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AN INVESTIGATION ON THE EFFECT OF MICORRIZHA AND THE TYPE OF FERTILIZATION ON MAIZE (*ZEA MAYS* L.) GROWTH AND NPK CONTENT

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Abstract

A field experiment was carried out for the autumn season 2018-2019 in private farms Babylon Governorate / Nile area in silty loam soils to study the effect of two levels of mineral, organic and bio-fertilizers (without fertilization and fertilization) and their interaction on some vegetative growth parameters of the *Zea mays* plant. A factorial experiment was designed with Randomized Complete Block Design (RCBD) system with three replicates. The results showed there were significant differences between the levels of mineral fertilization in the positive effect on the studied growth indicators. As well as, the level of mineral fertilization was significantly superior in increasing the mean growth indicators (plant height, number of days from planting to male flowering, number of days from planting to female flowering, leaf area, Chlorophyll content and NPK leaf content). The highest average of growth indicators were 180.84 cm, 59.3 days, 66.6 day, 29.84 spad, 4476.8 cm^2, 14.08 leaf, 1.26%, 0.08% and 3.29% respectively. Furthermore, the level of organic fertilization was significantly superior in increase the average growth indicators and gave the highest averages by 178.90 cm, 59.2 days, 66.3 day, 28.83 spad, 4596.2 cm^2, 14.50 leaf, 1.26%, 0.08% and 3.28%, respectively. Finally, the study results also showed that the level of bio-fertilizer was significantly superior in increase the mean growth indicators above and gave the highest averages of 181.20 cm, 59.4 days, 67.4 day, 29.21 spad, 4469.1 cm^2, 15.09 leaf, 1.14%, 0.09% and 3.51% respectively.

Key words : Micorrizha, Fertilization, Maize.

Introduction

Zea mays L. is one of the most important strategic and economic crops in the world, which is ranked as the third in the most important grain crop after wheat and rice. It is a multi-crop used as animal feed and human food as it is involved in many industries such as oils and paper industry, as well as, its seeds have high nutritional value for containing essential amino acids and vitamins. Thus, it is one of the important food sources for humans and animals, and it is widely cultivated in Iraq, with a total cultivated area for the year 2016 a total of 76.00 thousand hectares and an average production of 3.415 $Mg.ha^{-1}$ (Directorate of Agricultural Statistics, 2017). The addition of Organic matter to soil, whether plant or animal residues play an important role in determining the physical properties of soil, as these materials directly affect in improved soil construction and increased soil aggregate stability. It also leads to increased soil water retention, and preserve the soil surface from erosion and drifting. (Mohammed *et al.,* 2015) observed during the studying the effect of organic, mineral, biofertilization on the readiness of phosphorus and iron elements in soil and the Zea mays growth, there is a significant superiority of the high levels of addition to phosphorus readiness characteristics, especially at the flowering stage. As well as, there has been a significant increase in the studied vegetative growth indicators. Micorrizha fungi had a major role in the formation and stability of soil aggregates through spreading the hypha between the initial soil particles and its aggregates, as well as secretion of hydrophobic gummy sticky compounds such as Glomalin, which collecting and bonding soil particles together, depending on the soil content of clay and organic matter (Quantity and quality). The soil inoculated with Micorrizha by the presence of organic matter and appropriate conditions stimulate the development of the relationship between the host and Micorrizha fungi, then a heavy hypha growth of fungi and their spread between soil particles and the formation of stable soil aggregates. Micorrizha also performs to decompose the organic materials and formation of different chemical compounds that are the source of their nutrition and energy, as well as the compounds that are produced from organic matter are also a bond materials for soil particles, which improve the soil structure and increase the aggregates stability (Rillig and Mummey, 2006). Phosphorus plays many important roles for the plant, which is essential for the germination process through its importance in the energy production of that process as it is stored in seeds in the form of phytin, which is calcium and magnesium salts of phytic acid. Phosphorus is also a major nutrient that a plant needs in relatively large quantities, and most phosphorus compounds are found in soils with low readiness for growing plants, where Iron and aluminum phosphate are dominating in the acidic soils, while calcium phosphate dominating in alkalinity soils. Furthermore, due to the importance of phosphorus in the plant growth and productivity, as well as, for the acceleration of its reactions and its deposition, adsorption in the Iraqi calcareous soils, it must be provided at an appropriate level of available phosphorus for absorption through adding phosphate fertilizers together to the organic fertilizers. This addition improves the chemical and physical properties of soil and the fertility when it decomposed in the soil by microorganisms (Al- Zubaidi, 2010). The aim of this study is to investigate the role of the Zea mays seed inoculation with the Micorrizha fungi spores. As well as, the addition of organic and mineral fertilizer in the readiness of phosphorus element, and the plant's ability on its absorption and the effect of this addition in some indicators of Zea mays plant growth.

Materials and Methods

A field experiment was carried out for the autumn season 2018-2019 on a private farm in Babylon Governorate / Nile area in silty loam soils classified as (Typic Torrifluvents) according to (AL-agidi 1976) classification. The land was divided into plots of (3m * 4m) area and 2m width, where 2m distance were left between the blocks to prevent fertilizer transport between blocks and a 1m distance between each experimental units. The plots were irrigated lightly for calibration, and the cultivation was carried out on 20/7/2018 by four seeds/ hill of *Zea mays* seeds (ibaa variety 5018) obtained from the General Organization for Agricultural Research, and then reduced after two weeks to become one plant/ hill. The distance between one hill and another was (25cm), and the distance between one line and another was (75cm) to become the number of lines (5) lines within each experimental plots and with a plant density of (53333 plant/ha). The irrigation of plots was a surface irrigation or according to the plant's need at a rate of one irrigation/ week. Mineral fertilizer (C) was used at two levels (without fertilization C_0, fertilization according to recommendation C_1). The fertilization included urea fertilizer (46% N) as a source of nitrogen element at a rate of 75 kg / dunum (added in two batches, the first one at the six leaf stage and the second batch 60 days after the first batch. Moreover, DAP fertilizer of 100 kg /dunum was added as a source of phosphorus at a rate of one batch. As well as, the Potassium sulfate fertilizer (43% K_2SO_4) of 50 kg / dunum was used as source of the Potassium element in two batches, the first batch with the second date of adding N, (60) days after planting and the second batch at flowering. Two levels of decomposed organic fertilizer (B) (sheep residues) are (without fertilization B_0, organic fertilization B_1), where the decomposed organic fertilizer was added to the experimental units and mixed with soil manually at a rate of 6 kg / plot, and two levels of bio-fertilizer (A) are (without fertilizing A_0, 100% bio-fertilizer A_1). A factorial experiment was designed according to RCBD system with three replicates, as samples of field soil were taken before cultivation at a depth of 0-30cm. These samples were air dried and milled, then passed through a sieve with 2 mm diameter opening, and mixed well to homogenize it where the sample was taken for conducting some chemical and physical analyzes of the field soil as shown in Table 1.

The number of days traits from cultivation to 75% male flowering were studied, and the number of days from cultivation to 75% female flowering, plant height (cm), the chlorophyll index (spad), where the chlorophyll meter plus 502 (Japanese-made) was used to measure the chlorophyll index in the three leaves under the ear (Jemison and Williams, 2006). Moreover, the plant leaf area (cm^2) (Elsahookie, 1985), and the number of leaves per plant, leaf content of nitrogen, phosphorus and potassium elements. Finally, the data were analyzed statistically according to RCBD, where the averages were compared using the least significant difference test (L.S.D) at the significant level (0.05) using the Excel program (Al-Rawi and Mohammed, 1990).

Results and Discussion

Effect of mineral and organic and bio-fertilization on plant height

Table 2 indicates that there were a significant difference between the fertilization treatments in the effect on the plant height trait, as the treatment A_1 was superior and gave the highest average that amounted to

Table 1: Some chemical and physical properties of soil study before cultivation.

Property		Value	Unit
PH value (1:1)		7.7	——
Electrical Conductivity EC (1:1)		5.0	ds/m
Exchange capacity of the cation ions CEC		10.1	Meq/100g m soil
Organic matter OM	1.21	%	
Available elements	Nitrogen N –NH_4^+	28.0	PPM
	Phosphorus	16.1	PPM
	Potassium	21.9	PPM
Bulk density		1.17	Mg/m3
Soil separators	Sand	41.2	%
	Silt	54.0	%
	Clay	4.8	%
Soil texture		Silty loam soil	

(181.2) cm compared to the treatment A_0, which gave the lowest average reached (169.9) cm with an increase of (6.65%). The treatment B_1 was significantly superior and gave the highest average of (178.9) cm, while the treatment B_0 gave the lowest average of (172.3) cm, and the increase percentage was (3.83%). As for mineral fertilization, the treatment C_1 was significantly superior by giving the highest average of (180.48) cm, and the treatment C_0 gave the lowest average reached (170.64) cm with an increase percentage (5.76%). Moreover, for the bilateral interaction, the treatment of (bio-fertilizer A_1 + organic fertilizer B_1) was superior and gave the highest average reached (186.6) cm, while the treatment (A_0, B_0) for both fertilizers gave the lowest average reached (168.7) cm with an increase of (10.6%). While the bilateral interaction between (Bio-fertilizer A + mineral fertilization C) was superior and gave the highest average of (187.08) cm, and the treatment (A_0, C_0) gave the lowest average that reached (165.95) cm with an increase of (12.7%). Finally, no significant differences were observed between the treatments for the bilateral interaction between (organic fertilization B and mineral C). The triple interaction between (A, B, C) the fertilization treatment of all fertilizer types (A_1, B_1, C_1) was significantly superior and gave the highest average reached (191.50) cm compared to the treatment without fertilization (A_0, B_0, C_0) which gave the lowest average reached (166.07) cm and with an increase percentage was (15.3%).

This may be due to the role of organic fertilizers, which led to improve the physical and chemical properties of the soil and reflected on the growth parameters, including plant height (Scotti *et al.,* 2015). Otherwise, it may be attributed to the role of bio-fertilizers in improving root growth and increasing the surface area of the absorption area which in turn increases the rate of water and nutrient absorption of the plant, this result were consistent what (Esmailpour *et al.,* 2013; Rady *et al.,* 2016) findings. Or else it may be attributed to the fact that mineral fertilizers provide Nitrogen, which has a role in cell division and elongation (Muhammad et al. 2014). As well as, potassium's role in the necessary enzymes activation in growth and its role in the transfer of nutrients from the roots to the leaves and then increase the growth and plant height. The current biological processes in plant require energy to accomplish, and here comes the role of phosphorus in transfer energy to complete these processes that leading to increased plant height (Havlin *et al*., 2005; Ali, 2007).

Effect of mineral, organic, bio-fertilization on male flowering

Table 3 indicates that there was a significant difference between the fertilization treatments in the effect of male flowering trait. The treatment of bio-fertilization A_1 was superior and gave the highest average reached (59.482 days) compared to the treatment A_0 that gave the lowest average of (57.467 days) with an increase by 3.5%. Furthermore, the treatment B_1 was significantly higher and gave an average reached (59.217 days), while treatment of B_0 gave the lowest average (57.742 days) with an increase of 2.5%. As for the mineral fertilization, the treatment C_1 was significantly superior by giving the highest average of (59.3 days), and treatment of C_0 gave the lowest average (57.65 days) with an increase rate of 2.8%. As for the bilateral interaction, the treatment of (A_1 + B_1) was superior and gave the highest average of (60.05 days), while treatment of (B_0, A_0) for both fertilizers gave the lowest average by (56.55 days) with an increase of 6.1%. Fertilization treatment was significantly higher and gave an average of (59,915 days), and the treatment (A_0, C_0) gave the lowest average of (56.25 days) with an increase rate of 6.5%. Finally, no significant differences were observed between the treatments for the bilateral interaction between (B + C). The triple interaction between (A, B, C) fertilizers the fertilization treatment of all fertilizer types was significantly superior and gave an average of (61.00 days) compared to the treatment (A_0, B_0, C_0) which gave the lowest average of (55.10 days) with an increase rate of 10.7%.

The addition of mineral fertilizers NPK with organic fertilizers has led to the continuation of vegetative growth and delayed flowering, where the high additions of nitrogen lead to flowering and maturity. About 39% of nitrogen absorbed by Zea mays plant used for forming

Table 2: Effect of organic and mineral and bio-fertilization on plant height (cm).

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	166.07	171.33	168.7
	fertilization	165.83	176.43	171.1
fertilization	Without fertilization	169.00	182.67	175.8
	fertilization	181.67	191.50	186.6
Average		170.64	180.48	
LSD0.05		1.65	3.30	2.33
Bio-fertilizer * mineral fertilizer				
Without fertilization		165.95	173.88	169.9
fertilization		175.33	187.08	181.2
LSD0.05		2.33		1.65
Organic fertilizer * mineral fertilizer				
Without fertilization		167.53	177.00	172.3
fertilization		173.75	183.97	178.9
LSD0.05		2.33		1.65

Table 3: Effect of organic and mineral and bio-fertilization on male flowering.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	55.10	58.00	56.55
	fertilization	59.00	58.83	58.915
fertilization	Without fertilization	57.40	59.37	58.385
	fertilization	59.10	61.00	60.05
Average		57.65	59.3	
LSD0.05		0.63	0.31	0.44
Bio-fertilizer * mineral fertilizer				
Without fertilization		56.25	58.685	57.467
fertilization		59.05	59.915	59.482
LSD0.05		0.44		0.31
Organic fertilizer * mineral fertilizer				
Without fertilization		57.05	58.415	57.742
fertilization		58.25	60.185	59.217
LSD0.05		0.44		0.31

the male and female organs, and its provision helps to growth and developed the reproductive organs. As well as, the abundance of nitrogen also increases the size and the speed of cells division, which leads to increased growth and its continuity that represented by plant height and leaf area. This increasing has led to increase the shadows, which in turn has led to increased auxins and gibberellins activities, leading to internodes elongation, then increasing plant height, and delaying male and female flowering (Duete *et al.,* 2008). As well as, the role of organic fertilizers and improve the physical and chemical properties of soil, which was reflected in the continuation of vegetative growth for a longer period, which led to delayed flowering.

3. Effect of mineral, organic, bio-fertilization on female flowering

Table 4 indicates that there was a significant difference between the fertilization treatments in the effect of female flowering. The treatment A_1 was superior and gave the highest average of (67,427 days) compared to the treatment A_0 that gave the lowest average of (65.025 days) with an increase of 3.6%. The organic fertilization treatment B_1 was superior and gave the highest average of (66.352 days), while the treatment B_0 gave the lowest average of (66.1 days) with an increase of 0.3%. Moreover, the mineral fertilization, the treatment C_1 was superior by giving the highest average of (66.61 days) and the treatment C_0 gave the lowest average of (65.842 days) with an increase of 1.1%. As for the bilateral interaction (A + B) was superior and gave the highest average of (67.62 days), while treatment of (A_0, B_0) for both fertilizers gave the lowest average of (64.965 days) with an increase rate of 4.0%. In addition, the bilateral interaction between (A1 + C_1) gave a significant increase with a higher average reached (67.67 days) and the treatment (A_0, C_0) gave the lowest average reached (64.5 days) with an increase rate of 4.9%. Finally, the bilateral interaction between (B and C), the treatment of (B_1, C_1) gave a significant increases and giving the highest average of (66.52 days), and the treatment (B_0, C_0) gave the lowest average of (65.5 days) with an increase of 1.5%. As for the triple interaction between fertilizers, the fertilization treatment for all fertilizers types (A_1, B_1, C_1) was significantly superior and gave the highest average of (66.61 days) compared to the treatment of without fertilization (A_0, B_0, C_0) which gave the lowest average of (64.00 days) with an increase of 4.0%.

Effect of mineral, organic, bio-fertilization on chlorophyll spad

Table 5 indicates that there is a significant difference between the fertilization treatments in the effect of chlorophyll trait. The treatment A_1 was superior and gave the highest average of (29.217 spad) compared to the treatment A_0 that gave the lowest average of (26.177 spad) with an increase rate of 11.6%. Furthermore, the

Table 4: Effect of organic and mineral and bio-fertilization on female flowering.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	64.00	65.93	64.965
	fertilization	67.00	67.47	67.235
fertilization	Without fertilization	65.00	65.17	65.085
	fertilization	67.37	67.87	67.62
Average		65.842	66.61	
LSD0.05		0.12	0.25	0.17
Biofertilizer * mineral fertilizer				
Without fertilization		64.50	65.55	65.02
fertilization		67.18	67.67	67.42
LSD0.05		0.17		0.12
Organic fertilizer * mineral fertilizer				
Without fertilization		65.50	66.70	66.10
fertilization		66.18	66.52	66.35
LSD0.05		0.17		0.12

Table 5: Effect of organic and mineral and bio-fertilization on chlorophyll trait.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	25.27	26.50	25.88
	fertilization	25.60	27.34	26.47
fertilization	Without fertilization	25.63	28,83	27.23
	fertilization	25.69	36.72	31.20
Average		25.54	29.84	
LSD 0.05		0.86	1.71	1.21
Bio-fertilizer * mineral fertilizer				
Without fertilization		25.43	26.92	26.17
fertilization		25.66	32.77	29.21
LSD 0.05		1.21		0.86
Organic fertilizer * mineral fertilizer				
Without fertilization		25.45	27.66	26.55
fertilization		25.64	32.03	28.83
LSD 0.05		1.21		0.86

organic fertilization treatment B_1 was superior and gave the highest average of (28.837 spad), while the treatment B_0 gave the lowest average of (26.557 spad) with an increase rate of 8.5%. Finally, the mineral fertilization C_1 was superior by giving the highest average of (29.847 spad), and the treatment C_0 gave the lowest average of (25.547 spad) with an increase rate of 16.8%. As for the bilateral interaction (A + B) was superior and gave the highest average of (31.205 spad), while treatment of (A_0, B_0) for both fertilizers gave the lowest average of (25.885 spad) with an increase of 20.5%. Then, the bilateral interaction between (A + C), the fertilization treatment of (A_1, C_1) gave a significant increases and giving the highest average reached (32.775 spad) and the treatment of without fertilization (A_0, C_0) gave the lowest average reached (25.435 spad) with an increase of 28.8%. Besides, the treatment of (B_1, C_1) gave a significant increases and giving the highest average reached (32.03 spad), and the treatment (B_0, C_0) gave the lowest average of (25.45 spad) with an increase of 25.8%. As for the triple interaction between fertilizers (A, B, C) , the fertilization treatment for all fertilizers types was significantly superior and gave the highest average of (36.72 spad) compared to the treatment of without fertilization (A_0, B_0, C_0) that gave the lowest average of (25.27 spad) with an increase of 45.3%.

The reason for the treatments superiority of the organic and bio-fertilization and humic acid fertilization may be attributed to the role of organic fertilizers in improving the chemical and physical soil properties. It reflects positively in increasing the roots growth and penetration, as well as, increase the absorption of nutrients from the plant, including nitrogen and magnesium, which are the basic component of building a chlorophyll molecule in the plant (Havlin *et al.,* 2005). In addition to micro-bio organisms plays an important role in promoting root growth and increasing the surface area of the absorption area and then increasing the absorption rate of water and nutrients from the soil which leads to increased plant leaf area and chlorophyll content (Bonkowski *et al.,* 2000; Tahir and Sarwar, 2013).

Effect of mineral, organic, bio-fertilization on leaf area

Table 6 indicates that there was a significant difference between fertilization treatments in the effect on leaf area. The treatment A_1 was superior and gave the highest average of (4496.01 cm^2) compared to the treatment A_0 that gave the lowest average of (4218.47 cm^2) with an increase rate of 6.5%. The organic fertilization treatment B_1 was superior and gave the highest average of (4596.21 cm^2) while the treatment B_0 gave the lowest average of (4091.28 cm^2) with an increase of 12.3%. While the mineral fertilization, the treatment C_1 was superior by giving the highest average of (4476.87 cm^2) and the treatment C_0 gave the lowest average of (4210.61 cm^2) with an increase of 6.3%. The bilateral interaction (A_1 + B_1) was superior and gave the highest average of (4622.45 cm^2), while the treatment (A_0, B_0)

Table 6: Effect of organic and mineral and bio-fertilization on leaf area (cm^2).

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	3461.30	4272.67	3766.98
	fertilization	4534.27	4605.67	4569.97
fertilization	Without fertilization	4256.23	4374.93	4315.58
	fertilization	4590.67	4654.23	4622.45
Average		4210.61	4476.87	
LSD0.05		131.59	263.18	186.09
Bio-fertilizer * mineral fertilizer				
Without fertilization		3997.78	4439.17	4218.47
fertilization		4423.45	4514.58	4469.01
LSD0.05		186.09		131.59
Organic fertilizer * mineral fertilizer				
Without fertilization		3858.76	4323.80	4091.28
fertilization		4562.47	4629.95	4596.21
LSD0.05		186.09		131.59

Table 7: Effect of organic and mineral and bio-fertilization on leaves number.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	11.80	12.33	12.06
	fertilization	12.50	13.00	12.75
fertilization	Without fertilization	13.50	14.37	13.93
	fertilization	15.87	16.63	16.25
Average		13.41	14.08	
LSD0.05		0.89	1.78	1.26
Bio-fertilizer * mineral fertilizer				
Without fertilization		12.15	12.66	12.40
fertilization		14.68	15.50	15.09
LSD0.05		1.26		0.89
Organic fertilizer * mineral fertilizer				
Without fertilization		12.65	13.35	13.00
fertilization		14.18	14.81	14.50
LSD0.05		1.26		0.89

for both fertilizers gave the lowest average of (3866.98 cm^2) with an increase of 19.5 %. As well as, the bilateral interaction between (A + C), the fertilization treatment of (A_1, C_1) gave a significant increases and giving the highest average reached (4514.85 cm^2), and the treatment of without fertilization (A_0, C_0) gave the lowest average reached (3997.78 cm^2) with an increase of 12.9%. Moreover, the bilateral interaction between (B_1 and C_1) gave a significant increase with the highest average that reached (4629.95 cm^2), and the treatment of without fertilization gave the lowest average of (3858.76 cm^2) with an increase of 19.9%. Finally, the triple interaction between fertilizers (A, B, C), the fertilization treatment for all fertilizers types was significantly superior and gave the highest average of (4654.23 cm^2) compared to the treatment of without fertilization (A_0, B_0, C_0) which gave the lowest average of (3461.30 cm^2) with an increase of 34.4%. This may be due to the effect of organic fertilizers on the readiness of most essential nutrients and their absorption from the plant, which results in the expansion and elongation of the cell and increase its activity, which leads to an increase in the amount of protein and carbohydrates accumulated in the leaves,

In addition to its role in improving the chemical, physical, and biological soil properties, then reduces the soil alkalinity, which is reflected in increasing readiness of most major and minor nutrients for absorption from the plant, which present good agreement with (Zafar *et al.,* 2011) and (Faisal *et al.,* 2013) findings. This was due to the role of microorganisms in the secretion of some hormones and active substances in the Rhizosphere, such as gibberellin, cytokinins. As well as, auxins and some organic acids mono or dicarboxyl, which in turn effects on the pH values around the root zone, which helps to readiness the elements and most important of which is phosphorus and activate the root and the root hairs that had a broad area. This was similar to (Abd Al-Razak and El-Sheshtawy, 2013; Pandy *et al.,* 2013; Muhammad *et al.,* 2014) findings, which may be attributed to the positive effect of mineral fertilizers in the general activity of the plant and increase its leaf area. Since the Nitrogen element has an important role in providing appropriate food environment for plant growth, and then increases leaf area, and increasing the leaf content of chlorophyll to enter its formation and as a result increase photosynthesis outputs. The lack of nitrogen leads to leaves aging as a result of the destruction of the protein already found in the leaf, as well as the role of phosphorus in the transfer of energy necessary to accomplish the biological processes of the plant. Moreover, the role of potassium is to activate the enzymes responsible for the photosynthesis process and the transfer its outputs, which are used in growth as well as its role in the transfer of nutrients from the roots to the leaves and then increase the leaf area, (Ali, 2007; Jumaili, 2009)

Effect of mineral, organic, bio-fertilization on leaves number

Table 7 indicates that there was a significant

Table 8: Effect of organic and mineral and bio-fertilization on Nitrogen percentage in leaves %.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	1.31	1.47	1.39
	fertilization	1.38	1.24	1.31
fertilization	Without fertilization	1.06	1.09	1.08
	fertilization	1.18	1.24	1.21
Average		1.23	1.26	
LSD0.05		0.14	0.27	0.19
Bio-fertilizer * mineral fertilizer				
Without fertilization		1.35	1.36	1.35
fertilization		1.12	1.17	1.14
LSD0.05		0.19		0.14
Organic fertilizer * mineral fertilizer				
Without fertilization		1.18	1.28	1.23
fertilization		1.28	1.24	1.26
LSD0.05		0.19		0.14

Table 9: Effect of organic and mineral and bio-fertilization on Nitrogen percentage in leaves%.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	0.05	0.06	0.055
	fertilization	0.06	0.07	0.065
fertilization	Without fertilization	0.07	0.09	0.080
	fertilization	0,09	0.10	0.095
Average		0.067	0.080	
LSD0.05		0.02	0.04	0.03
Bio-fertilizer * mineral fertilizer				
Without fertilization		0.055	0.065	0.06
fertilization		0.080	0.095	0.087
LSD0.05		0.03		0.02
Organic fertilizer * mineral fertilizer				
Without fertilization		0.060	0.075	0/067
fertilization		0.075	0.085	0.080
LSD0.05		0.03		0.02

difference between the fertilization treatments in the effect on the number of leaves. The treatment A_1 was superior and gave the highest average of (15,092) compared to the treatment A_0 that gave the lowest average of (12.307) with an increase of 22.6%. Furthermore, the treatment B_1 was superior and gave the highest average of (14.5) while the treatment B_0 gave the lowest average of (13) with an increase of 11.5%, while no significant difference was observed between the mineral fertilization treatments. As well as, no significant differences were observed between all the bilateral interaction treatments.

As for the triple interaction between fertilizers, there was also no significant difference between treatments. This may be due to the role of microorganisms in releasing the organic matter from their sources and the release of sufficient major and minor nutrients from the root zone and absorption by the plant from the initial stages of growth and increasing shoot. This action was reflected in increasing the photosynthesis outputs from the source (leaves) till the reproductive stage, which led to support and strengthen the grain with all the essential elements and increases its number (Narula, 2000; Swedrzynska, 2000; Barsoum and Attia, 2013). Else, this may be because the mineral fertilizers increase nutrients in the soil solution and increase the readiness for absorption from the plant, which positively reflected in the indicators of crop growth in general.

Effect of organic, mineral, bio-fertilization on Nitrogen percentage in leaves%

Table 8 indicates that there was a significant difference of the treatment A_1 in the effect on the nitrogen percentage, which gave the highest average of the Nitrogen percentage in leaves reached (1.35%) compared to the treatment A_0 that gave the lowest average of (1.14%) with an increase of (18.4%), while the organic and mineral fertilization treatments. As well as, no significant differences were observed between for all the bilateral and triple interaction treatment. This may be due to the role of the organic matter in releasing the elements involved in its composition, especially nitrogen and phosphorus. As well as, miner nutrients then increasing their readiness in the soil and then easily absorbed by the plant, this consistent with (Blackmore, 2000; Havlin *et al.,* 2005) findings. It also may be due to the ability of microorganisms to preparation the energy sources and decomposed the organic matter, which helps to improve soil properties and reduces nitrogen losses, and this consistent with (Turan *et al.,* 2006; Khan *et al.,* 2006) findings.

Effect of organic, mineral bio-fertilization on Phosphorus percentage in leaves%

Table 9 indicates that there was a significant difference of the treatment A_1 in the effect on the phosphorus percentage, which gave the highest average of the Phosphorus percentage in leaves reached (0.087%) compared to the treatment A_0 which gave the lowest average of (0.06%) with an increase of (45%). While the organic and mineral fertilization treatments. As well as, no significant differences were observed between for all the bilateral and triple interaction treatment.

Table 10: Effect of organic and mineral and bio-fertilization on Potassium percentage in the leaves %.

Bio-fertilizer	Organic fertilizer	Mineral fertilizer		Average
Without fertilization	Without fertilization	2.20	2.60	2.40
	fertilization	2.67	2.27	2.97
fertilization	Without fertilization	3.27	3.60	3.44
	fertilization	3.50	3.70	3.60
Average		2.91	3.29	
LSD0.05		0.17	0.34	0.24
Biofertilizer * mineral fertilizer				
Without fertilization		2.44	2.94	2.69
fertilization		3.39	3.65	3.52
LSD0.05		0.24		0.17
Organic fertilizer * mineral fertilizer				
Without fertilization		2.74	3.10	2.92
fertilization		3.09	3.85	3.29
LSD0.05		0.24		0.17

This may be due to the positive effect of bio-fertilization in increasing the readiness of phosphorus in the soil and plant, in addition to the ability of fungi and bacteria in the production of growth regulators, especially gibberellins, cytokinins, auxins. This process stimulates better growth for plant and building a high dense root, which is reflected in the increased absorption of nutrients, including phosphorus this is agreed with (Dobbelaere *et al.*, 2003; Afzal *et al.*, 2005). This increase may be due to the role of organic matter in stimulating the root to absorb nutrients and its impact on the phosphorus percentage in the leaves as (Kaleem *et al.,* 2009) pointed out. Additionally, this may be due to the availability of essential nutrients in mineral fertilizer, as well as, the role of bio-fertilizer in the production of organic acids that solvents phosphorus, calcium chelates compounds, phosphorus release and the role of organic matter in improving the chemical and physical soil properties, this is consistent with (Shekhar *et al.,* 2006) findings.

Effect of mineral, organic, bio-fertilization on Potassium percentage in leaves %

Table 10 indicates that there was a significant difference between the fertilization treatments in the effect on the potassium percentage in the leaves. The treatment A_1 was superior and gave the highest average of (3.517%) compared to the treatment A_0 that gave the lowest average of (2.685 %) with an increase of 30.9%. The organic fertilization treatment B_1 was superior and gave the highest average of (3.285%), while the treatment B_0 gave the lowest average of (2.917%) with an increase of 12.6%. Moreover, the treatment C_1 was superior by giving the highest average of (3.292%) and the treatment C_0 gave the lowest average of (2.91 %) with an increase of 13.1%. As for the bilateral interaction (A + B) was superior and gave the highest average of (3.6 %), while treatment (A_0, B_0) for both fertilizers gave the lowest average of (2.4 %) with an increase of 50%. Finally, no significant differences were observed between other bilateral interaction and triple interaction treatment.

This may be due to the ability of bio-fertilizers to secretion growth regulators, including hormone Indole-3-acetic acid (IAA), which stimulates the absorption of nutrients, including potassium. As well as the role of bacterial organisms in increasing the readiness of potassium and preserved it from the fix and loss processes through the secretion of some enzymes and organic acids. This role increase the readiness of nutrients, including potassium, and the role of organic matter in releasing the nutrients from its compounds, including potassium and increase its readiness and absorption from the plant, and this is consistent with (Zahir *et al.,* 2004; Naveed *et al.,* 2008) findings.

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