

# Response Of Maize To Organic And Mineral Fertilizer In Iraq Conditions

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## Abstract

To evaluate of efficiency mineral NPK organic fertilizer on productivity of maize, the mineral fertilizers were supplied as rate (0, 25, 50 and 100 % from recommendation) and give symbols (M1, M2, M3 and M4). While, the organic fertilizers were supplied as rates (0.5 and 10 megagram.ha<sup>-1</sup>) and give symbols (OM0, OM1 and OM2), the experiment was carried applied in Alanbar province of Iraq and (RCBD) design with factorial arrangement and three replicates was used. Statistical analysis of data had significant effects under this study. Some of traits in individual of Plant was studied such as; height (cm), NO. of leaves per plant, leaf area (cm), chlorophyll content (mg.kg<sup>-1</sup>), total dry matter (mega gram. ha<sup>-1</sup>) and percent of protein in the grain. The M4×OM3 scored highest plant (199.0 cm), and (180.310 cm) at two season respectively. While M4 with OM1, OM2 and OM3 scored (63.01, 64.01 dcm<sup>2</sup>), (64.02, 65.10 dcm<sup>2</sup>) and (67.05, 65.21 dcm<sup>2</sup>) under two seasons sequentially. Moreover, the M4×OM3 scored (64.53 mg.kg<sup>-1</sup>) and (65.21 mg.kg<sup>-1</sup>), sequentially. In addition to, the M4×OM(2) scored the highest value of total dry matter (11.60 mega-gram.ha<sup>-1</sup>) and (11.70 mega-gram.ha<sup>-1</sup>) under two season. Finally, the organic fertilizer (OM) and mineral fertilizer (M) caused increased of protein in the grain of maize via scored highest value (9.713 and 9.757 %) at two seasons, respectively. We conclude that the increasing of organic fertilizers and mineral fertilizers caused improved of plant traits.

**Keywords:** maize, organic fertilizers, mineral fertilizers

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## INTRODUCTION

Despite having rapid expanding population and the worst rate of soil deterioration in the some regions of Iraq to use of mineral fertilizers less than 25 kg.ha<sup>-1</sup> (Okab and Abed, 2022). This is mostly due to the expensive cost of purchasing these fertilizers (Cui, et al., 2010). Maize is one of main cereal crops in Iraq for 40 million people in the area (Okab and Abed, 2022). However, maize productivity in the county remain low compared with other country decreasing tendency over many years. For instance, in the 2023, the average of maize productivity 1.5 tan.ha<sup>-1</sup> compared with other countries about 2.6 tan.ha<sup>-1</sup> (Okab and Abed, 2023). The use of nitrogen fertilizer (N) on the agriculture of maize increased yield with percent 20% compared the same land without nitrogen fertilizers. This result consist with (Bai et al., 2013) who report that more than 50 % of agriculture region in Iraq suffering of mineral fertilizers especially NPK, and employment of mineral fertilizer to rise of yield efficiency in maize from 40-70% (Mbah et al., 2009; Al-Essawi and Abed, 2020). The excessive usage of mineral fertilizers could be caused pollution in the soil, water and air. Furthermore, the mineral fertilizers are expensive and the smallholder farmers who mainly poor and threat of human health by emission some of gases like: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), ammonia (NH<sub>3</sub>), and it will be increased of global warming (Chaoui, et al., 2003). The bio fertilizer of vermicompost is rich of nutrient element, low of C:N ratio, microorganisms and improved of soil characters (Bulluck, et al., 2002). The effects of biofertilizers vermicompost also shown to stimulate of maize to flowering, increasing of biomass, crop growth rate, speed of maturation and number of fruits (Curia-Cayupán et al., 2009). Furthermore, previous studies show that vermicompost decrease of plant invasion but also number of parasitic insects in the soil. This has been reported by Swathi et al. (1998) who reported that supplied of vermicompost to soil caused decrease of percentage of invasion parasite nematode *Meloidogyne incognita* in the tobacco. The aim

of this study to supplied of organic (vermicompost) to elevate of productivity of , a improving of quality and function in the cell plant.

## MATRIAL AND METHODS

This study was conducted in Anbar Governorate (56 km west of Baghdad) by planting maize ((Ibaa 99) during the autumn seasons 2021 and 2022 on 15/8 in both seasons in a soil with a loam clay mixture classified below the level of the Typic - Torrifluent super groups according to the modern American classification (2006 Soil Survey ) and controlled on weeds according to AL-Behadili, and Abed(2019) . The soil samples was taken from area to be cultivated with a depth of (0-30) cm, and mixed each sample separately and then dried a sieve diameter of its holes (2) mm. and then analyzed of soil (Table 1). RCBD design with three replicates and factorial arrangement were used.

### Factors of the experiment and their levels

1-Mineral fertilizer depend on recommendation for maize fertilizers in Iraq

A-Without supplied ( M0)

B-25% of mineral fertilizer (80N kg . ha<sup>-1</sup> , 15 P kg . ha<sup>-1</sup> and 22.5 K kg. ha<sup>-1</sup> )

C-25% of the fertilizer recommendation (80 kg N .ha<sup>-1</sup>, 15 kg P .ha<sup>-1</sup> and 22.5 kg K.ha<sup>-1</sup> ( M1)

E-50% of the fertilizer recommendation (160 N kg.ha<sup>-1</sup>), 30 P kg .ha<sup>-1</sup> and 45K kg (M2)

F-75% of the fertilizer recommendation (240 kg N ha<sup>-1</sup>, 60 P kg .ha<sup>-1</sup>, 90 K kg .ha<sup>-1</sup>(M3)

1.Organic fertilizer ( vermicompost )

A-without supplied (OM1)

B-5 megagram .ha<sup>-1</sup>(OM2)

C-10 megagram .ha<sup>-1</sup>(OM3)

Irrigation was carried out at the drain of 50-60% of available water and the charisterics of plant was taken at physiological harvest period .

Table 1. Some of soil characteristics before sowing

Characteristics	Value	Units
PH	7.6	
ECe	4.29	dsm.m <sup>-1</sup>
CEC	21.0	Cin .mol .kg <sup>-1</sup>
O.M	11.1	
Carbonate Minera	211	gm.kg <sup>-1</sup>
2H2O.CaSO4	9.0	gm.kg <sup>-1</sup>
Ca+2	9.25	gm.kg <sup>-1</sup>
Mg+2	7.3	gm.kg <sup>-1</sup>
Na+	8.1	Millimol L <sup>-1</sup>
K+	0.20	Millimol L <sup>-1</sup>
Cl-	13.3	Millimol L <sup>-1</sup>
SO4	15.4	Millimol L <sup>-1</sup>
HCO3-	2.0	Millimol L <sup>-1</sup>
CO3-	Nil	Mimol . L <sup>-1</sup>
Nitrogen available	23.5	Milgram . kg <sup>-1</sup>
Phosphor	10.0	Milgram . kg <sup>-1</sup>
Potassium	180	Milgram . kg <sup>-1</sup>
Bulk density	1.35	Megagram .m <sup>3</sup>
Sand	231	gm.kg <sup>-1</sup>
Silt	439	
Clay	330	
Soil texture	Clay Loam	

### Plant height (cm)

The data of Table (1) indicated that mineral fertilization had a difference effect to increasing of plant height with increasing of supplied M1, M2, M3 and M4 with an increase of 11.679, 18.882, 34.971 and 43.93% respectively compared control treatment (M0). Which enhanced of the importance role of supplied of mineral fertilizer and contains nutrients available to be absorbed by the plant, as well as availability of nutrients (NPK), especially N-element, and the role nitrogen in the structure of amino acids (Ning et al.,2018). In the autumn season2021, organic fertilization OM (1) and OM (2) significantly increased of plant height by 8.130 and 4.281%, sequentially, as compared to the OM (0). These results consist with (Qi et al., 2014 ). Who found that the supplied of organic fertilizer led to an increase in the plant height, as well as improving of soil characteristics, with increasing roots to absorb nutrients necessary for the plant and this may be attributed to the increase in cell division and elongation, which led to improved vegetative growth of plant. In second season2022, the results of interaction between mineral and organic fertilization M4 × OM(2) on the plant height scored 199.53 cm and percentage of 58.407% compared with M0 ×OM(0) which is scored 125.96 cm. Moreover, in the second year, the mineral fertilization had effects on plant height with increase of supplied rates M1, M2, M3, and M4, that which scored 13.080, 22.877, 34.555, and 36.991%, respectively. The results consist with ( Xu et al.,2017 ).

Table (1). Effect of supplied mineral and organic fertilizer on plant height (cm) of maize at atuman season 2021 -2022.

First season2021					Second season2022			
M	Organic matter			Mean	Organic matter			Mean
	OM0	OM1	OM2		OM0	OM1	OM2	
M <sub>0</sub>	125.96	138.06	144.40	136.14	120.11	128.52	134.32	127.65
M <sub>1</sub>	151.71	155.20	149.21	152.04	143.62	150.91	138.51	144.35
M <sub>2</sub>	150.13	163.30	172.11	161.85	148.70	159.55	162.31	156.85
M <sub>3</sub>	178.22	182.72	190.31	183.75	170.35	177.62	167.31	171.76
M <sub>4</sub>	193.25	195.09	199.53	195.96	168.60	175.70	180.31	174.87
LSD5%	6.669**			3.851**	6.874**			3.969**
Mean	159.85	166.87	171.11		150.28	158.46	156.55	
LSD5%	2.983**				3.074**			

### Number of leaves per plant.

The data of Table (2) showed that mineral fertilization had different effect on increasing the number of leaves per the plant with an increase of supplied M1, M2, M3 and M4 with an increase of 1.284, 3.789, 4.721 and 5.684% sequentially compared with M0. The effect of organic fertilization OM (1) and OM (2) significantly of increasing in number of leaves with an increase of 7.972 and 4.205% compared to control OM (0) in the autumn 2021season. However, the interaction between mineral and organic fertilization M4×OM(2) scored the largest number of leaves per plant (15.6 leaves), with an increase 5.5% compared with control M0×OM(0) which is recorded (13.5 leaves ).This results consist with Al-Mehemdi and Abed (2016) . However, in the 2022 autumn season the mineral fertilization had a a significant effects in the increasing of leaves per plant with increasing of rates M1, M2, M3 and M4, with an increase of 5.014, 6.088, 6.948 and 8.524%, sequentially, compared with M0. The interaction between mineral and organic fertilization M4×OM (2) scored highest number of leaves per plant (17.55 leaves) compared with M0×OM(0) in the percentage 17.55% . The increasing of leaves per plant with increasing of rates mineral or organic fertilizer because of the Vitol role in absorb of nutrients ( Yasir and Abed,2024).

Table (2) Effect of supplied Mineral and Organic Fertilizer on the Number of Leaves per Maize at 2021 -2022 autumn seasons

First season2021					Second season2022			
M	Organic matter			Mean	Organic matter			Mean
	OM0	OM1	OM2		OM0	OM1	OM2	
M <sub>0</sub>	13.50	14.50	14.76	14.25	13.10	14.20	14.60	13.97
M <sub>1</sub>	14.07	14.13	15.10	14.43	14.20	14.50	15.30	14.67
M <sub>2</sub>	14.26	14.80	15.33	14.80	14.40	14.65	15.40	14.82
M <sub>3</sub>	14.36	14.99	15.46	14.94	14.70	14.80	15.30	14.93
M <sub>4</sub>	14.43	15.17	15.60	15.07	14.97	15.20	15.40	15.19
LSD5%	0.581**			0.335**	0.237**			0.137**
Mean	14.12	14.72	15.25		14.27	14.67	15.20	
LSD5%	0.260**				0			

#### Leaf area (cm<sup>2</sup>)

The data of the 2021 autumn season in Table (6) showed that mineral fertilization had a different effect on increasing the leaf area of maize with an increase in the levels of supplied : M1, M2, M3, and M4 with an increase of 16.310, 26.494, 33.862, and 39.496%, respectively, compared to M<sub>0</sub>, which gave a leaf area of 46.376 dcm<sup>2</sup> plant<sup>-1</sup>. the mineral fertilizers caused cell division and expansion of leaf. The effect of organic fertilization OM(1) and OM(2) had a significantly in increasing the average leaf area with an increase of 2.777 and 10.133% compared to the control treatment OM(0) in the 2021 autumn season, which gave 54.788 dscm<sup>2</sup> plant. The interaction between mineral and organic fertilization M<sub>4</sub> × OM(2) scored the highest average leaf area of 67.05 dcm<sup>2</sup> plant<sup>-1</sup> with an increase of 63.456% compared with M<sub>0</sub> × OM(0), which is scored the lowest Leaf area of 41.02 dcm<sup>2</sup> plant<sup>-1</sup>. This results consist with ( Mousavi et al.,2018 ). While in the 2022 autumn season, the mineral fertilization had a significantly affected in the increase of the leaf area per plant with an increase of supplied M1, M2, M3 and M4, with an increase of 21.263, 31.902, 37.454 and 43.815%, sequentially, compared to M<sub>0</sub>, which recorded the lowest rate of leaf area of 43.16 dcm<sup>2</sup>. plant<sup>-1</sup>. The effect of organic fertilization OM(1) and OM(2) had a significantly on the average leaf area of the plant with an increase of 1.32 and 3.18% compared to the comparison treatment OM(0) in the 2022 autumn season. Organic fertilizers improve of soil properties, which help to release nutrients such as N , P and K element in the soil solution, it will be available to absorb by mineralizing via microorganisms. This agree with ( Subedi and Ma,2005 )

Table (6).Effect of supplied of the mineral and organic fertilizer on the leaf area of maize at 2021-2022 autumn seasons.

First season2021					Second season2022			
M	Organic matter			Mean	Organic matter			Mean
	OM0	OM1	OM2		OM0	OM1	OM2	
M <sub>0</sub>	41.02	44.12	53.99	46.38	42.00	43.13	44.36	43.16
M <sub>1</sub>	51.81	53.77	56.24	53.94	54.52	55.20	54.63	54.78
M <sub>2</sub>	58.05	58.53	59.41	58.66	59.00	58.05	60.67	59.24
M <sub>3</sub>	60.05	61.18	65.01	62.08	61.22	63.00	64.80	63.01
M <sub>4</sub>	63.01	64.02	67.05	64.69	64.01	65.10	65.21	64.77

LSD5%	2.478**			1.431**	2.613**			1.509**
Mean	54.79	56.32	60.34		56.15	56.90	57.93	
LSD5%	1.108**				1.169**			

#### Chlorophyll content (mg.kg<sup>-1</sup>)

The data of the first season in Table (5) showed that mineral fertilization had differences effect on increasing the chlorophyll content of the leaves in maize with an increase of the rate of supplied of the minerals M1, M2, M3 and M4 , With excess of 26.04, 44.962, 50.474 and 53.626% respectively compared to M0 that which scored the lowest chlorophyll content value in the leaves about (41.82 mg.kg<sup>-1</sup>). This result agree with (Al-Temimi and Abed,2016). The effect of organic fertilization OM(1) and OM(2) had a significantly in increasing the average chlorophyll content with an increase of 4.369 and 6.391% compared to OM(0) in the 2021 autumn season, which gave 54.51 mg.kg<sup>-1</sup>. The interaction between mineral and organic fertilization M4×OM(2) recorded the highest rate of chlorophyll content 64.53 mg.kg<sup>-1</sup> with an increase of 61.204% compared to M0 ×OM(0), which scored of chlorophyll content about 61.204%. while in the 2022 autumn season, the mineral fertilization had a significantly affected in increasing of the chlorophyll with an increase in the levels of addition to levels M1, M2, M3 and M4 with excess 19.187, 35.981, 47.292 and 51.937%, respectively, compared to M0, which gave the lowest rate of chlorophyll content 42.84 mg.kg<sup>-1</sup>. This result agree with (Birch net al.,2016) who report that increasing of nitrogen caused increased of chlorophyll pigment plant tissue .The interaction between between mineral and organic fertilization M4 ×OM(2) at the highest rate of 65.21 mg.kg<sup>-1</sup> and an increase compared to M0×OM(0 ) of 58.932%. The increase in the concentration of chlorophyll content of leaf because of increased of organic fertilizers ( Ziyad et al.,2018).

Table (7). The effect of supplied mineral and organic fertilizer in chlorophyll content of maize (mg.kg<sup>-1</sup>) at 2021-2022 autumn seasons .

First season2021					Second season2022			
M	Organic matter			Mean	Organic matter			Mean
	OM0	OM1	OM2		OM0	OM1	OM2	
M <sub>0</sub>	40.03	42.10	43.33	41.82	41.03	43.13	44.36	42.84
M <sub>1</sub>	50.25	52.35	55.53	52.71	48.36	50.20	54.63	51.06
M <sub>2</sub>	57.05	62.20	62.62	60.62	56.05	58.05	60.67	58.26
M <sub>3</sub>	61.22	63.60	63.96	62.93	61.52	63.00	64.80	63.11
M <sub>4</sub>	64.00	64.21	64.53	64.25	64.96	65.10	65.21	65.09
LSD5%	8.876**			7.762**	9.765**			8.653**
Mean	54.51	56.89	57.99		54.38	55.90	57.93	
LSD5%	2.654**				2.432**			

#### Total dry matter (mega gram. ha<sup>-1</sup>)

The data of Table (8)showed that mineral fertilization had differences effect on increasing the dry matter of maize with an increase in supplied of rates M1, M2, M3 and M4 with an increase of 16.719, 17.705, 24.605 and 34.069% respectively compared to M0 . The effect of organic fertilization OM (1) and OM (2) had a significantly in increasing the average dry weight 4.476 and 7.253% compared to the control treatment OM(0) in 2021 autumn season. This result consist with (Guan et al.,2022).The interaction between mineral and organic fertilization M4×OM(2) scored the highest dry weight about

11.60 with excess of 60.00% compared to the  $M_0 \times OM(0)$  which recorded in increasing percentage 7.25%. While in the 2022 autumn season, the mineral fertilization had a significantly affected in the increase of the dry matter of maize, with an increase of levels of supplied minerals  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$ , scored 15.884, 17.098, 24.556 and 35.593%, respectively, compared to  $M_0$ . The effect of organic fertilization  $OM(1)$  and  $OM(2)$  had a significantly in increasing the rate of dry matter 5.714 and 8.321% compared to  $OM(0)$  in the 2022 autumn season. The interaction between mineral and organic fertilization  $M_4 \times OM(2)$  scored the highest rate of dry matter about 111.7 mega gram.  $ha^{-1}$  with an excess compared with  $M_0 \times OM(0)$  that which scored percentage 59.183%. the organic fertilizers enter in the many vital process such as cell division, cell membrane and elongation of stems ( Jessup et al.,2020 ).

Table (8).The effect of supplied mineral and organic fertilizer on the total day matter (mega gram.  $ha^{-1}$ ) of maize at 2021 -2022 autumn season.

First season2021					Second season2022			
M	Organic matter			Mean	Organic matter			Mean
	OM0	OM1	OM2		OM0	OM1	OM2	
$M_0$	7.25	8.26	9.85	8.45	7.35	8.58	9.44	8.46
$M_1$	9.60	10.50	9.50	9.87	9.30	9.90	10.30	9.83
$M_2$	9.80	9.65	10.40	9.95	9.70	9.81	10.20	9.90
$M_3$	10.50	10.70	10.40	10.53	10.40	10.90	10.30	10.53
$M_4$	11.10	11.30	11.60	11.33	11.20	11.50	11.70	11.47
LSD5%	0.237**			0.137**	0.581**			0.335**
Mean	9.65	10.08	10.35		9.59	10.14	10.39	
LSD5%	0.106**				0.260**			

#### Percentage of protein in grains

The data of Table (9) showed that mineral fertilization had differences effects on increasing the percentage of protein win maize with an increase in supplied minerals  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$  with an increase of 8.894, 11.176, 17.612 and 19.962% respectively compared to the control treatment. The effect of organic fertilization  $OM(1)$  and  $OM(2)$  had a significant in increasing the protein content of grains, with an increase percentage of 3429 and 5842% compared to  $OM(0)$  in the first autumn season. The results consist with (Moghadam et al.,2012). The interaction between mineral and organic fertilization  $M_4 \times OM_2$  scored the highest protein percentage of 9.713% and an increase of 35.979% compared to the  $M_0 \times OM(0)$  that which is scored %7.143. However, In 20202 autumn season, the mineral fertilization had a significantly affected the increase in the percentage of protein with an increase of supplied minerals  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$ , the rate increasing of 8.952, 10.628, 17.448 and 19.577%, sequentially, compared with  $M_0$ . The effect of organic fertilization  $OM(1)$  and  $OM(2)$  had a significantly in increasing the percentage of protein with an increase of 3.906 and 5.407% compared to  $OM(0)$  in 2022 autumn season. The interaction between mineral and organic fertilization  $M_4 \times OM_2$  scored the highest percentage rate of protein in grains (9.752%) and an increase compared with  $M_0 \times OM_0$  about 33.840%. The reason of increased of protein in the grain because of the organic matter content nitrogen, phosphor and potassium, that will be enhance the protein contents ( Moraditochae et al.,2013 )

Table (9). Effect of Mineral and Organic Fertilizer supplied on Protein Percentage of grain Maize at 2021-2022 autumn seasons.

First season2021					Second season2022			
M	Organic matter			Mean	Organic matter			Mean
	OM0	OM1	OM2		OM0	OM1	OM2	
M <sub>0</sub>	7.14	8.19	8.46	7.93	7.29	8.35	8.64	8.09
M <sub>1</sub>	8.55	8.57	8.78	8.64	8.70	8.85	8.91	8.82
M <sub>2</sub>	8.70	8.78	8.97	8.82	8.72	9.05	9.10	8.95
M <sub>3</sub>	9.20	9.30	9.48	9.33	9.41	9.46	9.65	9.51
M <sub>4</sub>	9.30	9.53	9.71	9.51	9.58	9.70	9.76	9.68
LSD5%	0.135**			0.078**	0.153**			0.089**
Mean	8.58	8.87	9.08		8.74	9.08	9.21	
LSD5%	0.602**				0.069**			

## CONCLUSION

The experimental factors are significantly in the trait of maize. The variability varied with level of mineral and vermicompost fertilizers. The interaction M<sub>4</sub>×OM<sub>2</sub> scored higher values in all traits. We concluded this level between of mineral and bio-fertilizer (vermicompost) will be recommendation of mix fertilizers.

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