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EFFECT OF INOCULATION WITH N_2 FIXERS, MICRONUTRIENTS AND INORGANIC N ON COUNTS OF AZOSPIRILLUM WITH RHIZOSPHERE OF BARLEY PLANT IN SOUTH SINAI AREA- EGYPT

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ABSTRACT

In order to study the effect of bio-fertilizers, micronutrients and N mineral application on barley plant under calcareous soil conditions. Field experiment was conducted at Experimental Research Station –Ras Sudr, D.R.C. in 2017-and 2018 winter seasons. Experimental factors were: micronutrients as foliar application (Fe, Mn Zn at 250 ppm), mineral N (50, 75 and100 kg N/fed) and Bio-fertilizers (control, *Azotobacter chroococcum* and *Azospirillum brasilense either* single or mixed application).

The obtained results found that, significant effects of either bio-fertilizers, mineral N and micronutrients as foliar application on yield parameters, mineral contents of barley plants, yield and its attributes, P and N mineral contents of barley grains and microbial activity in barley plant rhizosphere. Interaction of mixed bio-fertilizers treatment micronutrients foliar application of 250 ppm gave maximum enhancement for most studied treatments. Barley straw and grains yield during the two successive seasons. While P, N contents of both barley shoots and grains yield recorded maximum values with mixed bio-fertilizers treatment, mineral N and Micronutrients as foliar application of 250 ppm. The most effect treatment for microbial counts of bio-fertilizers, yield parameters and nutrients content was Mixture bio-fertilizers Mineral N at 100 units/fed and Mocronutrients 250ppm.

Key Words: Barley, Salinity- Bio-Fertilization, Micronutrients and Mineral N.

INTRODUCTION

Barley is grown in Egypt on a large scale under wide range of environmental conditions. Generally it is considered as one of the most adequate cereal crops where environmental conditions are not suitable for growing others **(Badr El-Din and Saber, 2007).** In recent years, about two thirds of barley crop has been used for feed, one-third for malting and about 2% directly for food **(Baik and Ullrich, 2008).**

Ghanbari *et al*., (2012) reported that barley is a fast growing, cool season, annual grain crop, that could be used as forage as well as cover crop to improve soil fertility**. Yousufinia *et al*. (2013)** stated that barley is considered highly salt tolerant of the agriculturally important cereals and has been grown successfully in fields that irrigation has rendered unsuitable for other crops.

Saline calcareous soils are frequently characterized by low bioavailability of plant nutrients. Nutrients deficiency in the soil for nitrogen, phosphorus, potassium, zinc, iron and manganese have been identified as some major constraints in crop production and should be added to the soil accordingly (**Armin and Asgharipour**). While , **Shomeili *et al*., (2011)** reported that the **s**alinity is one of the most devastating forms of land degradation which severely affects crop production worldwide especially in arid and semiarid regions. **Al Hakimi, (2000)** decided that the increasing osmotic stress in plants leads to stomatal closure, resulting in reduction of CO_2 availability and photosynthesis, thus increasing the possibility of reactive oxygen species formation . **Ashraf and Harris, (2004)** stated that the deleterious effects of salinity on plant growth are associated with (1) low osmotic potential of soil solution (water stress), (2) nutritional imbalance, (3) specific ion effect (salt stress), or (4) a combination of these factors .

Several environmental problems like drought, salinity, nutrient imbalances (including mineral toxicities and deficiencies) and extremes of temperature adversely affect plant growth , development and final yield performance of a crop and destroyed farming stability systems and biological cycles. These problems altogether encourage the use of bio-fertilizers to increase crop productivity worldwide (**Grewal, 2010**).

Bio-fertilizers including Azospirillum and Azotobacter, which have been given much attention for their role in biological fixation of N_2 and thus growth and total yield of plant (**Abdel-Mouty *et al*., 2001; Rawia *et al*., 2006 and Kizilkaya, 2008**). Inoculation of plants with Azospirillum and Azotobacter causes morphological changes, such as an increase in root surface area through the production of more root hairs, which in turn enhance mineral uptake (**Steenhoudt and Vanderleyden, 2000**). The effects of microorganisms, which fixing nitrogen in free life; i.e. Azospirillum and Azotobacter, are mainly in the promotion of cereal growth, as they produce growth promoting substances. The great interest in the biological fixation of nitrogen in cereal is related to the better

utilization of water and also by showing better photosynthetic effectiveness by these crops (**James, 2000 and Ramos *et al.*, 2002**).

Bio-fertilizer is defined as a substance which contains living organisms which, when applied to seed, plant surface, or soil, colonize the rhizosphere or the interior of plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (**Turan and Fikrettin,2013**). **Hassan *et al.*,** (**2015**) reported that the integration treatment (Bio and mineral fertilizers) for yield, nutrients and biochemical components contents of wheat was (P4+Zn1 plus Mycorrhizae + Azotobacter) which achieved 5.45 and 2.21ton/fed for straw and grains respectively in sandy soil, while being 9.5 and 4.16 ton/fed in clay soil of New Valley, Egypt. **Attia *et al.*, (2015)** reported that the integration between bio and mineral fertilizers was P_2+ (AZ)+ (SD)+(PDB)+ Zn_1 under conditions of the irrigation of every 10 days which gave 2.34, 11.1, 0.99 and 1.82 for weight straw, seeds, oil and fiber (Mg/ha^{-1}) of flax plant respectively in the first season, while in the second season it achieved 2.48, 11.4, 1.09 and 1.89 (Mg/ha^{-1}).

Nowadays attention to bio-fertilizer has been increased due to the advancement in countries research development, prices of chemical fertilizers and attention to sustainable agricultural systems (**Yosefi *et al.*, 2011**).The plant growth promoting rhizobacteria (PGPR) as Azospirillum , Azotobacter and phosphate dissolving bacteria (PDB) are a group of bacteria that actively colonize plant roots and increase plant growth and yield. The mechanisms by which PGPRs promote plant growth are not fully understood, but are thought to be due to:(a) the ability to produce phytohormons (b) asymbiotic N_2 fixation (c) against phytopathogenic microorganisms by producing siderophores, the synthesis of antibiotics, enzymes and/or fungicidal compounds, and also (d) solubility of mineral phosphates and other nutrients (**James, 2000 ; Burdman *et al.*, 2002 ; Ramos, *et al.*, 2002; Jarak *et al.*, 2004 and Gholami *et al.*, 2009**).

The purpose of this research was to study the effect of bio-fertilizers, micronutrients and mineral nitrogen application on barley plants grown under saline conditions.

MATERIALS AND METHODS

A field experiment was carried out at two successive seasons of (2017 and 2018) completely randomized field experiments with three replications in Ras Sader at Sinai area, (between the intersection of the longitude 30º 34' 51" N and the altitude 30º 15' 40" E). Some physico-

chemical properties of the studied soils were reported in Table (1). The experimental field was flood irrigated of 4x3 m dimensions for the experimental plots.

The response of barley plant to bio-fertilizers and N mineral and micronutrients application was measure under saline conditions was conducted at agricultural experimental station of Desert Research Center (D.R.C.) at Ras Sadr, South Sinai. Barley (*Hordeum vulgare*) was the investigated crop, sown in the last week of Novemeber 2017 in plots (3×4m) in rows. The mineral fertilization was applied as a general treatment using single rates of 31kgP_2O_5/fed. as calcium super phosphate(15.5%P_2O_5) mixed with the soil during soil preparation .N fertilizers were added at three rates 50, 75 and 100 kgN/fed. as ammonium sulphate $(NH4)_2SO_4$ .While K applied at one rate 45 kg K_2O as potassium sulphate K_2SO_4 . N and K applied at three stages seedling, tillering and heading stages. The dose of $10m^3$ organic manure was added by mixing with 0-20 surface layer before sowing for all treatment. Physical and chemical analyses of the soil and irrigation water are presented in Tables (1 and 2).

Table (1): Chemical analysis of the experimental soil (Average of both seasons).

Mechanical analysis				pH	E.C dSm^{-1}	CaCO %	Chemical analysis							
Sand %	Silt %	Clay %	Textur				Soluble cations (meq/l)				Soluble anions (meq/l)			
							Na^+	Ca^{++}	Mg^{++}	K+	CO_3^-	HCO_3	Cl^-	SO_4^{--}
69.28	17.2	13.52	Sandy loam	8.42	9.61	46.2	64	21.6	10.82	0.57	--	21.7	61.6	13.6

Available nutrients mg/kg							
N	P	K	Zn	Mn	Fe	Cu	Mo
32	3.7	108	0.61	4.28	2.5	0.44	0.028

Soil chemical analysis were conducted and measured at soil paste extract.Soil pH was measured at 1:2.5 soil/water suspension

Table (2): Chemical analysis of irrigation water.

pH	EC dSm^{-1}	Soluble cations (meq/l)				Soluble anions (meq/l)				S.A.R
		Na^+	Ca^{++}	Mg^{++}	K^+	CO_3^-	HCO_3^-	Cl^-	SO_4^{--}	10.4
7.62	8.01	48.32	25.93	5.35	0.48	---	2.41	58.5	20.6	

Bio-fertilization: Four different bio-fertilizers treatments (control, *Azotobacter chroococcum, Azospirillum brasilense* and mixed bio-fertilizers treatments (*A. chroococcum + Azospirillum brasilense*) were performed.

Isolation of *Azotobacter* and *Azospirillum*:

For isolation of *Azotobacter* and *Azospirillum* different soil samples were collected from saline soil at different sites of South Sinai. The highest isolates for nitrogen fixation according to **Page *et al.*,1982** were selected for further study. Each isolate was grown on its specific medium containing different sodium chloride concentrations (2,4,6,8,10%). Also, at different incubation temperature (25,30,40,45,50°C) and different pH (5-9). Growth was measured at 600 nm. Selected Azotobacter and *Azospirillum* isolates were purified and identified according to **Bergey's Manual of Determinative Bacteriology (1994).** The selected isolates (Azotobacter *chroococcum* and *Azospirillum brasilense*) were subjected to different biochemical tests for screening their hormonal **(Rizzolo *et al.*, 1993)** and enzymatic activity **(Barrow andVeltham,1993).**

Fresh liquid culture of *Azotobacter chroococcum and Azospirillum brasilense* was used for soil applications single or in combination at the rate of 10^8colony forming unit (cfu/ml).

Rhizosphere soil samples were collected at heading and harvesting stages. The samples were analysed for total counts of microorganisms according to **Nautiyal (1999).** Ashbys and Doberiner media were used for *Azotobacter* and *Azospirillum* densities, respectively. Soil samples were analyzed for: Nitrogenase activity using a standard acetylene reduction assay as described by **Haahtela *et al.*, (1981)**. For determination of phosphatase activity disodium phenylphosphate was served as enzyme substrate **(Őhlinger, 1996).** Plant samples were taken at harvesting from each treatment, dried at 70°, and ground using stainless steel equipment for the determination of N,P, K, Mg, Ca and Na. Plant nutrients were determined as follows: Total nitrogen using the micro kjeldahl method **(AOAC,1980).** Phosphorus, potassium, calcium, magnesium and sodium using dry ashing technique according to **Cottenie *et al.*, (1982).**

Growth parameters: At heading and harvesting stages plants were taken from each plot for estimating plant height, fresh and dry weights.

Yield and yield components: At harvest, one square meter from each plot was taken to determine grains, straw and biological yields.

Nutritional value of grains: The dried grains were finally ground to determine P, K, Mg, Ca and Na concentration as stated by **Cottenie *et al.*, 1982.** Total nitrogen percentage was determined according to the method described by **AOAC. (1980)** . The crude protein content was

calculated by multiplying total nitrogen concentration by a factor of 6.25. Total free amino acids and proline contents were determined calorimetrically according to **Bates *et al.*,(1973).**

Statistical analysis: All the obtained data from each season were exposed to the proper statistical analysis of variance according to **Gomez and Gomez (1984).** LSD at 0.05 level of significance was used for the comparison between means.

RESULTS AND DISSUASION

Effect of salt stress on Nitrogen fixation by *Azotobacter* and *Azospirillum* isolates and on their densities.

Data presented in Table 3 indicate the ability of bacterial isolates to alleviate salt stress, which were grown in different salt concentrations. The results showed that the ***Azotobacter*** isolate (No.3) and ***Azospirillum*** isolate (No. 1) were recorded the highest mean value for N_2 fixation. Obtained results were in compatible with obtained by **Abd El-Gawad and El-Shazly (2021).**

Selection and identification of bacterial isolates.

The most active *Azotobacter* and *Azospirillum* isolates in N_2 fixation were No. 3 and No. 1 respectively**..**

Table (3): Viable count, total nitrogen and nitrogenase activity of azotobacter and azospirillum – isolates under different salinity levels.

Strains No.	Counts of Azotobacter and Azospirillum (10^4 CFU / ml)				Total Nitrogen (ppm)				N2-ase activity (ml C2 H4 / L / dray)			
	Salinity levels (ppm)				Salinity levels (ppm)				Salinity levels (ppm)			
	2000	4000	6000	8000	2000	4000	6000	8000	2000	4000	6000	8000
Azotobacter 1	46	26	10	11	58	70	49	22	94.4	93.9	71.5	53.9
Azotobacter 2	73	57	21	8	70	77	56	24	141.3	140.9	123.5	109.9
Azotobacter 3	86	72	70	33	112	105	70	73	133.2	230.1	198.2	170.2
Azotobacter 4	76	50	66	24	84	91	83	35	205.4	196.1	175.1	162.3
Azotobacter 5	68	50	40	5	63	54	62	46	115.65	101.5	82.9	56.5
Azospirillum 1	80	86	56	20	105	91	77	62	205.36	196.1	174.20	161.23
Azospirillum 2	64	60	36	12	84	77	56	25	94.36	93.9	70.4	53.25
Azospirillum 3	74	80	54	16	56	63	61	21	96.2	95.8	72.1	55.40
Azospirillum 4	66	70	45	15	42	28	23	14	88.3	86.5	66.3	49.4
Azospirillum 5	51	31	17	9	49	56	48	19	90.5	88.7	71.5	55.8

Effect of salt stress on phytohormones and proline content by *Azotobacter* and *Azospirillum* isolates.

Results presented in Tables 4 clearly showed the ability of bacterial isolates to alleviate salt stress, and produce indole acetic acid, gibberellic acid and cytokinine on different salt concentration. Also, obtained results in Table 4 showed the ability of *Azotobacter* and *Azospirillum* isolates on producing proline with varying concentration

with different salt concentrations.The results showed that the *Azotobacter* isolate (No.3) and *Azospirillum* isolate (No. 1) were recorded the highest mean value for production of plant growth regulators and proline content. The results are in compatible with that obtained by **Abd El-Gawad and Omar (2014).**

Table (4): Auxin (IAA), gibberellins (ga), cytokinins (cks) and proline content of Azotobacter and Azospirillum – isolates under level of salinity.

Strains No.	IAA content (ppm)				GA content (ppm)				Cks content (ppm)				Proline content (ppm)			
	Salinity levels (ppm)				Salinity levels (ppm)				Salinity levels (ppm)				Salinity levels (ppm)			
	2000	4000	6000	8000	2000	4000	6000	8000	2000	4000	6000	8000	2000	4000	6000	8000
Azoto 2	3.9	0.73	0.21	0.00	8.8	3.1	1.12	0.61	4.70	4.12	2,35	0.82	0.224	0.518	0.798	0.810
Azoto 3	5.63	3.14	2.65	1.90	7.75	5.70	3.40	1.63	6.04	5.69	3.80	2.75	0.294	0.866	1.174	1.833
Azoto 4	4.13	2.39	2.12	1.61	7.81	6.01	3.30	1.51	6.55	6.84	2.96	1.48	0.269	0.539	0.788	0.800
Azosp 1	4.71	2.51	1.98	1.16	6.31	4.37	3.31	1.60	5.72	4.18	3.24	2.33	0.292	0.771	0.918	1.224
Azosp 3	3.56	0.62	0.17	0.00	8.11	2.84	1.01	0.43	4.20	3.92	2.13	0.80	0.214	0.508	0.611	0.63
Azosp 4	3.11	2.60	1.96	1.28	5.82	6.86	3.82	2.71	4.88	4.97	3.55	2.80	0.209	0.502	0.537	0.64

Selection and identification of bacterial isolates.

The most active ***Azotobacter*** and ***Azospirillum*** isolates in N_2 fixation were No. 3 and No. 1 respectively. Results presented in Table 5 showed that the morphological and biochemical characteristics of selected bacterial isolates, ***Azotobacter*** isolate No.3 identified as ***Azotobacter chrococcum,*** *Azospirillum* No. 1 identified as ***Azospirillum brasilensce.***

Table (5): Morphological and biochemical characters of the isolated selected bacteria.

Test	*Azotobacter* No. 3	*Azospirillum* No.1
Shape	Ovoid	Curved
Gram stain	-	-
Motility test	+	+
Catalase	+	+
Starch hydrolysis	+	-

Effect of bio-fertilizers, micronutrients and N mineral application on soil microbial activity in rhizosphere of barley plant.

Active microbiological processes in soil increase the speed of synthesis and mineralization of organic matter leading to healthy plant nutrition.

Total microbial counts:

The results in Table 6 showed that, initial total microbial counts in Ras Sadr soil was 31×10^5 cfu/g dry soil. The changes in the counts affected by salinity, stage of plant growth, bio-fertilizers treatments, micronutrients and mineral N application .

Generally, the total counts tended to increase in all treatments compared to control. Remarkable increases were recorded at heading stage compared with harvesting stage of plant growth. Mixed bio-fertilizers treatment recorded highest total microbial counts in rhizosphere of barley plant compared with single bacterial treatment. The most effect treatment for microbial counts of bio-fertilizers, yield parameters and nutrients content was mixture bio-fertilizers mineral N at 100 kg/fed and micronutrients at concentration 250 ppm.

Bio-fertilizers treatments increased microbial counts by 30 % relative to control. **SubbaRao (1993)** reported that microbial inoculants improve fertilization, increase the number and biological activity of desired microorganisms in the root environment. These results are compatible with those obtained by **Ashrafuzzaman *et al.*, (2009)** who reported that inoculation with the plant growth promoting rhizobacteria (*Azotobcter, Bacillus megaterium*) had stimulation effect on the population of rhizosphere microorganism by increasing their numbers more than 50% at the end of the experiment comparing with the number recorded before planting.

Azospirillum counts:

Results in Table, 7 revealed that Azospirillum counts were generally higher in inoculated treatments than in non-inoculated ones. Bio-fertilizer application either alone or in mixed treatments significantly increased counts in ascending order compared to control treatment. Application of bio-phosphate fertilizer and mineral P fertilizer may tend to increase the counts of effective microorganisms. i.e. *Azotobacter* spp., *Azospirillum* spp, rhizobium spp. and the total viable bacteria as well.

Azotobacter densities:

The growth of *Azotobacter* colonies were recorded during two stages and two seasons in the rhizosphere of barley as being influenced by different bio-fertilizers treatments, micronutrients and mineral N application. Results in Table 8 showed that Azotobacter treatment harbored a lesser density of Azotobacter colonies than the inoculated one. Inoculation significantly increased Azotobacter densities in the rhizosphere of barley especially in mixed treatment at vegetative stage (90 days) of the second season amounted to 148×10^3cfu/g dry soil. The promoting effect due to application of *A. chroococcum* was not only due to the nitrogen fixation but also to the production of plant growth promoting substances, production of amino acids, organic acids, vitamins and antimicrobial substances as well, which increase soil fertility, microbial community and plant growth **(Revillas *et al.*, 2005 and Yosefi *et al.*, 2011).**

Table (6): Effect of N mineral, micronutrients and bio-fertilizers on total microbial counts with rhizosphere of barley plant.

Micronutrient	N- Mineral	Bio-Fertilizers	Total microbial counts (10^5 CFU / g dry soil)							
			Days after sowing							
			1st Season				2nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	52	66	69	65	58	79	81	66
		Azotobacter	81	96	99	90	89	108	110	99
		Azospirillum	69	84	88	75	78	96	97	84
		Mixture	93	108	113	99	101	119	122	110
	75 Unit	Control	58	73	83	67	65	81	94	76
		Azotobacter	86	112	120	91	65	81	94	76
		Azospirillum	69	93	100	79	77	111	110	87
		Mixture	106	122	131	115	115	137	142	124
	100 Unit	Control	64	81	92	78	72	93	102	89
		Azotobacter	96	123	134	97	104	134	146	109
		Azospirillum	83	109	122	103	92	120	135	92
		Mixture	117	139	148	125	127	141	161	134
With	50 Unit	Control	71	88	95	81	79	91	103	91
		Azotobacter	83	102	111	96	97	114	124	107
		Azospirillum	78	95	103	90	88	102	112	99
		Mixture	108	127	136	116	120	139	147	125
	75 Unit	Control	82	99	108	89	91	112	119	98
		Azotobacter	97	116	124	114	103	128	135	125
		Azospirillum	90	108	115	106	97	119	128	114
		Mixture	129	147	156	136	138	160	170	145
	100 Unit	Control	85	104	114	89	94	113	124	109
		Azotobacter	101	128	136	115	111	141	148	126
		Azospirillum	93	120	130	103	106	134	133	114
		Mixture	140	165	174	151	151	171	181	163
$LSD_{0.05}$ Micronutrients			4.34	4.57	4.81	4.79	5.50	5.31	5.45	6.40
$LSD_{0.05}$ N-Mineral			4.31	5.90	6.87	4.53	4.66	6.11	7.12	4.80
$LSD_{0.05}$ Bio-fertilizers			0.99	1.04	1.04	0.95	1.04	1.06	1.07	0.99
$LSD_{0.05}$ M x N			1.81	2.47	2.88	1.90	1.95	2.56	2.99	2.01
$LSD_{0.05}$ M x Bio			1.40	1.47	1.47	1.34	1.47	1.51	1.51	1.39
$LSD_{0.05}$ N x Bio			1.40	1.47	1.47	1.34	1.47	1.51	1.51	1.39
$LSD_{0.05}$ Inter.			1.98	2.08	2.08	1.90	2.08	2.13	2.13	1.97

Table (7): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on counts of azospirillum with rhizosphere of barley plant.

Micronutrient	N- Suplementation	Inoculation	Counts of Azospirillum (10^3 CFU / g dry soil)							
			Days after sowing							
			1st Season				2 nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	35	43	49	38	40	51	53	40
		Azotobacter	61	74	80	70	68	80	86	73
		Azospirillum	52	63	68	64	57	69	74	67
		Mixture	71	75	93	78	80	100	100	83
	75 Unit	Control	41	52	60	46	47	57	65	53
		Azotobacter	68	90	99	71	75	98	104	76
		Azospirillum	60	70	78	59	65	79	76	68
		Mixture	91	100	111	89	98	107	114	102
	100 Unit	Control	44	60	69	56	51	69	76	61
		Azotobacter	75	104	110	87	76	110	119	86
		Azospirillum	64	88	101	80	71	96	106	78
		Mixture	100	118	127	110	106	124	134	115
With	50 Unit	Control	55	68	75	62	60	75	80	66
		Azotobacter	67	81	91	78	76	89	97	87
		Azospirillum	58	73	82	70	66	80	89	80
		Mixture	81	105	114	96	89	112	120	95
	75 Unit	Control	63	78	88	68	71	86	94	72
		Azotobacter	75	95	101	92	83	101	110	99
		Azospirillum	70	86	93	84	76	91	100	89
		Mixture	109	126	135	113	124	131	140	120
	100 Unit	Control	70	88	95	78	75	96	100	82
		Azotobacter	82	101	113	92	90	108	118	104
		Azospirillum	71	96	105	83	80	95	107	96
		Mixture	115	130	142	130	120	133	155	127
$LSD_{0.05}$ Micronutrients			3.65	4.50	4.48	4.69	4.17	3.72	4.81	5.09
$LSD_{0.05}$ N-Mineral			4.21	5.98	6.15	4.85	4.11	5.19	6.38	4.62
$LSD_{0.05}$ Bio-fertilizers			0.92	0.95	1.00	0.93	0.97	0.97	1.05	0.92
$LSD_{0.05}$ M x N			1.77	2.51	2.58	2.03	1.72	2.17	2.68	1.94
$LSD_{0.05}$ M x Bio			1.31	1.35	1.42	1.32	1.37	1.38	1.49	1.30
$LSD_{0.05}$ N x Bio			1.31	1.35	1.42	1.32	1.37	1.38	1.49	1.30
$LSD_{0.05}$ Inter.			1.85	1.91	2.01	1.87	1.93	1.95	2.10	1.84

Table (8): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on counts of azotobacter in rhizosphere of barley plant.

Micronutrient	N-Suplementation	Inoculation	Counts of Azotobacter (10^3 CFU / g dry soil)							
			Days after sowin g							
			1st Season				2 nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	44	54	58	48	49	61	65	51
		Azotobacter	70	84	89	80	78	90	96	85
		Azospirillum	60	72	77	74	67	79	85	78
		Mixture	82	95	102	88	90	102	110	93
	75 Unit	Control	49	62	70	56	58	68	77	62
		Azotobacter	77	100	109	81	85	107	116	85
		Azospirillum	68	81	89	69	76	88	86	80
		Mixture	100	111	121	109	109	118	129	113
	100 Unit	Control	53	70	79	66	61	77	87	71
		Azotobacter	84	113	121	96	88	121	129	96
		Azospirillum	73	99	110	90	81	106	117	90
		Mixture	109	128	136	118	117	134	145	125
With	50 Unit	Control	64	79	84	72	70	86	90	76
		Azotobacter	78	92	101	89	86	99	108	98
		Azospirillum	69	84	93	80	77	90	100	92
		Mixture	91	116	125	107	99	122	131	106
	75 Unit	Control	73	88	98	78	81	96	105	83
		Azotobacter	85	104	112	103	93	111	120	109
		Azospirillum	79	97	103	95	87	102	111	99
		Mixture	118	136	145	124	125	143	153	130
	100 Unit	Control	77	99	104	88	86	106	112	92
		Azotobacter	92	112	123	104	100	119	130	115
		Azospirillum	82	109	119	93	86	107	115	107
		Mixture	126	152	161	140	133	148	169	139
$LSD_{0.05}$ Micronutrients			3.91	4.72	4.90	4.69	3.89	4.22	4.79	5.14
$LSD_{0.05}$ N-Mineral			4.10	5.98	6.52	4.66	4.09	5.57	6.43	4.55
$LSD_{0.05}$ Bio-fertilizers			0.94	1.01	1.04	0.97	0.95	0.98	1.08	0.93
$LSD_{0.05}$ M x N			1.72	2.51	2.73	1.95	1.71	2.33	2.70	1.91
$LSD_{0.05}$ M x Bio			1.33	1.43	1.47	1.37	1.34	1.38	1.53	1.31
$LSD_{0.05}$ N x Bio			1.33	1.43	1.47	1.37	1.34	1.38	1.53	1.31
$LSD_{0.05}$ Inter.			1.88	2.02	2.08	1.93	1.90	1.96	2.16	1.85

Effect of bio-fertilizers, micronutrients and N mineral application on yield parameters of barley plant:

Yield parameters of barley plant

Regard to the yield components of barley plants at Tables (9, 10, 11, 12, 13 and 14) for plant height cm, shoot dry weight (g / plant), root dry weight (g / plant), number of tillers per plant, earing features, grain and straw yield of barley plants respectively . These yield parameters take the same trend as the following; the foliar application of micronutrients had higher effect in increasing yield parameters of barley than untreated with micronutrients. The addition of mineral N increase yield parameters with increasing mineral N rates. The bio-fertilizers

application increased yield parameters especially up to 100 kg N/fed. with mineral fertilizers . Bio- fertilizers were arrange as power effect on yield components as follows : Azotobacter and Azospirillum > Azotobacter > Azospirillum. The most effect treatment for yield parameters and nutrients content was mixture bio-fertilizers mineral N at 100 kg/fed under foliar application with micronutrients. Therefore, the increases of yield may be due to the increase in soluble phosphrous in plants and/or production of some growth promoters by P-dissolving bacteria and some other microbes in the plant rhizosphere. These findings are in accordance with **Ghanem and El-Abbas, (2009).**

Table (9): Effect of inoculation with N2 fixers, micronutrients and inorganic N on plant height with rhizosphere of barley plant.

Micronutrient	N- Mineral	Inoculation	Plant height cm							
			Days after sowing							
			1st Season				2 nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	42.5	50.4	62.6	80.3	46.2	53.8	65.2	84.3
		Azotobacter	60	67.5	78	87.4	65.6	78.4	86.7	92.2
		Azospirillum	53	62.1	73	76.2	59.7	65.1	73.9	83.1
		Mixture	65.5	70.9	84	91.6	69.1	79.8	90.5	98.7
	75 Unit	Control	45.7	54.8	65.4	83.5	50.4	58.7	70.2	92.5
		Azotobacter	65	70.6	82.9	99.8	76.1	83.1	89.2	103.1
		Azospirillum	56.9	67.2	78.1	97.2	70.4	74.8	83.1	99.2
		Mixture	66.7	77.5	88.6	102.1	81.8	87.3	95.4	104.2
	100 Unit	Control	48.6	56.9	67.8	86.4	52.3	66.7	87.5	93.2
		Azotobacter	67.2	74.1	88,2	95,3	79.4	85.2	96.7	105.2
		Azospirillum	62.5	68.6	81.4	90.1	70.2	78.9	89.6	101
		Mixture	69.4	81.2	91.3	97.5	82.5	88.8	99.9	108
With	50 Unit	Control	46.2	55.4	66.2	88.2	49.2	58.9	70.6	89.7
		Azotobacter	70.4	76.1	84.8	97.4	74.2	79.2	88.9	93.1
		Azospirillum	66.6	70.2	80.4	90.2	68.6	73.6	82.5	93.1
		Mixture	73.1	75.8	93.6	99.6	76.1	83.5	96.1	103
	75 Unit	Control	49.8	58.2	69.2	93.2	56.6	70.6	82.4	95.9
		Azotobacter	73.6	78.9	94.1	102.1	77.1	85.1	82.4	95.9
		Azospirillum	70.1	73.2	89.9	91.9	72.5	79.6	90.8	93.5
		Mixture	78.5	81.5	96.1	105.2	83.8	87.2	99.5	107
	100 Unit	Control	54.9	66.8	71.3	75.2	60.8	76.1	84.1	87.5
		Azotobacter	76.8	87.5	99.3	102.9	80.8	96.3	105.3	110.9
		Azospirillum	70.3	81.1	90.2	96.7	74.5	85.2	96.2	99.5
		Mixture	79.8	92.2	99.2	105.1	82.7	99.1	107	113.8
$LSD_{0.05}$ Micronutrients			2.54	2.25	2.20	1.43	1.26	0.01	1.37	0.43
$LSD_{0.05}$ N-Mineral			1.52	2.46	1.95	2.12	2.35	1.43	3.30	2.55
$LSD_{0.05}$ Bio-fertilizers			0.52	0.48	0.54	0.40	0.58	0.64	0.47	0.36
$LSD_{0.05}$ M x N			0.64	1.03	0.82	2.12	0.98	1.43	1.38	1.07
$LSD_{0.05}$ M x Bio			0.74	0.68	0.76	0.56	0.81	0.91	0.67	0.51
$LSD_{0.05}$ N x Bio			0.74	0.68	0.76	0.56	0.81	0.91	0.67	0.51
$LSD_{0.05}$ Inter.			1.05	0.66	1.08	0.79	1.15	1.28	0.95	0.72

Table (10): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on shoot dry weight with rhizosphere of barley plant.

Micronutrient	N-Mineral	Inoculation	Shoot dry weight (g / plant)							
			Days after sowing							
			1st Season				2 nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	15.9	20.5	28.65	39.85	21.5	30.5	36.85	47.2
		Azotobacter	21.4	30.8	41.2	55.2	26.8	41.6	48.6	62.7
		Azospirillum	18.3	24.6	35.6	49.4	23.6	35	43.1	57.9
		Mixture	24.8	36.2	48.2	60.6	30.2	46.8	56.3	67.8
	75 Unit	Control	17.5	31.1	42.2	52.7	22.8	42.3	50.2	60.1
		Azotobacter	31.2	42.4	53.85	65.2	31.6	53.4	62.7	72.3
		Azospirillum	28.2	37.9	48.5	61.4	33.2	48.2	56.9	68.6
		Mixture	35.6	47.2	62.2	73.2	40.8	57.8	70.9	80.4
	100 Unit	Control	21.4	38.65	49.8	58.2	27.4	48.8	59.2	65.2
		Azotobacter	34.62	51.2	62.2	74.6	40.2	54.6	63	81.6
		Azospirillum	30.8	46.8	58.6	70	36.2	50.2	56.2	77.5
		Mixture	41.75	53.5	65.2	79.4	47.2	62.4	71.4	86.5
With	50 Unit	Control	20.4	32.5	44.5	55.2	26.4	33.1	52.8	62.4
		Azotobacter	31	44.6	58.6	72.4	37	59.2	68.8	79.8
		Azospirillum	26	39.4	50.2	63.2	31.5	52.6	61.2	70.6
		Mixture	37.2	51.2	65.8	77.8	43	68.5	76.4	85.1
	75 Unit	Control	24.8	45.1	56.8	67.2	30	41.5	50.1	74.2
		Azotobacter	42.2	58.2	72.2	86.4	48.2	59.8	68.6	93.1
		Azospirillum	38.6	53.9	65.8	77.4	44	54	61.4	85.3
		Mixture	48.8	63.8	78.6	90.8	55.2	65.4	74.2	96.5
	100 Unit	Control	28.56	38.85	49.7	60.2	34.2	44.2	53.8	67.4
		Azotobacter	53	65.2	79.4	90.4	59	63.4	71.4	96.9
		Azospirillum	48.8	62.8	74.8	83.8	51.2	60.5	69	91.1
		Mixture	60.6	75.4	89.6	95.6	66.1	76.8	85	102.5
LSD $_{0.05}$ Micronutrients			3.28	4.03	4.50	4.28	3.42	2.54	2.78	4.20
LSD $_{0.05}$ N-Mineral			3.73	4.51	4.65	4.21	3.60	2.99	3.08	4.09
LSD $_{0.05}$ Bio-fertilizers			0.43	0.44	0.50	0.52	0.44	0.50	0.47	0.51
LSD $_{0.05}$ M x N			1.56	1.89	1.95	1.76	1.51	2.99	3.08	1.72
LSD $_{0.05}$ M x Bio			0.61	0.62	0.71	0.73	0.62	0.71	0.66	0.72
LSD $_{0.05}$ N x Bio			0.61	0.62	0.71	0.73	0.62	0.71	0.66	0.72
LSD $_{0.05}$ Inter.			0.87	0.88	1.00	1.03	0.87	1.00	0.93	1.02

Table (11): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on root dry weight with rhizosphere of barley plant.

Micronutrient	N-Mineral	Inoculation	Root dry weight (g / plant)							
			Days after sowing							
			1st Season				2 nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	7.1	8.8	10.1	11.7	8.5	9.98	11.8	13.2
		Azotobacter	10.46	11.98	13.5	15.8	11.96	13.4	15.2	17.1
		Azospirillum	8.6	9.9	11.7	13.9	9.9	11.2	13.4	15.3
		Mixture	10.9	13.1	15.4	17.2	11.8	14.6	17.1	18.9
	75 Unit	Control	14.2	20.6	23.2	27.2	16.7	23.1	25.7	29.7
		Azotobacter	22.6	29.9	33.8	36	24.1	33.2	36.2	38.8
		Azospirillum	20.3	24.6	27.9	32.6	22.7	26.7	30.3	34.2
		Mixture	28.1	32.6	35.2	37.1	30.6	35.8	37.8	39.9
	100 Unit	Control	16.8	19.1	24.2	28.6	19.4	22.6	27.7	32.1
		Azotobacter	28.6	30.2	33.9	34.6	32.2	33.7	35.5	39.9
		Azospirillum	23.8	24.8	30.8	32.2	27.3	28.3	34.2	35.6
		Mixture	29.8	34.6	35.9	38.9	34.2	37.4	39.1	42.3
With	50 Unit	Control	9.6	10.8	12.2	13.7	11.4	12.3	13.8	15.4
		Azotobacter	11.2	13.8	16.7	18.2	12.8	15.8	18.4	19.9
		Azospirillum	10.5	11.6	13.9	16.5	11.2	13.2	15.3	18.1
		Mixture	12.7	15.1	18.8	19.9	14.2	16.7	20.2	21.6
	75 Unit	Control	18.2	22.8	26.9	28.2	20.7	25.3	28.9	30.7
		Azotobacter	29.6	34.8	36.6	37.8	31.8	36.9	39.2	40.1
		Azospirillum	27.7	29.2	32.4	35.6	29.9	32.2	34.7	37.4
		Mixture	32.5	36.9	38.3	40.1	35.1	38.8	40.8	43.5
	100 Unit	Control	20.8	25.8	28.9	31.8	24.3	27.9	32.5	34.5
		Azotobacter	31.2	36.1	37.9	39.6	34.7	38.5	40.2	43.6
		Azospirillum	28.3	31.8	33.8	36.8	31.3	34.2	37.3	40.2
		Mixture	34.8	38.1	39.9	41.5	38.2	41.6	44.2	46.9
$LSD_{0.05}$ Micronutrients			1.09	1.10	0.96	0.80	1.10	1.03	0.98	0.83
$LSD_{0.05}$ N-Mineral			4.18	4.75	4.95	5.12	4.62	5.08	5.29	5.57
$LSD_{0.05}$ Bio-fertilizers			0.24	0.24	0.22	0.19	0.24	0.25	0.22	0.21
$LSD_{0.05}$ M x N			1.75	1.99	2.08	2.15	1.94	2.13	2.22	2.34
$LSD_{0.05}$ M x Bio			0.34	0.34	0.21	0.27	0.23	0.35	0.31	0.30
$LSD_{0.05}$ N x Bio			0.34	0.34	0.31	0.27	0.35	0.35	0.31	0.30
$LSD_{0.05}$ Inter.			0.48	0.48	0.43	0.38	0.49	0.49	0.43	0.42

Table (12): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on number of tillers with rhizosphere of barley plant.

Micronutrient	N- Mineral	Inoculation	Number of tillers per plant	
			1 st Season	2 nd Season
Without	50 Unit	Control	2.8	2.8
		Azotobacter	3.2	3.4
		Azospirillum	3	3.2
		Mixture	3.4	3.4
	75 Unit	Control	3.2	3.4
		Azotobacter	3.8	4
		Azospirillum	3.5	3.8
		Mixture	4	4.2
	100 Unit	Control	3.5	3.6
		Azotobacter	4.1	4.4
		Azospirillum	3.8	4
		Mixture	4.4	4.8
With	50 Unit	Control	4	4
		Azotobacter	4.6	4.6
		Azospirillum	4.4	4.4
		Mixture	4.8	4.8
	75 Unit	Control	4.2	4.4
		Azotobacter	4.8	4.8
		Azospirillum	4.6	4.6
		Mixture	5	5.2
	100 Unit	Control	4.4	4.6
		Azotobacter	4.8	5
		Azospirillum	4.6	4.8
		Mixture	5.2	4.5
$LSD_{0.05}$ Micronutrients			0.301	0.254
$LSD_{0.05}$ N-Mineral			0.149	0.175
$LSD_{0.05}$ Bio-fertilizers			0.016	0.017
$LSD_{0.05}$ M x N			0.149	0.175
$LSD_{0.05}$ M x Bio			0.023	0.024
$LSD_{0.05}$ N x Bio			0.023	0.024
$LSD_{0.05}$ Inter.			0.033	0.034

Table (13): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on earing features with rhizosphere of barley plant.

Micronutrient	N-Mineral	Inoculation	Earing features							
			1 st Season				2 nd Season			
			Leanth of ear	Dry weight of ear	No. grains/ ear	Dry w 1000 grains (g)	Leanth of ear	Dry weight of ear	No. grains/ ear	Dry w 1000 grains (g)
Without	50 Unit	Control	10	1.1	32	31.7	10.5	1.4	38	33.9
		Azotobacter	12.4	1.9	39	37.2	12.9	2.1	47	40.5
		Azospirillum	11.1	1.7	35	33.9	11.6	1.9	41	34.8
		Mixture	12.8	2.1	42	41.4	13.3	2.2	48	42.7
	75 Unit	Control	11.5	1.7	34	32.4	12.2	1.8	40	34.8
		Azotobacter	13.6	2.2	40	40.4	14.3	2.2	51	42.5
		Azospirillum	12.8	1.9	36	37.9	13.5	2	47	39.8
		Mixture	13.9	2.4	46	42.2	14.6	2.4	53	43.6
	100 Unit	Control	13	1.9	36	38.8	13.9	2.1	44	40.1
		Azotobacter	14.6	2.4	44	42.5	15.4	2.6	53	43.6
		Azospirillum	13.2	2.2	39	38.8	13.9	2.4	49	40.8
		Mixture	15.2	2.5	46	44.6	16	2.6	57	44.9
With	50 Unit	Control	13.8	2.2	45	43.7	14.3	2.6	53	45.9
		Azotobacter	14.3	2.8	55	54.2	15.1	3.2	64	57.2
		Azospirillum	13.9	2.6	52	52.1	14.6	3	60	53.1
		Mixture	14.8	3.1	62	60.1	15.5	3.28	69	65.5
	75 Unit	Control	14.3	2.4	54	50.2	15	2.8	57	56.1
		Azotobacter	16.1	2.8	64	59.1	16.8	3.9	70	69.4
		Azospirillum	15.4	3.6	58	56.8	16.2	3.62	63	61.3
		Mixture	16.1	4.01	64	61.3	17.1	4.25	78	69.9
	100 Unit	Control	15.2	2.6	58	55.7	16.1	2.9	60	59.28
		Azotobacter	17.4	4.8	75	65.4	18.3	4.95	73	78.9
		Azospirillum	16.3	4.6	56	59.2	17.2	4.8	66	64.1
		Mixture	18.2	5.1	82	69.1	5.3	5.3	79	83.8
$LSD_{0.05}$ Micronutrients			0.751	0.394	6.07	5.33	0.46	0.448	5.31	6.69
$LSD_{0.05}$ N-Mineral			0.581	0.283	2.44	1.82	0.57	0.257	1.80	2.74
$LSD_{0.05}$ Bio-fertilizers			0.050	0.030	0.34	0.24	0.13	0.027	0.33	0.33
$LSD_{0.05}$ M x N			0.244	0.283	2.44	0.76	0.57	0.257	0.75	2.74
$LSD_{0.05}$ M x Bio			0.071	0.042	0.49	0.34	0.18	0.038	0.47	0.47
$LSD_{0.05}$ N x Bio			0.071	0.042	0.49	0.34	0.18	0.038	0.47	0.47
$LSD_{0.05}$ Inter.			0.101	0.060	0.69	0.48	0.25	0.054	0.66	0.67

Table (14): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on grain and straw yield with rhizosphere of barley plant.

Micronutrient	N-Mineral	Inoculation	Grain yield (Ardab / Fed)		Straw yield (Ton / Fed)	
			1 st Season	2 nd Season	1 st Season	2 nd Season
Without	50 Unit	Control	10.2	10.4	3.65	3.8
		Azotobacter	10.6	10.9	4.6	4.9
		Azospirillum	10.4	10.6	4.25	4.7
		Mixture	10.8	11.1	4.4	5.01
	75 Unit	Control	10.8	11.05	4	4.26
		Azotobacter	11.4	11.95	4.8	5.35
		Azospirillum	11.2	11.5	4.6	4.95
		Mixture	11.8	12.06	4.9	5.5
	100 Unit	Control	11.2	11.45	4.35	4.56
		Azotobacter	11.6	12.3	5.6	5.8
		Azospirillum	11.2	11.9	5.2	5.15
		Mixture	12.1	12.8	5.6	5.95
With	50 Unit	Control	10.9	11.75	4.25	4.65
		Azotobacter	11.8	13.25	5.8	7.83
		Azospirillum	12.3	12.8	4.9	5.45
		Mixture	12.9	13.1	5.85	6.32
	75 Unit	Control	11.7	12.1	4.8	5.6
		Azotobacter	12.8	13.2	7.2	8.22
		Azospirillum	15.5	12.9	6.4	7.11
		Mixture	13.4	13.9	8.1	8.4
	100 Unit	Control	12.2	13.4	5.1	5.9
		Azotobacter	15.9	16.8	8.6	9.85
		Azospirillum	14.5	15.2	7.5	8.15
		Mixture	16.3	17.1	8.84	10.7
$LSD_{0.05}$ Micronutrients			0.64	0.65	0.51	0.67
$LSD_{0.05}$ N-Mineral			0.48	0.57	0.41	0.44
$LSD_{0.05}$ Bio-fertilizers			0.05	0.04	0.05	0.06
$LSD_{0.05}$ M x N			0.48	0.57	0.17	0.44
$LSD_{0.05}$ M x Bio			0.07	0.06	0.07	0.08
$LSD_{0.05}$ N x Bio			0.07	0.06	0.07	0.08
$LSD_{0.05}$ Inter.			0.11	0.08	0.10	0.12

The present results agree with those obtained by **Grewal, (2010) ; Armin & Asgharipour, (2011) ; Darwesh, (2013) ; Turan & Fikrettin, (2013)** and **Hassan , *et al.*, (2015)**.

Effect of bio-fertilizers, micronutrients and N mineral application on nutrients contents of barley plant:

Nutrients contents of barley plant:

The results obtained in Tables (15 and 16) assure that total N content was increase with mineral N rates. Azotobacter had higher effect on increasing N content than Azospirillum and control treatment. While mixture treatment was highest treatment. The total nitrogen was higher increase with applied micronutrients than unapplied micronutrients (Table15).While P and N content were behavior the same trend (Table16). Increasing N addition rate up to 100 kg/fed. The treatment with mixed plus 100 kg N/ fed. Under foliar application of micronutrients

gave the highest values of total N and P contents. The current results agree with those obtained by **Burdman *et al.*, (2002) ;James, (2000); Ramos, *et al.*, (2002); Jarak *et al.*, (2004) and Gholami *et al.*, (2009**).

Table (15): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on total nitrogen % in rhizosphere soil of barley plant .

Micronutrient	N- Mineral	Inoculation	Total nitrogen %							
			Days after sowing							
			1 st Season				2 nd Season			
			45	90	120	150	45	90	120	150
Without	50 Unit	Control	0.197	0.202	0.199	0.208	0.202	0.211	0.202	0.214
		Azotobacter	0.202	0.222	0.210	0.277	0.216	0.230	0.222	0.233
		Azospirillum	0.199	0.218	0.208	0.220	0.212	0.225	0.218	0.226
		Mixture	0.210	0.237	0.230	0.239	0.236	0.245	0.239	0.236
	75 Unit	Control	0.218	0.225	0.222	0.228	0.228	0.232	0.229	0.234
		Azotobacter	0.225	0.254	0.249	0.250	0.253	0.260	0.256	0.265
		Azospirillum	0.221	0.230	0.236	0.236	0.249	0.241	0.234	0.242
		Mixture	0.230	0.260	0.255	0.263	0.258	0.276	0.262	0.266
	100 Unit	Control	0.238	0.260	0.252	0.263	0.256	0.235	0.260	0.270
		Azotobacter	0.244	0.266	0.260	0.269	0.264	0.263	0.268	0.275
		Azospirillum	0.237	0.254	0.250	0.254	0.252	0.241	0.262	0.261
		Mixture	0.240	0.271	0.268	0.277	0.268	0.276	0.277	0.283
With	50 Unit	Control	0.224	0.248	0.240	0.250	0.244	0.275	0.248	0.257
		Azotobacter	0.266	0.283	0.279	0.285	0.282	0.286	0.286	0.272
		Azospirillum	0.259	0.268	0.266	0.268	0.266	0.268	0.270	0.278
		Mixture	0.272	0.285	0.280	0.285	0.282	0.301	0.284	0.292
	75 Unit	Control	0.242	0.268	0.261	0.270	0.265	0.256	0.270	0.278
		Azotobacter	0.271	0.295	0.290	0.298	0.292	0.292	0.296	0.306
		Azospirillum	0.261	0.284	0.280	0.288	0.280	0.280	0.284	0.296
		Mixture	0.283	0.348	0.341	0.348	0.348	0.292	0.350	0.356
	100 Unit	Control	0.262	0.282	0.279	0.280	0.281	0.298	0.284	0.287
		Azotobacter	0.290	0.322	0.301	0.308	0.304	0.316	0.310	0.315
		Azospirillum	0.281	0.301	0.299	0.301	0.299	0.308	0.306	0.310
		Mixture	0.295	0.352	0.348	0.350	0.349	0.358	0.356	0.359
$LSD_{0.05}$ Micronutrients			0.0129	0.0151	0.0148	0.0130	0.0142	0.0141	0.0146	0.0142
$LSD_{0.05}$ N-Mineral			0.0077	0.0101	0.0102	0.0082	0.0099	0.0088	0.0104	0.0105
$LSD_{0.05}$ Bio-fertilizers			0.0006	0.0011	0.0010	0.0012	0.0011	0.0009	0.0011	0.0010
$LSD_{0.05}$ M x N			0.0032	0.0042	0.0043	0.0034	0.0042	0.0088	0.0044	0.0044
$LSD_{0.05}$ M x Bio			0.0009	0.0015	0.0015	0.0016	0.0015	0.0013	0.0015	0.0014
$LSD_{0.05}$ N x Bio			0.0009	0.0015	0.0015	0.0016	0.0015	0.0013	0.0015	0.0014
$LSD_{0.05}$ Inter.			0.0013	0.0021	0.0021	0.0023	0.0021	0.0018	0.0022	0.0020

Table (16): Effect of inoculation with N_2 fixers, micronutrients and inorganic N on N and P content in barley grains.

Micronutrient	N- Mineral	Inoculation	N content		P content	
			N%	N mg / 1000 gram	P%	P mg / 1000 gram
Without	50 Unit	Control	1.224	271.72	0.270	51.87
		Azotobacter	1.352	292.1	0.276	59.22
		Azospirillum	1.290	287.3	0.273	56.01
		Mixture	1.361	293.5	0.279	60.5
	75 Unit	Control	1.290	287.1	0.272	68.52
		Azotobacter	1.370	302.84	0.279	66.28
		Azospirillum	1.352	290.20	0.276	62.14
		Mixture	1.375	314.39	0.282	69.21
	100 Unit	Control	1.352	304.24	0.276	66.28
		Azotobacter	1.390	355.38	0.284	73.27
		Azospirillum	1.369	345.5	0.279	71.00
		Mixture	1.395	360.20	0.285	75.45
With	50 Unit	Control	1.404	389.50	0.284	73.27
		Azotobacter	1.450	365.6	0.292	78.52
		Azospirillum	1.435	342.4	0.286	75.02
		Mixture	1.450	371.3	0.299	81.04
	75 Unit	Control	1.439	324.52	0.284	75.3
		Azotobacter	1.481	397.22	0.315	86.3
		Azospirillum	1.450	355.00	0.310	81.84
		Mixture	1.502	411.50	0.316	90.76
	100 Unit	Control	1.468	345.11	0.288	77.02
		Azotobacter	1.496	460.2	0.320	90.84
		Azospirillum	1.475	425.3	0.320	81.3
		Mixture	1.534	488.7	0.324	93.5
$LSD_{0.05}$ Micronutrients			0.035	23.03	0.0073	4.86
$LSD_{0.05}$ N-Mineral			0.015	14.87	0.0040	2.86
$LSD_{0.05}$ Bio-fertilizers			0.002	1.61	0.0005	0.25
$LSD_{0.05}$ M x N			0.006	6.23	0.0040	1.20
$LSD_{0.05}$ M x Bio			0.003	2.28	0.0007	0.35
$LSD_{0.05}$ N x Bio			0.003	2.28	0.0007	0.35
$LSD_{0.05}$ Inter.			0.004	3.23	0.0010	0.49

CONCLUSION

Significant effects of either bio-fertilizers, mineral N and micronutrients as foliar application on improving yield parameters, mineral contents of barley plants, yield and its attributes, P and N contents of barley grains and microbial activity in barley plants rhizosphere. Interaction of mixed bio-fertilizers treatment micronutrients foliar application of 250 ppm gave maximum enhancement for most studied treatments. Barley shoots and grains yield during the two successive seasons. While P, N contents of both barley shoots and grains yield recorded maximum values with mixed bio-fertilizers treatment, mineral N and micronutrients as foliar application of 250 ppm. The most effect treatment for microbial counts of bio-fertilizers, yield parameters and nutrients content was mixture bio-fertilizers mineral N at 100 units/fed and foliar application with micronutrients at rate 250 ppm.

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تأثير التلقيح بمثبتات الازوت والعناصر الصغرى والنيتروجين الغير عضوى على أعداد الازوسبيريللم فى ريزوسفير نبات الشعير فى منطقة جنوب سيناء– مصر

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لدراسة تأثير الأسمدة الحيوية والعناصرالصغرى واضافة النيتروجين المعدنى على نبات الشعير النامى تحت ظروف التربة الجيرية، أجريت تجربة حقلية فى محطة بحوث رأس سدر ، جنوب سيناء والتابعة لمركز بحوث الصحراء . فى موسمى الشتاء 2017 و 2018. وكانت العوامل التجريبية هى: العناصر الصغرى بالرش الورقى (الحديد والمنجنيز والزنك بمعدل 250 ملليجرام)، والنيتروجين المعدنى بمعدلات (50 و 75 و 100 كجم/فدان) والأسمدة الحيوية (كنترول ، ازوتزباكتر كروكوككم وازوسبيريللم برازيلينس فردي أو مختلط).

أظهرت النتائج وجود تأثيرات معنوية لكل من الأسمدة الحيوية والنيتروجين المعدني، والرش الورقي، بالعناصر الصغرى على، قياسات المحصول والمحتوى المعدني، لنباتات الشعير والمحصول وصفاته والنشاط الميكروبي، في، محيط جذور نبات الشعير. وأكدت النتائج ان التفاعل بين الأسمدة الحيوية والعناصر الصغرى على، هيئة رش ورقي، أعطى، أقصى، قدر من التنشيط والتحفيز لمعظم المعاملات المدروسة. قياسات الشعير والحبوب خلال الموسمين المتتاليين. بينما سجلت محتويات الفسفور والنيتروجين لكل من محصول الشعير والحبوب أعلى، القيم عند معاملة الأسمدة الحيوية المختلطة والنيتروجين المعدني، بمعدل 100 كجم/فدان مع الرش الورقي، بالعناصر الصغرى 250 جزء في، المليون. وكانت المعاملة الأكثر تأثيراً للأعداد الميكروبية للأسمدة الحيوية قياسات المحصول ومحتوى العناصر الغذائية هي، المعاملة بمخلوط من الأسمدة الحيوية المعدنية النيتروجين بمعدل 100 وحدة/ فدان والرش الورقي بالعناصر الصغرى 250 جزء في المليون.