaf area	1000 grains weight	Seed yield	disc diameter
Replicates	2	19.75	208.861	0.055	0.003	0.130
mineral fertilization	1	3422.25*	17088578*	555.387*	4.788*	173.800*
organic fertilization	1	1308.027*	2748411.36*	418.884*	5.546*	80.102*
Bio Fertilization1	2	1409.083*	1193876.19*	174.685*	1.332*	21.413*
Mineral×Organic	1	156.25*	85556.25*	27.04*	0.043*	6.333*
mineral x bio	2	129.083*	36842.694*	24.186*	0.265*	0.863*
Organic × bio	2	91.861*	73486.861*	11.475*	0.268*	1.697*
Triple interaction	2	217.75*	32425.583*	13.697*	0.145*	5.395*
Experimental error	2	25.871	2708.982	0.298	0.003	0.233

3.2. DISCUSSION

According to analysis of the variance for the studied traits (Table 8) there are significant differences for all the studied traits of mineral, organic, and biological fertilization, as well as the binary and triple interactions. It should be *noticed* that *there* are significant differences between the arithmetic means of plants in the presence of mineral, organic, and bio- fertilization and without it for the characteristic of plant height, as the plants resulting from fertilization by giving them the highest mean, from Table (3) which amounted to 179.83, 176.11 and 178.42 cm compared to the control treatment, which amounted to 160.33, 164.06 and 157.83 cm, respectively. As for the interaction, it was significant for mineral and organic, mineral with bio fertilization, and organic fertilization with bio fertilization by giving it the highest mean, which reached 183.77, 190.50, and 186.00 cm compared to the control treatment, which amounted to 152.22, 151.83 and 155.00 cm, respectively. The triple interactions differed significantly among the treatments, as the triple interaction resulting from the fertilization process gave the highest mean, reaching 198.33 cm. Compared to the control treatment, which gave the lowest mean, as it reached 142.00 cm. The reason is that role of nutrients available to the plant through the supply of soil by mineral, organic, and bio fertilization and the interactions between them, which allow the plant to grow better and activate the process of cell division and elongation, thus increasing the height of the plant was consistent with what was found [11], [12]. It is noticed from Table (4) that there is a significant difference between the arithmetic means of the plants In the presence of mineral, organic, and bio fertilization and without it for leaf area, as the plants resulting from the fertilization outperformed them by giving them the highest mean, which amounted to 3693.20, 3280.50 and 3196.30 cm^2 $plant^{-1}$, compared to the control treatment, which amounted to 2315.20, 2727.90 and 2640.20 cm^2 $plant^{-1}$, respectively. As for the binary interactions, the interactions were significant for mineral and organic fertilization, mineral fertilization with bio, and organic fertilization with bio fertilization by giving them the highest mean, which reached 4018.22, 3907.70 and 3444.83 cm^2 $plant^{-1}$, compared to the control treatment, which amounted to 2087.67, 2013.80 and 2275.50 cm^2 $plant^{-1}$, respectively. The triple interactions differed significantly among the treatments, as the triple interaction resulting from the fertilization process gave the highest mean, reaching 4177.66 cm^2 $plant^{-1}$, and did not differ significantly with the second level of biological fertilization, as it gave 4137.33 cm^2 $plant^{-1}$ compared to the comparison treatment, which gave the lowest mean, reaching 1757.66 cm^2 $plant^{-1}$. The reason for this is through the effectiveness of microorganisms in the soil in activating the processes of converting nutrients from their complex state to the state ready for absorption and providing the elements in an appropriate manner for plant growth, which led to the creation of physiological balance and the activation of vital activities in the plant, which was positively reflected in the increase in the

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process of photosynthesis. The accumulation of the manufactured substance in the tissues of the plant, in turn, contributed to an increase in cell division and elongation, and consequently, an increase in their area. This is consistent with what he found [13], [14]. Table (5) shows that there are significant differences between the arithmetic means of plants with and without mineral, organic, and biological fertilization for the weight of 1000 seeds, as the plants obtained from the fertilization outperformed them by giving them the highest mean, which amounted to 64.74, 64.22 and 63.39 g compared to the comparison treatment, which amounted to 56.88, 57.40 and 56.43 g, respectively . The binary interaction gave significant differences for mineral and organic fertilization and for mineral with bio and organic with bio fertilization by giving them the highest mean, which amounted to 67.28, 66.53, and 66.35 g compared to the control treatment, which amounted to 52.61, 50.86 and 51.90 g, respectively. The triple interactions showed a significant difference between the treatments, as the triple interaction resulting from the fertilization process gave the highest mean, reaching 69.26 g, and did not differ significantly between the second level of bio fertilization, which gave 68.16 g, compared to the comparison treatment, which gave the lowest mean, which amounted to 44.23 g. The reason for this is through the efficiency of the plant due to the abundance of nutrients in converting the largest amount of the net product of photosynthesis into a stored substance and transporting it, Which increases the production of manufactured materials and thus increases the seed yield, and this is consistent with what was found [16], [17]. It is noticed from Table (7) that there are significant differences between the arithmetic means of plants with and without mineral, organic, and bio fertilization for disk diameter. The plants got from the fertilization outperformed them by giving them the highest mean, reaching 23.93, 23.22, and 22.94 cm compared to the comparison treatment, which amounted to 19.53, 20.24, and 20.30 cm pespectively. As for the bilateral interaction, it was significant for mineral and organic fertilization, mineral fertilization with bio, and organic with bio fertilization by giving it the highest mean, which reached 25.84, 25.43, and 24.46 cm compared to the control treatment, which amounted to 18.46, 18.16 and 18.45 cm, respectively. Three interactions showed a significant difference between them were 18.46, 18.16, and 18.45 cm, respectively. The triple interactions showed a significant difference between the treatments, as the triple interaction resulting from the fertilization process gave the highest mean, reaching 28.10 cm, compared to the comparison treatment, which gave the lowest mean, reaching 16.13 cm. The reason for this is through the abundance of nutrients, which gave a better stimulus to plant growth by raising the efficiency of the photosynthesis process, which contributed to an increase in materials represented in leaves and other plant tissues. This contributed to transferring these materials, which increased the diameter of the disc and this is consistent with previous findings [11], [18].

4. CONCULSIONS

We conclude the importance of mineral fertilization for plants, as it gave the highest rates for most of the studied traits and the importance of the three types of fertilization through the results of the studied traits through bilateral and triple interactions between the three types of fertilization by giving them the best results for the studied traits.

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