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The Role of Bio-Fertilizers from *Azosprillum* Spp. And *Bacillus Megaterium* in Improving Wheat Yields of Sham 2 in Desert Soils.

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Summary

A field experiment was conducted in desert soil located in the Qaim district of Iraq, 560 km west of Baghdad. In the season 2018-2019, with the aim of evaluating the performance of local bacterial isolates Azosprillum sp and Bacillus megaterium in increasing the readiness of some nutrients for the Sham 2 wheat crop cultivated in desert soil under pivot sprinkler irrigation systems. The experiment included nine treatments, which are the control treatment and the chemical fertilization treatment according to the fertilizer recommendation 200 kg superphosphate (19.5% and 240 kg urea (46% N) / e, and the treatment of animal wastes (aerobically fermented sheep and cows mixed with C: N 27: 1)% 1.5 for soil depth of 15 cm, with three treatments of bacterial inoculum for the two isolates Azosprillum sp and Bacillus megaterium and a mixture of the two isolates, once with animal wastes and the other without it The treatments were organized according to a fully randomized design with three replications of experimental units of 500 m2 for the experimental unit. Measurements were taken after 60 and 90 Day of planting and at harvest, and included morphological characteristics which are number of branches, plant length, leaf area, dry weight, number of spikes, number of grains per spike, weight of a thousand grains, and grain yield, and some physiological and qualitative characteristics which are chlorophyll, carbohydrates, protein, phosphorous and total nitrogen in the soil The density of microbes in the soil was also estimated.

Keywords: Bio-fertilizers, Microbiology, Sham 2, desert soils.

Introduction

The use of microbial blisters has become a common occurrence and it is called TM (total microbe) and contributes to the dissolution and readiness of some mineral nutrients in the soil, increasing the quality of microbial populations and their normalization of the new soil environment (1). Studies also confirm the ability of some isolates to dissolve phosphate compounds in the soil through their production of some mineral and organic acids. These acids have a direct or indirect role in dissolving and preparing many important plant nutrients in the soil (4). In an experiment conducted for ten consecutive years of biological or mineral fertilization, it was observed that the yield decreased by 20% while continuing to use only mineral fertilizers, while the soil content of ready phosphorus, total nitrogen, zinc and iron increased when organic fertilizers and Bacillus vaccine, Pseudomonas were introduced.

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Azotobacter. (5). In view of the increase in the production of fermented organic fertilizers of most crops and avoiding the pollution problems caused by the increased use of mineral fertilizers in the soil and crops (6). Microorganisms are used as decomposers for plant materials and wastes to prepare organic fertilizers, which in turn increase the activity of micro-soil regeneration, which works to decompose organic compounds and liberate nutrients ready for the plant, in addition to that the fermented organic materials are easy to decompose, and that the mineralization varies according to the type of source of organic matter, such as Vegetable or animal, or being one of the easy-to-dissolve materials and explain that the organic wastes that are added to the soil are subjected to biodegradation by different types of micro-soil biology (7), the organisms take their needs of nutrients in the first stage of decomposition and put more than their needs into the soil In the form of metallized and semi-reductive elements. The addition of organic matter to soil whose content is less than 2% is necessary to increase the effectiveness of microbes in it (8). (9) demonstrated the existence of a relationship between the different carbon sources and the rate of activity and microbial competition, especially the nitrogen fixing and phosphate dissolving bacteria. It was also mentioned (6) that with 2.5 -3.3% of the organic matter in the soil, the numbers of beneficial bacteria remain within the range of 6 Lg cfu g^{-1} in the ventilated root zone, and the plants may not need to add phosphate fertilizers. The phosphate fertilizers currently used have been unable to provide continuous readiness for the phosphorous component, as is the case for nitrogen fertilizers that suffer from volatilization and washing losses (10 and 3). It was found that mixing cow, poultry, and peat moss with soil led to an increase in the number of microorganisms in the soil and an increase in the dry weight of the root and vegetable group and the plant yield.

Materials and methods:

A field experiment was conducted in desert soil in Al-Qaim district to the west of Baghdad, 560 km. It was woven sandy mixture with a salinity of 3.2 $ds.m^{-2}$ with a content of 12.7%, 18% and 0.23% gypsum, lime and organic matter, respectively. The wheat variety Sham 2 was planted with a density of 132 $kg.h^{-1}$ on 11/22/2018 under an axial sprinkler irrigation system of the Kharif type covering an area of 30 h under the second system tower, and the water of the Euphrates River was used for irrigation. Use a vaccine from Azosprillum sp. And B. megaterium. And a mixture of them and the first isolate is a solvent for phosphate compounds with a dissolving diameter of 10 mm, and the second is a nitrogen fixer with an efficiency of 3 mg N / 150 gm OM analyzer, obtained from the microbiology laboratory at the Desert Studies Center / University of Anbar. Inoculations were prepared in 9 and 8 Log cfu g^{-1} broth medium for the two isolates respectively and loaded on flour bran and fermented organic matter.

In addition, 1.5% aerobically fermented animal wastes were used for soil with a depth of 15 cm (C: N 27: 1), and the treatments were as in Table 1. Vaccines were added to the field six hours before the irrigation process. The transactions were of 500 m² and three replicates (total trial area 13,500 m²) using RCBD. All service operations were carried out for the crop and measurements and tests were taken after 60 days of germination. They included the number of branches, plant height,

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leaf area, dry weight, total chlorophyll and carbohydrates (2), the amount of ready phosphorus, total nitrogen and microbial density in the soil, as well as phosphorous and nitrogen in the plant (3) as well. When harvesting, record the number of spikes per square meter 2, the number of grains a spike, the weight of 1000 grains, the grain yield, the protein percentage (2).

Table 1 of the coefficients used in the experiment

Treatment	characters	Symbol
Comparison	Soils contain 78 and 6.5 mg N and P kg-1	C
Fertilizer recommendation	200 kg E-1 superphosphate (19.5% P) with terry and 240 kg E-1 in 6 batches of sprinkles 20 days after germination, then 15 days between batch	T
Animal wastes OM C: N = 27: 1	By 1.5% for the soil	OM
Azosprillum sp.	10^6 bacterial cells / g of soil	A
B. megaterium	10^6 bacterial cells / g of soil	B
B. megaterium. Azosprillum sp.	10^6 bacterial cells / g of soil per species	A-B
Azosprillum sp. +O.M.	10^6 bacterial cells / g of soil + 1.5% OM	A-OM
B. megaterium. +O.M.	10^6 bacterial cells / g of soil + 1.5% OM	B-OM
B. megaterium. Azosprillum sp. +OM	10^6 bacterial cells / g of soil per species + 1.5% OM	A-B-
Azosprillum sp.	OM	OM

Results and discussion

Morphological and specific characteristics of the plant at the age of 60 and 90 days:

The results shown in Tables 2 and 3 show that used desert soils have a weak ability to supply plants with their nutritional needs, as the average of all planted plant traits estimated at the age of 60 and 90 days decreased by 35 to 70% of the treatments used to improve productivity in the experiment. It was used in its ability to improve plant characteristics at the age of 60 days, as it investigated the treatments of Azosprillum sp. + OM-B megaterium and organic matter with Azosprillum sp. Without it, the highest mean branch count was 5 plant-1, and fertilizer recommendation and Azosprillum sp-B-megaterium + OM were superior. Azosprillum sp. + O.M was treated with the highest rate of leaf area of 2.8 dm2, while the recommendation fertilizer treatment achieved the highest increase in dry weight and protein, reaching 18.3 g plant^{-1} and 10.21%, followed by Azosprillum sp. + O.M. And B. megaterium + O.M. It ranged between 16.8-17.4 g plant^{-1} and 8.28-9.56%, and these results were consistent with the chlorophyll values, and the highest carbohydrate rate was 86.6 g plant^{-1}

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under the fertilizer recommendation. Growth rates and improvement in soil properties were linked through bio-organic fertilizers in Poor desert soils (1 and 8).

Table 2 shows the effect of the treatments used on some traits of the 60-day-old wheat crop

Treatments	Number of branches of a plant $^{-1}$	Plant height cm	Plant Ear area Dcm^2	Dry weight in g of plant $^{-1}$	Chlorophyll mg^{-1}	Plant carbohydrates g^{-1}	Protein%
C	3	40	1.6	4.1	0.608	44.7	4.06
T	4	63	2.8	18.3	1.311	86.6	10.21
OM	4	60	2.6	14.3	1.012	65.3	8.12
A	5	50	1.9	12.8	0.889	57.7	7.87
B	4	50	1.7	12.6	0.837	58.3	5.93
A-B	4	52	1.6	11.9	0.605	55.4	7.18
A-OM	5	61	2.8	16.9	1.268	76.0	9.06
B-OM	4	62	2.7	16.8	1.251	79.3	8.28
A-B-OM	5	64	2.8	17.4	1.280	84.3	9.56
LSDP=0.05	1.3	3.4	0.32	2.36	0.41	2.20	1.23

It is noted from Table 3 that the amount of phosphorus absorbed in the plant reached the highest level of 1.05 $mg.g^{-1}$ when treating the fertilizer recommendation in the 60-day stage, and it ranged between 0.9-0.91 mg^{-1} plant for the two treatments Azosprillum sp-B. megaterium + OM. And B. megaterium + OM., And it was found that the 90-day growth phase maintained the highest rate of phosphorous absorption, at 1.31, 1.12 and 1.14 $mg.mg^{-1}$ plants, according to the order, but at the 150-day harvest phase, there was no significant difference between the above treatments, which was characterized by the highest. The content was 1.69, 1.66 and 1.63 mg per plant.

Two treatments investigated fertilizer recommendation and Azospr-illum sp. + O.M. And Azosprillum sp-B. megaterium + OM was the highest amount of nitrogen in the plant at the 60-day growth stage, and it ranged between 1.68 and 1.65 $mg.g^{-1}$ plant, and this was reflected in the protein ratio of the same growth stage, which ranged between 10.21 to 9.56% in the plant (Table 2). The arrangement of the treatments with their nitrogen content continued with increasing the amount in its 90-day phase, as well as in its 150-day phase, and it was 2.43, 2.35 and 2.36 $mg.gm^{-1}$ for the above treatments, according to the order.

While the vaccine for isolates used without adding the organic matter did not achieve the required results, and this confirms the role of organic matter as a carbon source for revival in desert soils to increase its activity, and this was confirmed by the low rate of values of traits estimated from using organic matter alone compared

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to mixing it with isolates (4 and 5). It was also found that the percentage of protein in wheat grains amounted to 15.18, 14.75 and 14.68% for the above treatments, according to the order, which reflected the correlation with the amount of nitrogen and phosphorous taken in the plant. The results confirm that the distinguished treatments were providing nutrients in a convenient way to the plant, which increased their absorption and representation, and this was reflected in the components of the estimated plant characteristics (1, 8 and 9).

Table 3: The effect of the study parameters on some qualitative characteristics of the wheat yield

Treatment	absorbed phosphorous is mg-1			The absorbed nitrogen is mg-1			Protein - cereals%
	60 days	90 days	150days	60 days	90 days	150days	
C	0.41	0.65	0.68	0.65	0.90	1.41	8.81
T	1.05	1.31	1.69	1.68	2.44	2.43	15.18
OM	0.65	0.95	1.13	1.30	1.48	1.80	11.25
A	0.59	0.78	0.96	1.26	1.35	1.70	10.62
B	0.60	0.80	1.25	0.95	1.20	1.68	10.50
A-B	0.53	0.60	1.04	1.15	1.30	1.60	10.00
A-OM	0.87	0.96	1.35	1.65	1.82	2.35	14.68
B-OM	0.92	1.14	1.63	1.12	1.45	1.92	12.00
A-B-OM	0.91	1.12	1.66	1.66	1.69	2.36	14.75
LSD P=0.05	0.23	0.11	0.20	0.32	0.22	2.13	1.33

The characteristics of the output components:

Note from Table 4 that not all of the treatments used achieved the production level achieved from the fertilizer recommendation of 3810 kg of E-1 grains, followed by Azosprillum sp-B. megaterium + OM treatment at a production rate of 3732 kg E^{-1} grains, followed by B. megaterium + O.M treatment. At a production rate of 2950 kg of H-1 grains, followed by Azosprillum sp .. + OM treatment. Which gave a production of 2660 kg / ha, with a difference of 5.33% from the treatment of the recommendation, and the decrease was greater in the absence of organic matter from the isolates as it is the carbon source that increases the activity of microbes in the soil. However, the protein content in grains reached its highest level of 15.18% and 14.75%. And 14.68% with the fertilizer recommendation coefficients, Azosprillum sp .. + OM, and Azosprillum sp-B. megaterium + OM. This confirms the level of absorption and representation of the elements better than the rest of the treatments. The highest number of spikes per square meter of the fertilizer recommendation was followed by the use factors. The vaccine isolates are repulsive and mixed with the organic matter Azosprillum sp. + OM And B. megaterium + O.M (305, 308 and 314 spikes per square meter). These results confirm the importance of low-cost biofertilization to compensate for part of the fertilizer shortage and cost 5 and 6).

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Table 4: The effect of the study parameters on some characteristics of the wheat yield

Treatments	Number of ears m 2	Number of seeds spike $^{-1}$	Weight of 1000 cereal	quotient of kg.h^{-1}
C	175	175	35	1500
T	329	329	40	3810
OM	314	314	37	2250
A	278	278	38	2011
B	270	270	38	2030
A-B	265	265	35	2210
A-OM	305	305	39	2660
B-OM	308	308	40	2950
A-B-OM	314	314	40	2373
LSD P=0.05	10.8	10.8	1..21	65

Microbial activity in soil

Table 5 shows the increase in microbial density in the soil with the addition of organic matter and pollen from isolates, and the highest levels were recorded at 6.37 Log cfu g^{-1}, while the highest rate of microbial density during growth stages after 60 and 90 days was 5.47 and 5.42 Log cfu g^{-1}, and the parameters were recorded. Azosprillum sp - B. megaterium + OM and B. megaterium + OM And Azosprillum sp. + O.M. The highest levels of intensity were 6.82, 6.54, and 6.45 Log cfu g^{-1}, then the intensity decreased at 150 days, reaching an average of 5.20 Log cfu g^{-1}. It also recorded a numerical increase with the organic matter alone and with the fertilizer recommendation, but it decreased after the addition when using the vaccine without organic matter, and this confirms the importance of the carbon source for the activity and reproduction of micro-organisms added, transported, or rooted in the soil (4 and 10).

Table 5: The microbial content in soil during growth stages and according to the period after germination Log cfu g^{-1}

Av.	150 day	90 day	60 day	germinal	Treatment
2.65	3.38	3.12	2.13	1.95	**C**
3.81	4.45	4.43	4.32	2.03	**T**
5.87	5.45	6.04	6.34	5.65	**OM**
5.20	4.87	5.28	5.21	5.44	**A**
5.94	5.53	5.87	6.02	6.32	B
5.51	5.18	5.56	5.43	5.86	**A-B**
6.15	5.88	6.02	6.45	6.32	**A-OM**
6.26	6.04	6.24	6.54	6.24	**B-OM**
6.37	6.00	6.18	6.82	6.46	**A-B-OM**

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	5.20	5.42	5.47	5.14	Av.
DAY=,0.16 TRE=,2.12 D*T=2.45					LSD P=0.05

Total nitrogen and ready phosphorous in soil- :

Table 6 shows that the total nitrogen level in the soil reached its highest level of 127.0 and 119.3 mg.kg^{-1} with the two treatments Azosprillum sp + OM. And Azosprillum sp-B. megaterium + OM was also found that the highest rate was 96.2 and 87.1 mg.kg^{-1} during the germination stage and after 60 days of germination, then the values decreased with the aging of the growth period under all treatments. As for the overlapping treatments, the highest amount was found to be 143 and 138 mg kg^{-1} for Azosprillum sp + OM. And Azosprillum sp-B. megaterium + OM results for the two organic matter treatments and the Azosprillum sp vaccine. The importance of the free fixation of nitrogen and its mineralization in the soil, and this necessitates increasing the amount of fertilizer doses after a period of 60 days to increase the plant's need and to decrease the availability of soil for its consumption, fixation or loss. It was found that the rate of biological nitrogen fixation is related to the availability of organic matter in the soil, as well as the nitrogen mineralization process was better with the use of pollen and organic fertilization (4, 6 and 7).

Table 6 Total soil nitrogen during growth stages and by period after germination mg.kg
B. megaterium + O.M and

Av.	150 day	90 day	60 day	Germination	Treatment
46.7	30	42	50	65	**C**
65.5	46	60	76	80	**T**
80.0	56	70	88	106	**OM**
60.3	48	54	60	79	**A**
54.5	43	49	58	68	B
69.7	50	65	76	88	**A-B**
127.0	105	128	143	132	**A-OM**
87.7	66	78	95	112	**B-OM**
119.3	86	117	138	136	**A-B-OM**
	58.9	73.6	87.1	96.2	Av.
DAY=10.3, TRE=13.7, D*T=16.6					LSD P=0.05

Table 7 shows that the amount of ready phosphorous under treatment Azosprillum sp-B. megaterium + OM reached its highest level of 10.23 mg.kg^{-1}, followed by treatment of B. megaterium + O.M and Azosprillum sp + OM at a rate of 9.84 and 9.05 mg.kg^{-1}. The estimation process was recorded during stages.

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Growth that the 60-day post-germination phase gave the highest ready amount of phosphorus, reaching 8.15 $mg.kg^{-1}$. Also, it was found from treatment Azosprillum sp-B. megaterium + OM that the highest ready amount in soil was 11.3 and 11.0 $mg.kg^{-1}$ after 60 and 90 days, respectively. Also, it reached 10.8 and 10.3 $mg.kg^{-1}$ within 60 and 90 days after germination from using the treatment B. megaterium + OM, but the amount of phosphorus at all treatments that were not equipped with organic matter and the vaccine was at the minimum levels or less after a period of 90 days and became An additional quantity of it needs to be added. It has been observed that the amount of ready-made phosphorus has increased from the treatments fertilized with organic matter and vaccine isolates, and this indicates that the phosphorus began to transform from the fixed or total part to soluble. The results confirm the importance of using biological and organic fertilizers with poor desert soils in order to supply the plant with its nutritional needs (1 and 4).

Table 7: Total ready phosphorus in the soil during the growth stages and according to the period after germination $mg.kg^{-1}$

Av.	150 day	90 day	60 day	germinal	Treatment
3.70	3.0	3.4	3.6	4.8	**C**
6.60	4.4	5.4	6.2	10.4	**T**
7.75	6.2	6.9	8.3	9.6	**OM**
6.40	5.8	6.4	7.2	6.2	**A**
7.00	6.7	7.0	7.6	6.7	B
6.95	6.5	7.2	7.6	6.5	**A-B**
9.05	8.4	9.6	10.8	7.4	**A-OM**
9.48	9.2	10.3	10.8	7.6	**B-OM**
10.23	9.8	11.0	11.3	8.8	**A-B-OM**
	6.66	7.46	8.15	7.55	Av.
DAY=0.52, TRE=1.65, D*T=2.16					LSD P=0.05

It is concluded from this study to the importance of bio-fertilizers and organic matter, which can be enhanced with additional quantities of available fertilizers to create complementarity in meeting plant needs of nutrients at lower economic costs in addition to improving soil performance for subsequent seasons.

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