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Effect Of Different Rates Of NPK And Vermicompost On Some Traits Of Maize

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Abstract
To evaluate of efficiency mineral NPK organic fertilizer on productivity of maize , the NPK 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 levels (0,5and 10 megagram.ha^{-1}) and the treatments were symbols as (OM0,OM1and OM2) , a field experiment was applied in the Alanbar province of Iraq by using design (RCBD) design with factorial arrangement and three replicates.The data analysis were shows a significant effects under this study. Concentration of Nitrogen per leaf , concentration of phosphorus per leaf, concentration of potassium per leaf , ear lenghth, number of kernels (mega gram. ha^{-1}) and yield ton per ha^{-1} . the M4×OM3 scored highest plant (**1.243** mg .kg^{-1}) and (1.29 mg.kg^{-1}) at two season Sequentially . While M4 with OM1, MO2 and MO3 scored of phosphorus concentration (**0.30** mg.kg^{-1}) ,وand (0.29 mg.kg^{-1}) under two seasons respectively. Moreover, the M4×OM3 scored to potassium level (**20.46 mg.kg^{-1}**) and (**20.23 mg.kg^{-1}**), respectively .In addition to, the M4×OM(2) recorded the highest value of kernel weight (**150.66** gm of 500 kernels) and (154.33 gm of 500 kernels) under two season . Finally, the organic fertilizer (OM) and mineral fertilizer (M) caused increased of yield of maize and scored highest value (150 **and 152 gm per plant)** at two seasons, respectively .we conclude that the increasing of organic fertilizers and mineral fertilizers caused improved of plant traits.
Key words: maize , NPK fertilizer , vermicompost , yield

INTRODUCTION

Corn is a third major crop after wheat and rice and is grown in wide climatic conditions. . kernel consist of 2.4% fiber ,70 %carboydrates ,4%oil , 10% protein,ohydrate , 10.4% aluminizes, 1.4% ash.(Okab and Abed ,2023). Maize has evolved to be extremely polymorphic due to cross-pollination, resulting in a wide range of varieties (Okab and Abed ,2023). Maize used as food to the human, livestock, poultry and many industrials (Cui et al., 2010; Al-Mehemdi and Abed, 2016). Mineral element is play a vital role in quantity of yield and contribution about 50-60 percent in the productivity. Moreover, the optimum quantity of nitrogen, phosphorus and potassium of improved of varies yield (Abed, and Abed ,2010; Jessup et al., 2020).The application of vermicomposts helps to improve soil fertility, maintains of soil and conserve of water (Prabh et al,2020). The vermicompost is organic manurs can be solve the food crisis through improved soil properties and sustain capability of maize productivity because of the content of 0.6-1.2% N, 0.13-0.22% P and 0.40-0.75% (Chen et al.,2014). Vermocompost is rich in the microbial societies , such as, actinomycetes ,bacteria and fungi . in addition to , contain to plant hormones like: ethylene, auxins, abscisic acid , phenolic acids (Al-Temimi Abed,2016). However , the use of vermeicompost will be promote of growth pattern , stem elongation , expansion of leaf area , photosynthesis , and flowering and fruiting of plants (Okab and Abed,2024). Maize needs different type of nutrient during growth that which can be acquired from mineral elements . The N-element is one of the most important macro- element which used for growth of maize , and deficiency of nitrogen fertilizers will be limiting the maize productivity (Cassman et

al,2002). The environmental pollution related with increasing of high rate of nitrogen fertilizers. The alternative approach depend on organic origin , safe and less expensive to nitrogen fertilizer management , and replacement of chemical fertilizers in the soil throught supplied of vermicompost will be reduction in the environmental pollution (Khan et al.,2011).

MATERIAL AND METHODS.

This experiment was applied in Anbar Governorate by sowing of maize ((Ibaa 99) varity in the autumn seasons 2021 and 2022 on 15/8 in both seasons in the loam clay of soil l Typic - Torrifluvent super groups according to the modern American classification (2006 Soil Survey) and Atlas herbicide are used to controlled on weeds (AL-Behadili, and Abed(2019) . The soil samples was taken from field to be sowing at depth (0-30) cm, and mixed each sample separately with dried a sieve diameter (2) mm. The soil analyzed (Table 1) depend on (Prabhu et al.,2020). The design (RCBD) with three replicates and factorial arrangement was used.

Factors of the experiment and their levels

1.Mineral fertilizer according to recommendation of fertilizers .

A-Without supplied (M0)

B-25% of mineral fertilizer (80 Nkg .ha^{-1} , 15 P kg . ha^{-1} and 22.5 K kg . ha^{-1})

C-25% of the fertilizer recommendation (80 N kg.ha^{-1}, 15 P kg .ha^{-1} and 22.5 K kg .ha^{-1} (M1)

E-50% of the fertilizer recommendation (160 N kg N.ha^{-1}), 30 kg P .ha^{-1} and 45 K kg (M2)

F-75% of the fertilizer recommendation (240 N kg .ha^{-1}, 60 P kg.ha^{-1}, 90 K kg .ha^{-1}(M3)

2.Organic (vermicompost)

A-without supplied (OM1)

B-5 megagram .ha^{-1}(OM2)

C-10 megagram .ha^{-1}(OM3)

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

1- Nitrogen: Estimated total nitrogen by distillation after supplied of NaOH by micro-Kieldahl .

2- Phosphorus: Phosphorus was measured in digested samples using spectrophotometer at wavelengths of 882 (Yan et al., 2017) by modified blue ammonium mollipid method after modifying the degree of reaction of solutions using paranaitrophenol dye as indicator.

3- Potassium: Estimated with flame photo meter .

Table 1. Some of soil characteristics before sowing.

Characteriscts	Value	Units
PH	7.6	
ECe	4.29	dsm.m^{-1}
CEC	21.0	Cin .mol .kg^{-1}
O.M	11.1	
Carbonate Minera	211	gm.kg^{-1}
2H2O.CaSO4	9.0	gm.kg^{-1}
Ca+2	9.25	gm.kg^{-1}
Mg+2	7.3	gm.kg^{-1}
Na+	8.1	Millimol L^{-1}
K+	0.20	Millimol L^{-1}
Cl-	13.3	Millimol L^{-1}
SO4	15.4	Millimol L^{-1}
HCO3-	2.0	Millimol L^{-1}

CO3-	Nill	Mimol . L^{-1}
Nitrogen available	23.5	Milgram . kg^{-1}
Phosphor	10.0	Milgram . kg^{-1}
Potassium	180	Milgram . kg^{-1}
Bulk density	1.35	Megagram .m^3
Sand	231	$gm.kg^{-1}$
Silt	439	
Clay	330	
Soil texture	Clay Loam	

RESULTS AND DISCUSSION.

Concentration of Nitrogen in leave of maize

The data in Table (11) shows that mineral fertilization has a significant effect on excess of N- content of leaves of maize with an increase in the levels of mineral fertilizers rates M1, M2, M3 and M4 with an increase of 11.23, 17.187, 19.335 and 21.484% respectively compared to the control treatments M0 at autumn 2021 . While in the 2022 the mineral fertilizers caused increasing of N-concentraion about 15.323, 18.001, 21.463 and 25.42%. The increasing of chemical fertilizers (NPK) caused increasing of N- concentration of leave plants (Meghvansi et al.,2020). However, the organic fertilizers MO1and MO2 were affected significantly on N-concentration in the leaves at flowering. The MO1and MO2 scored 3.321, 1.74 % and 4.004, 2.260% in the 2021 and 2022 respectively. Moreover, The interaction between mineral and organic fertilization M4×MO2 scored a significant increased and the highest value 34.88 % and 38.37 % in the 2021 and 2022 respectively. The integrated between the chemical and organic fertilizer have been enhanced Nitogen synthesis in leave and elevated of N- concentration in the tissues (Ren et al.,2021).

Table (2).Effect of Mineral and Organic Fertilizer supplied on Nitrogen Concentration in the Leaves (mg.kg^{-1}) of maize in autumn 2021-2022.

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	0.927	1.050	1.097	1.025	0.933	1.040	1.060	1.011
M_1	1.133	1.133	1.150	1.139	1.155	1.160	1.180	1.165
M_2	1.207	1.170	1.223	1.200	1.190	1.180	1.210	1.193
M_3	1.213	1.243	1.210	1.222	1.220	1.225	1.240	1.228
M_4	1.253	1.237	1.243	1.244	1.255	1.260	1.291	1.269
LSD5%	0.015**			0.009**	0.013**			0.009
Mean	1.147	1.167	1.185		1.151	1.173	1.196	
LSD5%	0.007				0.006**			

Concentration of Phosphor in the leave of maize

The data of Table (12) shows that mineral fertilization had a different effect in the increasing the phosphorus content in leaves of maize with increasing supplied of M1, M2, M3 and M4 with an increase of 2.78, 12.5, 18.98 and 37.5% respectively, in the autumn2021 . However, The mineral fertilization has a significant effects on increasing the percentage of phosphorous with an increase in supplied rates M1, M2, M3 and M4 with an increase of 12.25, 19.1125, 25.98 and 45.58%, respectively, compared to control treatment M0 that which

scored **(0.20) in the autumn 2022 .** The chemical fertilizer caused of elevated of phosphorous due to content high level of phosphorous (Qi et al., 2014). While, The organic fertilization OM1 and OM2 have significantly affect the increase percent of phosphorus in the leaves 0.24 and 0.26 for two season 2021 and 2022 respectively. The interactions between mineral and organic were not significant effects on the concentration of Phosphorus in the leave of maize .

Table (3).Effect of Mineral and Organic Fertilizer supplied on phosphor Concentration in the Leaves (mg.kg^{-1}) of maize in autumn 2021-2022.

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	0.21	0.20	0.23	0.22	0.18	0.20	0.23	0.20
M_1	0.21	0.23	0.23	0.22	0.23	0.23	0.23	0.23
M_2	0.25	0.23	0.25	0.24	0.25	0.23	0.25	0.24
M_3	0.24	0.26	0.27	0.26	0.24	0.26	0.27	0.26
M_4	0.29	0.29	0.30	0.30	0.29	0.29	0.30	0.30
LSD5%	ns			0.018**	ns			0.014**
Mean	0.24	0.24	0.26		0.24	0.24	0.26	
LSD5%	ns				0.011**			

Potassium concentration (mg.kg^{-1}).

The data of Table (4) shows that mineral fertilization had a difference effect on increasing of potassium content in leaves of maize with an increase in the levels of mineral fertilizers rates M1, M2, M3 and M4 with an increase of 17.97, 19.11 , 19.55 and 20.16 mg.kg^{-1} , respectively compared with M0 that which scored 16.82 mg.kg-1 at autumn 2021. While, The effects of mineral fertilizers scored 17.19, 17.89, 18.73 and 19.58 mg.kg-1 at 2022 the increased of mineral fertilizers caused elevated of P-concentration in the leaf of maize (Jaliya et al,2008). In addition to, the organic fertilizer caused increasing of increased of K-concentration in the leaf of maize , the treatments of OM1 and OM2 scored 20.71 and 20.46 mg.kg-1 compared with OM0 that which scored 18.12 mg.kg^{-1} . Moreover , in 2022 the organic fertilizer caused increased of phosphorus concentration in the leave of maize , and scored 18.08 and 18.79 mg.kg-1 compared with control M0 record 17.16 mg.kg^{-1} . The results consist with (Noonari, et al.,2016) . However, The interaction between mineral and organic fertilization M4×MO2 scored a significant increased and the highest value 20.71 and 20.46 compared with M0×OM0 scored 16.25 and 16.11 mg.kg^{-1} in the 2021 and 2022 sequenctially.

Table (4).Effect of supplied of Mineral and Organic Fertilizer on Potassium Content (mg.kg^{-1}) in leaves of Maize 2021-2022.

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	16.25	16.82	17.39	16.82	16.11	16.63	17.24	16.66

M_1	17.21	18.10	18.61	17.97	16.08	17.01	18.49	17.19
M_2	18.86	18.96	19.51	19.11	17.51	17.96	18.21	17.89
M_3	19.00	19.66	20.00	19.55	17.80	18.50	19.89	18.73
M_4	19.30	20.71	20.46	20.16	18.30	20.32	20.11	19.58
LSD5%	0.083**			0.048**	0.535**			0.309**
Mean	18.12	18.85	19.19		17.16	18.08	18.79	
LSD5%	0.037**				0.239**			

Ear length (cm)

The data analysis in Table (5) shows that mineral fertilization had a different effect on increasing the ear length of maize with an increase in the levels of mineral fertilizers rates M1, M2, M3 and M4 with an increase of 17.97 , 19.11 , 19.55 and 20.16 cm, respectively compared to the control treatments M0 that which scored 16.82cm at autumn 2021. While, The effects of mineral fertilizers scored 17.19 , 17.89, 18.73 and 19.58 cm compared with control M0 that which scored 16.66 cm at 2022 the increased of mineral fertilizers caused cell division on promordia cells . In addition to, the organic fertilizer caused increasing of increased of ear length in the ears of maize, the treatments of OM1 and OM2 scored 18.85 and 19.19 cm compared with OM0 that which scored 18.12 cm . Moreover, in 2022 the organic fertilizer caused increased of ear length in the leave of maize, and OM1 and OM2 scored 18.08 and 18.79 cm compared with control OM0 record 17.16 cm . This results consist with (Jaliya et al.,2008) . However, The interaction between mineral and organic fertilization M4×MO2 scored a significant increased and the highest value 20.46 and 20.11 cm compared with M0×OM0 scored 16.25 and 16.11 cm in the 2021 and 2022 respectively.

Table (5). Effect of supplied Mineral and Organic Fertilizer on ear Length (cm) of maize during 2021-2022 autumn season.

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	16.25	16.82	17.39	16.82	16.11	16.63	17.24	16.66
M_1	17.21	18.10	18.61	17.97	16.08	17.01	18.49	17.19
M_2	18.86	18.96	19.51	19.11	17.51	17.96	18.21	17.89
M_3	19.00	19.66	20.00	19.55	17.80	18.50	19.89	18.73
M_4	19.30	20.71	20.46	20.16	18.30	20.32	20.11	19.58
LSD5%	0.083**			0.048**	0.535**			0.309**
Mean	18.12	18.85	19.19		17.16	18.08	18.79	
LSD5%	0.037**				0.239**			

Number of kernels in ear

The data analysis in Table (6) shows that mineral fertilization had a different effect in increasing of kernels number per ear of maize with an increase in the levels of mineral fertilizers rates M1, M2, M3 and M4 with an increase of 425.17, 465.07, 500.00 and 526.20 kernels per ear , respectively compared to the control treatments M0 that which scored 370.33 kernels at autumn 2021. While, The effects of mineral fertilizers scored 428.20, 474.10, 504.20 and kernels compared with control M0 that which scored 529.77 kernels

per ear at 2022, the increased of mineral fertilizers increased of assimilation net (Okab and Abed,2022) . In addition to, the organic fertilizer caused increasing of increased of kernels number per ear of maize, the treatments of OM1 and OM2 scored 458.48 and 478.38 kernels per ears, compared with OM0 that which scored 435.20 kernels per ear . Moreover, in 2022 the organic fertilizer caused increased of ear length in the leave of maize, and OM1 and OM2 scored 464.58 and 483.52 kerenels, compared with OM0 record 441.54 kernels per ear . However, the interaction between mineral and organic fertilization M4×MO2 scored a significant increased and the highest value 540.30 and 541.71 kernels per ear, compared with M0×OM0 scored350.50 and 360.10 kernels per ear in the 2021 and 2022 respectively.

Table (6).The effect of supplied mineral and organic fertilizer on kernels number in the ear of maize

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	350.50	370.10	390.40	370.33	360.10	380.10	399.20	379.80
M_1	410.20	425.00	440.30	425.17	415.10	427.20	442.30	428.20
M_2	445.00	460.00	490.20	465.07	447.20	475.80	499.30	474.10
M_3	470.20	499.10	530.70	500.00	475.20	502.30	535.10	504.20
M_4	500.10	538.20	540.30	526.20	510.10	537.50	541.71	529.77
LSD5%	10.01			0.00	8.2			0.00
Mean	435.20	458.48	478.38		441.54	464.58	483.52	
LSD5%	0				0			

Weight 500 kernels.

The data of Table (6) shows that mineral fertilization had difference effect in increasing of weight (500) kernels of maize with an increase in the levels of mineral fertilizers rates M1, M2, M3 and M4 with an increase of 127.22 , 132.33 , 144.11 and 146.23 weight of 500 kernels , respectively compared to the control treatments M0 that which scored 124.34 weight of 500 kernels at autumn 2021. While, The effects of mineral fertilizers scored 130.61 , 135.00 , 146.00 and 149.97 weight 500 kernels compared with control M0 that which scored 124.96 weight of 500 kernels at 2022, the increased of mineral fertilizers increased of assimilation net . The results consist with (Jaliya et al., 2008). In addition to, the organic fertilizer caused increasing of increased of number of kernels per ear of maize, the treatments of OM1 and OM2 scored 135.44 and 138.87 weight of 500 kernels, compared with OM0 that which scored 130.23 weights of 500 kernels. Moreover, in 2022 the organic fertilizer caused increased of weight of 500 kernels of maize, and OM1 and OM2 scored 137.53 and 140.75 weight of 500 kernels, compared with control OM0 record 133.64 weight of 500 kernels . This results consist with (Meghvansi et al.,2012). However, the interaction between mineral and organic fertilization M4×MO2 scored a significant increased and the highest value 150.66 and154.33 weight of 500 kernels , compared with M0×OM0 scored 130.23 and 133.64 weight of 500 kernels in the 2021 and 2022 respectively.

Table (7). Effect of supplied Mineral and Organic Fertilizer on Weight of 500 gm. Kernel^{-1}) to Maize at 2021 -2022 autumn season .

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	118.67	124.67	129.67	124.34	120.70	126.10	128.07	124.96
M_1	126.33	127.00	128.33	127.22	129.17	130.00	132.67	130.61
M_2	128.67	132.33	136.00	132.33	131.33	135.33	138.33	135.00
M_3	137.00	145.67	149.67	144.11	141.67	146.00	150.33	146.00
M_4	140.50	147.52	150.66	146.23	145.34	150.23	154.33	149.97
LSD5%	0.123**			0.071**	0.252**			0.145**
Mean	130.23	135.44	138.87		133.64	137.53	140.75	
LSD5%	0.055**				0.113**			

Yield of plant (gm.plant^{-1}).

The data of Table (8) shows that mineral fertilization had differences effect in increasing of yield per plant with an increase in the levels of mineral fertilizers rates M1, M2, M3 and M4 with an increase of 111.91 , 123.17 , 134.60 and 142.68 gm.plant-1 , respectively compared to the control treatments M0 that which scored 97.18 gm.plant-1 at autumn 2021. While, The effects of mineral fertilizers scored 116.30, 126.02, 137.12 and 144.73 gm.plant-1 compared with control M0 that which scored 97.43 gm.plant-1 at 2022, the increased of mineral fertilizers increased of assimilation net . In addition to, the organic fertilizer caused increasing of increased of gm.plant^{-1} of maize, the treatments of OM1 and OM2 scored 143.11 and 129.54 gm.plant^{-1}, compared with OM0 that which scored 114.47 gm.plant^{-1}. Moreover, in 2022 the organic fertilizer caused increased of weight of 500 kernels of maize, and OM1 and OM2 scored 145.03 and 152.50 gm.plant-1 compared with OM0 record 136.67 gm.plant-1 . This consist with (Tejada and Benítez , 2011) . However, the interaction between mineral and organic fertilization M4×MO2 scored a significant increased and the highest value 150.90 and 152.50 gm.plant^{-1} , compared with M0×OM0 scored 134.03 and 136.67 gm.plant-1 in the 2021 and 2022 respectively.

Table 8. Effect of supplied Mineral and Organic Fertilizer on Single Plant Yield (gm.Plant^{-1}) for Maize .

First season2021					Second season2022			
	Organic matter				Organic matter			
M	OM0	OM1	OM2	Mean	OM0	OM1	OM2	Mean
M_0	84.97	96.67	109.90	97.18	87.07	99.20	106.03	97.43
M_1	103.37	113.37	119.00	111.91	112.63	115.17	121.10	116.30
M_2	120.90	122.09	126.53	123.17	123.27	125.57	129.23	126.02
M_3	129.07	133.35	141.37	134.60	131.17	136.23	143.97	137.12
M_4	134.03	143.11	150.90	142.68	136.67	145.03	152.50	144.73
LSD5%	2.046**			1.181**	1.655**			0.956**
Mean	114.47	121.72	129.54		118.16	124.24	130.57	
LSD5%	0.915**				0.740**			

CONCLUSION

The charastistics in this experiments are significantly effects on Ibaa variety of maize under the levels of mineral and vermicompost fertilizers and the intraction between M4×OM2recoreded highest value in the yield per plant (150 and 154 gm per plant) , and we could conclude that mix between NPK and vermicompost will enhance the productivity of maize .

References

Abed, R. D., & Abed, Z. A. (2010). Breeding crops for nitrogen use efficiency. Iraqi Journal of Agricultural Sciences, 41(4). 47-64.

AL-Behadili, A. A., & Abed, Z. A.2019. Effectiveness of oxidation enzymes in the ratio of gluten to wheat bread via different treatments of weeds control. Indian Journal of ecology,46(8):119-122. http://dx.doi.org/10.13140/RG.2.2.23914.75203

Al-Mehemdi , A. F., Abed ,Z.A. 2016. Decision making of selection using GGE biplot. The Iraqi Journal of Agricultural Sciences.47(1): 208-215.

Al-Temimi, A. H., and Z. A. Abed. 2016. Evaluation The Performance and Stability of Cowpea Selected Generations Under Drought Tolerance. The Iraqi Journal of Agricultural Sciences 3 (47), 791-803.

Asghar, A., Ali, A., Syed, W. H., Asif, M., Khaliq, T., & Abid, A. A. (2010). Growth and yield of maize (Zea mays L.) cultivars affected by NPK application in different proportion. Pakistan journal of Science, 62(4), 211-216.

Cassman, K. G., Dobermann, A., & Walters, D. T. (2002). Agroecosystems, nitrogen-use efficiency, and nitrogen management. AMBIO:A Journal of the Human Environment, 31, 132–140 .

Chen, X., Cui, Z., Fan, M., Vitousek, P., Zhao, M., Ma, W., ... & Zhang, F. (2014). Producing more grain with lower environmental costs. Nature, 514(7523), 486-489. .

Cui, Z., Chen, X., & Zhang, F. (2010). Current nitrogen management status and measures to improve the intensive wheat–maize system in China. Ambio, 39, 376-384. .

Jaliya, M. M., Falaki, A. M., Mahmud, M., & Sani, Y. A. (2008). Effect of sowing date and NPK fertilizer rate on yield and yield components of quality protein maize (Zea mays L.). ARPN Journal of Agricultural and Biological Science, 3(2), 23-29.

Jessup, R. W., Abed, Z. A., Najeep, H. F., & Al-Azawi, N. M. (2020). Genetic analysis of sorghum cultivars from USA using SSR markers. Plant Archives, 20(1), 1121-1125.

Khan, H. Z., Iqbal, S., Iqbal, A., Akbar, N., & Jones, D. L. (2011). Response of maize (Zea mays L.) varieties to different levels of nitrogen. Crop and Environment, 2(2), 15-19.

Meghvansi, M.K., Khan, M.H., Gupta, R., Gogoi, H.K. and Singh, L., 2012. Vegetative and yield attributes of okra and naga chilli as affected by foliar sprays of vermiwash on acidic soil. Journal of crop Improvement, 1(4): 520-531.

Noonari, S., Kalhoro, S. A., Ali, A., Mahar, A., Raza, S., Ahmed, M., ... & Baloch, S. U. (2016). Effect of different levels of phosphorus and method of application on the growth and yield of wheat. Natural Science, 8(7), 305-314. **DOI:** 10.4236/ns.2016.87035.

Okab, S.I., Abed, Z.A. 2023. Gene expression of a nitrogen tolerance gene ZmNR1 under the influence of different levels of nitrogen in maize. Bionatura 8(1):1-9.

Okab, Sarah I., and Ziyad A. Abed.2022. Effect Of Nitrogen Fertilizers On Growth And Yield Traits Of Maize. Iraq Journal of Market Research & Consumer Protection . 14(2): 40-49.

Prabhu, S., Revandekar, P., Shirdhankar, S., & Paygude, S. (2020). Soil analysis and crop prediction. International Journal of Scientific Research in Science and Technology, 7(4), 117-12.

Qi D L, Wu X, Hu T T. 2014. Effects of nitrogen supply methods on root growth, yield and nitrogen use of maize. Scientia Agricultura Sinica, 47, 2804–2813. https://doi.org/10.1038%2Fs41598-019-44759-2.

Ren, H., Jiang, Y., Zhao, M., Qi, H., & Li, C. (2021). Nitrogen supply regulates vascular bundle structure and matter transport characteristics of spring maize under high plant density. Frontiers in Plant Science, 11, 602739. http://dx.doi.org/10.3389/fpls.2020.602739.

Sara, Z. S., & Shah, T. (2018). Residual effect of biochar on soil properties and yield of maize (Zea mays L.) under different cropping systems. Open Journal of Soil Science, 8(1), 16-35. https://doi.org/10.4236/ojss.2018.81002.

Tejada, M., & Benítez, C. (2011). Organic amendment based on vermicompost and compost: differences on soil properties and maize yield. Waste management & research, 29(11), 1185-1196.

Yan Xiao, Yan Xiao, et al. "Phosphorus fractions and sorption characteristics in a subtropical paddy soil as influenced by fertilizer sources." (2017): 80-85.