



EFFECT OF BIO FERTILIZERS ON INCREASING THE EFFICIENCY OF USING CHEMICAL FERTILIZERS ON THE YIELD COMPONENT OF MAIZE (*ZEA MAYS L.*)

Rukaea Abd-Alzahra Alafeea, *Abbas Ali Alamery and Issa Talib Kalaf

Agriculture College, Karbala University, Iraq

*abas.hussian@uokerbala.edu.iq

Abstract

To study the effect of Bio Fertilizers on Increasing the Efficiency of the Use of Chemical Fertilizers, A field experiment was conducted during the spring season 2018 at fields of Ibn Al-Bitar Vocational Preparatory in Al-Atishi, Karbala. The experiment arranged in Factorial experiment with three factors by using R.C.B.D design with three replicates, the first factor was three genotypes of maize (5018, Fajr and Baghdad), the second factor was the bio fertilizer (Control and Azotovit + phosphatovit) and the third factor was Four levels of chemical fertilizer Urea (46%N) with Dap (50% P, 18%N) were applied at rates of (control, 100 kg N h⁻¹+ 33.33 kg P h⁻¹, 200 kg N h⁻¹+ 66.66 kg Ph⁻¹ and 300 kg N h⁻¹+ 99.99 kg P h⁻¹). Data were collected on number of grain/cob, weight of 500 grains, and grain yield ton/ ha. Results showed that bio fertilizers have significantly ($p < 0.05$) increased crop productivity component with the treatment that without application, the combinations of chemical fertilizer fixer inoculants with bio- fertilizer improved grain quality of maize under field conditions. The interaction between factors was also significantly, so the combination (V3 Q2 with L3) was the best.

Keyword : Bio fertilizers, Chemical fertilizer, Maize, yield.

Introduction

Corn (*Zea mays L.*) follows the Poaceae family, which is one of the important crops of this family. It comes after wheat and rice crops in terms of economic importance for its multiple uses (Orhun, 2013). In the Arab world, maize occupies the second position after wheat, while it occupies the third place in the Arab world after wheat and barley in terms of cultivated area and second place of production after wheat according to the report of the General Mesopotamia Seed Company (Jassem, 2016) It is mainly used as a food crop, mixed with wheat flour to make bread and pastries. Corn starch is also used for the manufacture of sweets, with a good percentage of oil in grains ranging from 10-4%. Its grains are incorporated into the basic components of poultry, cattle and sheep to contain them A good proportion of protein, starch, oil, vitamins and minerals, its grow in most Iraq governorates (Babil, Baghdad, Wasit, Kirkuk and Maysan), the average production per unit area is still low. The total cultivated area for 2013 is 72 thousand hectares with an average production of 24, 3 tons h⁻¹ (Directorate of Agricultural Statistics, 2017). The continued addition of conventional chemical fertilizers and their excessive use to compensate for nutrient deficiencies lead to environmental pollution as well as the high costs of these fertilizers (Alwan *et al.*, 2009; Walpola and Yoon, 2012; Almosawy *et al.*, 2018a). As a result of the negative effects of the unfiltered use of chemical fertilizers, such as the problem of soil pollution, as well as increasing the salinity of soil, it was necessary to consider the use of modern fertilizers alternative mixed with traditional fertilizers to provide the nutrients necessary for plant growth and productivity, and maintain the soil clean and good (Miransari, 2011; Almosawy *et al.*, 2014; Alamery *et al.*, 2018). These fertilizers are the most environmentally friendly fertilizers called Bio Fertilizer. The use of bio fertilizers, which are considered to be safe and environmentally safe sources of food, are considered effective means of addressing some problems and increasing productivity when compared with chemical fertilizers. Increase the efficiency of the use of chemical fertilizers (Kartani and Al-Tai, 2011; Alamery *et al.*, 2019) It is an

effective source of plant nutrients and the most cost-effective to supplement chemical fertilizers for sustainable agriculture (Panda, 2011).

Materials and Methods

Experimental Details and Treatments

A field experiment was carried out in the fields of Ibn Al-Bitar Vocational Preparatory in Al-Atishi, Karbala. During the spring season 2018, in order to determine the effect of Bio Fertilizers (Q1=Control and Q2= A+P) A= bio fertilizer application amount 0.5Lh⁻¹ on Increasing the Efficiency of Using Nitrogen Mineral Fertilizers, P= bio fertilizer application amount 0.5Lh⁻¹ on Increasing the Efficiency of Using Phosphate Mineral Fertilizers with chemical fertilizer (L0, L1, L2 and L3) were:-

L0= Control

L1= 33.33 KgP h⁻¹ from Di-ammonium phosphate(50% P+ 18%N) + 100 Kg N h⁻¹ from Urea (46%N).

L2= 66.66Kg P h⁻¹ from Di-ammonium phosphate(50% P+ 18%N) + 200 Kg N h⁻¹ from Urea (46%N).

L3= 99.99KgP h⁻¹ Di-ammonium phosphate(50% P+ 18%N) + 300 Kg N h⁻¹ from Urea (46%N).

and its Effect on some growth parameters of three varieties of Maize were:-

V1= 5018, V2= Fajr and V3= Baghdad.

Experiment was applied on a clay loam soil, potassium fertilizers were added at a rate of 100 kg ha⁻¹ as Potassium sulphate (21% K) respectively in one doses at seedling growth stage.

Physical and chemical soil characteristics

A sample from the experiment field was taken to depth (0-30 cm) to determine some physical and chemical properties according to the methods mentioned at Page *et al.* (1982) and Ryan *et al.* (2003), the soil was alkaline in reaction (pH 7.59, EC 2.3 dSm⁻¹, organic matter 0.9%, available P 18.0 mgL⁻¹, NH₄ and NO₃ 29.1mg L⁻¹).

Statistical Analysis

Data analyzed using the Genestat program and means were compared using LSD at a probability level of 5%.

Results and Discussions**Weight of 500 Grains (gm)**

Table (1) showed the results of the statistical analysis of the varieties (V). Baghdad and Fajr cultivars significantly on the 5018cultivar which were giving the highest weight of 500 grains (203.1 and 195.7 g) respectively. The chemical fertilizer (L) was significant as the percentage of increase in the weight of 500 grain (21.46%, 12.73% and 2.72%) for the level of the third and the second and the first, respectively,

the third level of the addition of chemical fertilizer to give the highest weight 500 grain (218.4 g), bio fertilizers (Q) treatments was significantly increased by (4.15%) for addition and the weight of 500 grains when adding bio fertilizer (200.4 g). The effect of the chemical fertilizer levels in the (V*L) cultivars was significantly reduced when we add chemical fertilizer @ L3 with Baghdad cultivar (225.9 g) weight of 500 grains .the minimum value was recorded @ L0 with 5018 cultivar (174.5 g). The results of the interaction between the bio fertilizer with the levels of chemical fertilizers (Q* L). bio fertilizer with the third level of chemical fertilizer was give highest value (221.1 g). The minimum weight of 500 grain was recorded @ non-addition to both of them (175.8g).

Table 1 : Effect of bio fertilizer and chemical fertilizer on weight of 500 grains (gm) for varieties of maize.

Var.	Fertilizer					V*Q
	Bio	chemical				
		L0	L1	L2	L3	
V1	Q1	172.9	179.4	181.7	211.3	186.3
	Q2	176.0	195.3	192.7	214.3	194.6
V*L		174.5	187.4	187.2	212.8	190.5
V2	Q1	172.3	173.6	204.1	215.8	191.4
	Q2	194.9	180.3	207.4	216.9	199.9
V*L		183.6	176.9	205.8	216.4	195.7
V3	Q1	181.3	184.2	211.8	219.9	199.6
	Q2	181.6	195.5	218.5	232.0	206.6
V* L		181.4	189.8	215.1	225.9	203.1
C		179.8	184.7	202.7	218.4	Q
Q* L	Q1	175.8	179.1	199.2	215.7	192.4
	Q2	183.9	190.4	206.2	221.1	200.4

L.S.D 0.05

V	5.60	Q	4.57	L	6.47	VQ	7.92
V L	11.20	Q L	9.15	VQL	15.85		

The effect of interaction of the cultivars with the bio fertilizer (V*Q) the lowest value (186.3 g) was recorded at Q1 with 5018 cultivar, while the highest value recorded at Q2 with Baghdad variety (206.6 g). The interaction between varieties and bio fertilizer and the levels of chemical fertilizer (V* Q * L). The lowest value for the weight of 500 grains (172.3 g) @ the Q1 and L0 with fajr cultivar, while the highest value of the weight of 500 grains (232.0 g) Which was recorded @ Q2 and L3 with Baghdad cultivar.

Number of Grain in cob (grain cob⁻¹)

Table (2) showed the effect of chemical fertilizer (L) on the number of grains in cob, the L3 gave the highest value of grain in cob (565.1). bio fertilizer (Q2) give the highest value (12.55%) compared with Q1 which was recorded (382.4) grain cob⁻¹. The results of this table show the Baghdad variety give the highest value (448.0) while the 5018 variety give lowest value(382.5).

Table 2 : Effect of bio fertilizer and chemical fertilizer on number of grains in cob for varieties of maize.

Var.	Fertilizer					V*Q
	Bio	chemical				
		L0	L1	L2	L3	
V1	Q1	176.4	326.4	377.8	562.4	360.8
	Q2	181.6	436.2	434.3	564.8	404.2
V*L		179.0	381.3	406.1	563.6	382.5
V2	Q1	169.9	286.4	465.7	506.4	357.1
	Q2	259.2	423.7	479.9	518.0	420.2
V*L		214.6	355.0	472.8	512.2	388.6
V3	Q1	206.8	404.3	527.7	578.8	429.2
	Q2	244.6	440.6	539.8	641.9	466.97
V* L		225.5	422.5	533.8	610.3	448.0
L		206.4	386.3	470.9	565.1	Q
Q* L	Q1	184.3	339.0	457.1	549.2	382.4
	Q2	228.5	433.5	484.7	574.8	430.4

L.S.D 0.05

V	37.30	Q	30.46	L	43.08	VQ	52.76
V L	74.61	Q L	60.92	VQL	105.51		

The effect of the interaction of chemical fertilizer with the cultivars (L*Q). the lowest value (179.0 grain cob⁻¹) recorded @ 5018 cultivar with L0. while the L3 level with Baghdad cultivar gave highest value (610.3 grain cob⁻¹). The effect of the addition of bio fertilizer on the varieties (V * Q), the highest value (466.97 grains cob⁻¹) recorded at the addition of bio fertilizer with the Baghdad cultivar, while the number of grains in cob were low in non- addition of bio fertilizer with the Fajr cultivar (357.1 grains cob⁻¹). The table also showed the effect of the bio fertilizer with the chemical fertilizer (Q * L) The highest value was recorded at the addition of the bio fertilizer with L3 (574.8 grain cob⁻¹), while the minimum value (184.3) recorded @ Q1 and L0.

The effect of interaction (V*L*Q) was significant. The lowest value of this interaction (169.9 gain cob⁻¹) recorded in the non-addition of both bio and chemical fertilizers @ Fajer variety. While the highest value recorded at the Baghdad cultivar with the third level of chemical fertilizer and the addition of bio fertilizer (641.9 grain cob⁻¹).

Grain Yield (ton ha⁻¹)

The results of the statistical analysis in Table (3) showed that the Baghdad variety was superior to gave high grain

yield (8.40 ton h⁻¹). While the third level of chemical fertilizer (L3) gave the high value (10.34 ton ha⁻¹) while the lowest grain yield were in non-addition chemical fertilizer (4.53 ton ha⁻¹). Bio-fertilizer (Q2) superior to give high value (8.16 ton ha⁻¹). The effect of the interaction of the varieties with the chemical fertilizer (V*L). L0 with fajr cultivar gave lowest value (4.41 ton ha⁻¹), while the L3 with the Baghdad cultivar gave the highest value (11.20 ton ha⁻¹). The results of the interaction of the bio fertilizer with varieties (V * Q) showed the addition of bio fertilizer with Baghdad cultivar give the highest value (8.69 ton ha⁻¹), while the low grain yield recorded @ Q1 with 5018 cultivar (6.80 ton ha⁻¹).

The effect of the bio-fertilizer interaction with the chemical fertilizer (Q * L), the lowest value (4.09 ton ha⁻¹) for both non- addition, while the highest value recorded @ addition of bio-fertilizer with third level of chemical fertilizer (10.68 ton ha⁻¹). The interaction between cultivars and bio-fertilizer with chemical fertilizer (V * Q * L), the highest value (11.50 ton ha⁻¹) was due to the addition of bio fertilizer with the third level Of the chemical fertilizer @ Baghdad cultivar, while the lowest value of the grain yield (3.60 ton ha⁻¹) was due to the non- addition of both bio-fertilizer and chemical fertilizer with the Fajr cultivar.

Table 3 : Effect of bio fertilizer and chemical fertilizer on grain yield (ton h⁻¹) for varieties of maize.

Var.	Fertilizer					V*Q
	Bio	chemical				
		L0	L1	L2	L3	
V1	Q1	4.38	6.24	6.76	9.83	6.80
	Q2	4.93	8.28	7.88	10.58	7.92
V*L		4.65	7.26	7.32	10.21	7.36
V2	Q1	3.60	5.84	8.68	9.26	6.85
	Q2	5.21	7.40	8.87	9.96	7.86
V*L		4.41	6.62	8.78	9.61	7.35
V3	Q1	4.30	7.40	9.81	10.91	8.11
	Q2	4.79	8.37	10.11	11.50	8.69
V* L		4.54	7.89	9.96	11.20	8.40
L		4.53	7.25	8.69	10.34	Q
Q* L	Q1	4.09	6.50	8.42	10.00	7.25
	Q2	4.98	8.01	8.95	10.68	8.16

L.S.D 0.05

V	0.697	Q	0.569	L	0.805	VQ	0.986
VL	1.395	QL	1.139	VQL	1.972		

Discussion

From the results of tables (1, 2 and 3) showed that the addition of biological fertilizers in this study played a significant role in all the studied traits. This confirms the role of addition bio fertilizers in increasing the efficiency of the use of chemical fertilizers in nutrient-poor soils (Alwan et al., 2009; Almoswy et al., 2018b). Baghdad variety was superior over other varieties in all traits. The interaction treatment Baghdad variety with addition bio fertilizers and L3 treatment was gave highest value in all studied traits.

This results illustrates the role of bio fertilizers in increasing the efficiency of the use of chemical fertilizers on different varieties, thus reducing the use of high levels of chemical fertilizers as well as reducing environmental pollution.

References

Abu, D.; Yousef, M. and Al-Yunis, M.A. (1988). Directory of plant nutrition. Ministry of Higher Education and

Scientific Research. Baghdad University. College of Agriculture.

Alamery, A.A.; Almosawy, A.N.; AlRubaei S.M.; Mohammed H.M.; A.H.; AlKinanai L.Q. and Alkrati H.G. (2018). Effect of potassium and g power calcium nanoparticle spray on growth and yield of some broad bean cultivars (*Vicia faba* L.) Biochem. Cell. Arch, 18(2): 2003-2007.

Alamery, A.A.; Lateef, S.M.; Almosawy, A.N.; Alhassaany, M.H. and Almosawy, M.M. (2019). Effect of Phosphate Bio Fertilizers on Increasing the Efficiency of the Use of Phosphate Mineral Fertilizers and its Effect on some growth Properties of Broccoli (*Brassica oleracea* var. *italica*).

Al-Kartani; Abdel-Karim; Oreibi, S. and Saleh Al-Din Hammadi Midi Al-Tai (2011). The effect of bio-fertilization with *Glomerus mosseae* and organic fertilization with acid humic and chemical fertilizers in some growth characteristics of growing maize plant in gypsum soil. Fifth Scientific Conference of the Faculty

- of Agriculture. University of Tikrit. For the period 26-27 April.
- Almosawy, A.N.; Alamery, A.A.; Al-Kinany, F.S.; Mohammed, H.M.; Alkinani, L.Q. and Jawad, N.N. (2018a). Effect of Optimus nanoparticles on growth and yield of some broad bean cultivars (*Vicia faba*L.). Int. J. Agricult. Stat. Sci. Vol, 14(2): 2018.
- Almosawy, A.N.; Alamery, A.A.; Al-Kinany, F.S.; Mohammed, H.M.; Alyasiri, N.A. and Alhusani, A.H. (2018b). Effect of proteck calbor nanoparticle on growth and yield of some wheat cultivars (*Triticum aestivum* L.). Biochem. Cell. Arch, 18(2): 1773-1178.
- Al-Mosawy, A.N.; Al-Farttoosl, H.A.; Al-Amery, A.A. and Attiya, R.L. (2014). Role of nutrient solution magnetizer of manganese sulphate in growth and yield in wheat which Grown in the fields of holy Karbala (*Triticum aestivum* L.). Karbala Heritage Quarterly Authorized Journal Specialized in Karbalā· Heritage, 1(2): 311-330.
- Alwan A.H.; Al-Anbari M.A.; Al-Aamry A.A.H and Abd-AlradaH, A. (2009).Effect of sowing date and phosphorus fertilizer on growth and yield of wheat (*Triticum aestivum* L.). Scientific Journal of Karbala University, 7 (3): Scientific.
- Directorate of Agricultural Statistics, Production of cotton, maize and potatoes (2017). Central Statistical Organization - Ministry of Planning - Iraq.
- Jassim, H.I. (2016). Marketing of maize crop in Iraq for the years 2013-2014-2015. Flags of Najaf.
- Miransari, M. (2011). Soil microbes and plant fertilization. Applied microbiology and biotechnology 92(5): 875-885.
- Orhum, G.E. (2013). Maize for Life. Int. J. Food Sci. and Nut. Eng. 3(2): 13-16.
- Panda, H. (2011). Manufacture of Biofertilizer and Organic Farming. Frédéric Zakhia and Philippe De Lajudie (2001). Taxonomy of rhizobia.
- Walpolo, B.C. and Yoon, M.H. (2012). Prospectus of phosphate solubilizing microorganisms and phosphorus availability in agricultural soils: A review. African J. of Microbiology Res. 6(37): 6600-6605.