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RESPONSE OF SWEET CORN TO BACTERIAL BIOFERTILIZERS AND SPRAYING WITH MINERAL NUTRIENTS

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ABSTRACT

This study was aimed to investigate response of two sweet corn hybrids to bacterial biofertilizers and spraying with Mg+2 and Ca+2 and their impact on the Yield during Spring season 2022, CASH seeds (H1) and ROI SOLEIL seeds (H2) were planted in pots, when they reached 2-3 leaves treated with four treatments which included without biofertilizer (B0), with Azospirillum brasilense (B1) with Pseudomonas fluorescens (B2) and the interaction with Azospirillum brasilense and Pseudomonas fluorescens (B3) then transferrd to the field, and sprayed the seedling after 20 and 30 days of seedling with three concentrations which included control, without spraying (N0), spraying with Mg++ and Ca++ with concentration of 25 mg L-1 (N1) and 50 mg L-1 each elements (N2), The experiment was carried out according to RCBD with in split plot arrangement. The results showed that hybrid H2, the treatment of bacterial biofertilizers B3 and the foliar spraying of Magnesium and Calcium N2 had significant effect in all studied traits. H2B3N1 had significant effect in plant height and the number of leaves, H2B3N2 had significant effect in leaf area and leaf area index and plant dry weight, H2B1N2 had significant effect in total chlorophyll concentration in leaves, It was found that the study factors and their interactions had a role in increasing the vegetative growth indicators of the sweet corn hybrids.

Key words: Sweet Corn, Magnesium, Calcium, hybrid, bacterial.

استجابة الذرة الحلوة للأسمدة الحيوية البكتيرية والرش بالمغذيات المعدنية

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الخلاصة

نفذت تجربة حقلية بهدف معرفة استجابة اثنان من هجن الذرة الحلوة للأسمدة الحيوية البكتيرية والرش بالمغنيسيوم والكالسيوم وتأثيرهما في مكونات الحاصل للموسم الربيعي 2022، زرعت بذور هجينين من الذرة الحلوة CASH (H1) وROI SOLEIL (H2) في اوعية بلاستيكية وعند وصولها لمرحلة تكوين 2-3 اوراق حقيقية تم تلقيح وسط البادرات بالسماد البكتيري والذي تضمن: من دون لقاح (B0) والتلقيح ببكتريا *Azospirillum brasilense* (B1) والتلقيح ببكتريا *Pseudomonas fluorescens* (B2) والتلقيح ببكتريا *Azospirillum brasilense* و *Pseudomonas fluorescens* (B3) بعدها تم نقلها للحقل، تم الرش بعد 20 و 30 يوم من الشتل بثلاثة تراكيز وتضمنت من دون رش (N0) والرش بالمغنيسيوم والكالسيوم بتركيز 25 ملغم لتر$^{-1}$ (N1) و 50 ملغم لتر$^{-1}$ لكل منهما (N2)، نفذت التجربة وفق تصميم القطاعات الكاملة المعشاة بترتيب الالواح المنشقة وبثلاثة مكررات. أظهرت النتائج أن الهجين H2 ومعاملة الأسمدة الحيوية البكتيرية B3 والرش الورقي بالمغنيسيوم والكالسيوم N2 كان لها تأثير معنوي في

* **The research is extracted from the doctoral thesis of the first. Researcher.**

جميع الصفات المدروسة. تفوقت المعاملة H2B3N1 معنويا في ارتفاع النبات وعدد الأوراق، وتفوقت المعاملة H2B3N2 معنويا في المساحة الورقية ودليل المساحة الورقية والوزن الجاف للنبات، وتفوقت المعاملة H2B1N2 معنويا في تركيز الكلوروفيل الكلي في الأوراق، مما تبين ان لعوامل الدراسة وتداخلاتها دور في زيادة مؤشرات النمو الخضري لهجين الذرة الحلوة.
الكلمات المفتاحية: الذرة الحلوة، مغنيسيوم، كالسيوم، هجين، بكتريا.

INTRODUCTION

Sweet corn (*Zea mays* L).var Saccharata is a corn variety with high sugar content in milky and early dough stage and its dry kernels are shrivelled transparent, it eats fresh, boiled or grilled and harvested at the horticultural maturity of the grains (the milky stage). Each 100 g of sweet corn grains contains 72.7 g of moisture, 96 calories, 3.5 g of protein, 1 g of fat, 22.1 g of carbohydrates, 0.7 g of fiber and 0.7 g of ash **(Hassan, 2004)**. Sweet corn did not take much attention farmers in Iraq, despite that the climatic conditions are suitable for its cultivation and production. hybrids of sweet corn are many and varied, production varies according to their ability to photosynthesis and individual productivity and also many quantitative and qualitative characteristics, and the loose of information on the cultivation of sweet corn in Iraq. Fertilizer types plays an important role in improving plant growth and increasing its productivity, especially bio-fertilizers, which have one of the topics that have received wide attention in recent years. It also play an important role in fixing nitrogen , improving the nutritional status of plants **(El-Gizawy & Mehasen, 2009)** and reducing the pathogens that may infect the plant **(Al-Merawi *et al*., 2013)**, Microorganisms differed in the functions they perform towards the plant, as they were believed that *Azospirillum brasilense* have the ability to fix nitrogen only, but it turned out later that its impact on plant growth is through the production of phytohormones and was then classified as Plant Growth Promoting Rhizobactria, While *Pseudomonas fluorescens* is described a great ability to coloniz around the roots of cultivated plants and produce that stimulate plant growth and raise the readiness of the phosphorous present in the rhizosphere and contribute to reduce the impact of growth inhibitors and the development of biological control factors **(Chu *et al*., 2020; AL- Shamma & AL-Shahwany, 2014)**. Foliar application its an important role in improving plant growth and increasing its productivity by supplying it with its needs of different nutrients, which contribute to many diverse physiological activities in the plant tissue. Magnesium is involved in many physiological and biochemical activities; it is an essential element for plant growth and development, The main function of Magnesium in plants is probably its role as the central atom of the chlorophyll molecule in the light-absorbing complex of chloroplasts and its contribution to photosynthetic fixation of carbon dioxide and enzyme activation for protein biosynthesis, and phloem export of photosynthates to ensure vegetative and generative growth. Magnesium pectate acts on the cellulose chains in the cell wall which is Calcium interacts with pectic acid to form insoluble Calcium pectate , and Calcium presence is important in fast-growing tissues such as stem and root meristems, which confirms the importance of the two elements in plant growth and the production quality **(Cakmak & Yazici, 2010; Gaj *et al*., 2018),** this study was aimed to investigate response of two sweet corn hybrids to bacterial biofertilizers and spraying with Mg^{+2} and Ca^{+2} and their impact on the Yield.

MATERIALS AND METHODS

The study carried out during Spring season 2022, at (A) Research Station, College of Agricultural Engineering Sciences, Jadiriyah. Peatmoss was sterilized by packing a weight of 250 g in thermal bags for 30 minute in an autoclave at a temperature of 121 °C and a pressure of 15 pounds, then left to cool and the sterilization process was repeated twice. then, plastic pots with a capacity of 32 plants were prepared and filled with sterilized peatmoss, and planted with sweet corn hybrid seeds on ^{15th}March /2022 **(Al-Hassani, 2015)**. When they reached the stage of forming 2-3 leaves, the seedling soil was inoculated with bio-bacterial fertilizer within the required transactions and was transferred to the field, after preparation of the field plants were planted with a space 65 cm between the rows and 20 cm with in the rows. 50% of the recommendation fertilizer has been added **(Hassan, 2004)** were follows:

- Nitrogen fertilizer rate of 178 kg . ha^{-1} with urea.
- Tri super phosphate fertilizer added rate of 100 kg ha^{-1} (P_2O_5).
- Potassium sulphate fertilizer added rate of 198 kg ha^{-1} (K_2O).

Treatments

The First Factor Includes the Inoculation with Bacterial Biofertilizer

Which was added to the soil of the seedlings using liquid inoculum, where the inoculation density of the bacteria used was (1×10^8 ml^{-1} cfu), which was prepared by the Ministry of Agriculture, Agricultural Research Department, The treatments were as follows:

- Comparative treatment (without bio-bacterial fertilizers(B0).
- Treatment of bio-bacterial fertilizers using *Azospirillum brasilense* (B1).
- Treatment of bio-bacterial fertilizers using *Pseudomonas fluorescens* (B2).
- Interaction treatment of two bio-bacterial fertilizers (*Azospirillum brasilense* and *Pseudomonas fluorescens*) (B3).

The Second Factor (the Most Important)

Includes foliar spray treatments using three concentrations of Magnesium and Calcium (in the forms of Magnesium Sulphate and Calcium Sulphate). The spraying was carried out twice after 20 and 30 days of seeding in the permanent field **(Abbas *et al*., 2021; Aslam *et al*., 2018)**, the treatments were as follows:-

- Without spraying (N0).
- Foliar spraying with Magnesium and Calcium at a concentration of 25 mg. L^{-1} each one(N1).
- Foliar spraying with Magnesium and Calcium at a concentration of 50 mg. L^{-1} each one(N2).

The third factor included the cultivation of two hybrids of sweet corn which were: -

- An American origin CASH hybrid (H1).
- A Dutch-origin ROI SOLEIL hybrid (H2).

Randomized complete block design (RCBD) with in split plot arrangement with three replicates were used the main plot included the hybrids, while the sub plots included treatments of bacterial inoculation and spraying with Magnesium and Calcium. with a 5% probability level **(Al-Sahoki & Waheeb, 1990)**.

RESULTS AND DISCUSSION

Plant Height (cm)

The results in Table 1 show that H2 hybrid had significant effect to the plant height with 126.66 cm compared to H1 hybrid, which had 122.82 cm, the biofertilizer treatment B3 had significant effect with 128.48 cm compared to the B0 which recorded 119.77 cm, the treatment of foliar spraying with Magnesium and Calcium N2 had significant effect with 125.46 compared to N0, which had 123.68 cm. The second interaction H2B3, had significant effect with 131.67 cm, compared to H1B0 which recorded 119.50 cm, H2N2 had significant effect with 127.72 cm compared to H1N0 which recorded 121.27 cm, B3N2 had significantly effect with 129.10 cm, which did not differed significantly from B3N1 compared to treatment B0N0, which gave 118.81 cm. The triple interaction H2B3N1 had significant effect with 132.37 cm, which did not differed significantly from H2B3N2 and H2B2N2 compared to the treatment H1B0N0 Which recorded 118.40 cm**.**

Leaves Number (leaf. plant^{-1})

The results in Table 2 show that H2 hybrid had significant effect to the number of leaves in the plant, with 9.370 leaves.plant^{-1} compared to the H1 hybrid, which had 7.287 leaves.plant^{-1}. Bacterial biofertilizer treatment B3 had significant effect which had 8.519 leaves.plant^{-1} compared to B0, which gave 7.944 leaves.plant^{-1}. The treatment of foliar spraying with Magnesium and Calcium N2 had significant effect with 8.444 leaves. Plant^{-1} in comparison to N0, which had 8.153 leaves. Plant $^{-1}$. The second interaction treatment H2B3, had significant effect, with 9.593 leaves. Plant $^{-1}$, which did not differs significantly from H2B2 and H2B1, compared to the H1B0, which had 6.963 leaves.Plant^{-1}.

Table (1): Effect of bacterial biofertilizers and spraying with Magnesium and Calcium and the interaction between them on plant height (cm) of sweet corn hybrids for the Spring season 2022.

Hybrids	Foliar Spraying	Bacterial Bio Fertilizer				H*N
		B0	B1	B2	B3	
H1	N0	118.40	121.42	123.23	124.41	121.87
	N1	118.89	123.44	124.22	125.58	123.03
	N2	121.22	123.47	123.71	125.89	123.57
H2	N0	119.22	124.44	128.00	130.33	125.50
	N1	119.91	125.33	129.42	132.37	126.76
	N2	121.00	126.44	131.11	132.31	127.72
						Means N
B*N	N0	118.81	122.93	125.62	127.37	123.68
	N1	119.40	124.39	126.82	128.97	124.90
	N2	121.11	124.96	127.41	129.10	125.64
						Means H
H*B	H1	119.50	122.78	123.72	125.29	122.82
	H2	120.04	125.41	129.51	131.67	126.66
	B Means	119.77	124.09	126.62	128.48	
LSD 5%						
H	B	N	H *B	H*N	N*B	H*B*N
0.292	0.611	0.530	0.760	0.626	1.059	1.440

H2N1 had significant effect, with 9.472 leaves. Plant $^{-1}$, which did not differed significantly from H2N2 and H2N0, compared to H1N0 treatment, which had 7.083 leaves.

Plant^{-1}. B2N1 had significant effect, with 8.667 leaves. Plant^{-1}, which did not differed significantly from B3N2, B3N1, B1N2, B1N1, and B3N0, compared to B0N0, which had 7.722 leaves. Plant $^{-1}$. The triple interaction treatment H2B2N1 had significant effect with 9.778 leaves.plant1- which did not differed significantly from H2B3N2, H2B3N1, H2B3N0, H2B2N2, H2B2N0 and H2B1N1 compared to H1B0N0 which had 6.667 leaves.plant^{-1}.

Table (2): Effect of bacterial biofertilizers and spraying with Magnesium and Calcium and the interaction between them on Leaves number (leaf. plant^{-1}) of sweet corn hybrids for the Spring season 2022.

Hybrids	Foliar Spraying	Bacterial Bio Fertilizer				H*N
		B0	B1	B2	B3	
H1	N0	6.667	7.222	7.222	7.222	7.083
	N1	6.889	7.222	7.556	7.556	7.306
	N2	7.333	7.555	7.442	7.556	7.472
H2	N0	8.778	9.222	9.333	9.556	9.222
	N1	8.889	9.667	9.778	9.556	9.472
	N2	9.111	9.556	9.333	9.667	9.417
						Means N
B*N	N0	7.722	8.222	8.278	8.389	8.153
	N1	7.889	8.444	8.667	8.556	8.389
	N2	8.222	8.555	8.388	8.611	8.444
						Means H
H*B	H1	6.963	7.333	7.407	7.444	7.287
	H2	8.926	9.481	9.481	9.593	9.370
	B Means	7.944	8.407	8.444	8.519	
LSD 5%						
H	B	N	H *B	H*N	B*N	H*B*N
0.3016	0.2201	0.1906	0.3099	0.2721	0.3812	0.5348

Leaf Area (cm^2.plant^{-1})

The results in Table 3 show that H2 had significant effect with 3974 cm^2 compared to H1 hybrid, which recorded 3692 cm^2, the biofertilizer treatment B3 had significant effect with 4069 cm^2 compared to B0, which recorded 3606 cm^2, the treatment of foliar spraying with Magnesium and Calcium N2 had significant effect with 3988 cm^2 compared to N0, which recorded 3669 cm^2. The second interaction treatment H2B3 had significant effect with 4319 cm^2 compared to H1B0, which recorded 3503 cm^2, H2N2 treatment had significant effect with 4179 cm^2 compared to H1N0 which recorded 3613 cm^2 , B3N2 had significant effect with 4179 cm^2 compared to B0N0, which recorded 3426 cm^2. The triple interaction treatment H2B3N2 had significant effect with 4408 cm2, which did not differed significantly from H2B3N1, H2B2N2, and H2B2N1 compared to H1B0N0, which recorded 3333 cm^2.

Leaf Area Index

The results in Table 4 show that H2 recorded 3.057 compared to H1 hybrid which had 2.840. The bacterial biofertilizer B3 had significant effect which recorded 3.130 compared to B0 which gave 2.774. The foliar spray treatment with Magnesium and Calcium N2 had significant effect which recorded 3.068 compared to N0, gave 2.822**.** The second interaction H2B3 had significant effect which recorded 3.323 compared to H1B0 which had2.695. H2N2 had significant effect which recorded 3.228 compared to H1N0, which gave 2.779 , B3N2 had significant effect which recorded 3.214, compared to B0N0, which gave 2.635. The triple interference H2B3N2 had significantly effect which gave 3.391, which did not differed significantly from H2B3N1 compared to H1B0N0, which recorded 2.564.

Table (3): Effect of bacterial biofertilizers and spraying with Magnesium and Calcium and the interaction between them on Leaf area ($cm^2.plant^{-1}$) of sweet corn hybrids for the Spring season 2022.

Hybrids	**Foliar Spraying**	**Bacterial Bio Fertilizer**				**H*N**
		B0	**B1**	**B2**	**B3**	
H1	N0	3333	3674	3723	3722	3613
	N1	3502	3675	3781	3782	3685
	N2	3675	3688	3805	3949	3779
H2	N0	3519	3549	3664	4169	3725
	N1	3561	3781	4281	4381	4001
	N2	4045	4052	4281	4408	4197
						Means N
B*N	N0	3426	3612	3693	3946	3669
	N1	3531	3728	4031	4081	3843
	N2	3860	3870	4043	4179	3988
						Means H
H*B	H1	3503	3679	3769	3818	3692
	H2	3708	3794	4076	4319	3974
	B Means	3606	3737	3922	4069	
LSD 5%						
H	**B**	**N**	**H *B**	**H*N**	**B*N**	**H*B*N**
100.8	96.3	83.4	127.6	108.7	166.8	230.4

Dry Weight of Shoots (g. plant^{-1})

The results in Table 5 show that H2 hybrid had significant effect in dry weight of the shoot with 96.01 gm.Plant^{-1}, compared to H1 hybrid, which gave 92.08 gm. plant^{-1}. The biofertilizer treatment B3 had significant effect with 99.76 gm.Plant^{-1} compared to B0 which recorded 89.08, the treatment of foliar spraying with Magnesium and Calcium N2 had significant effect with 98.43 gm.plant^{-1} compared to N0 which recorded 90.01 gm.plant^{-1}. The second interaction treatment H2B3, had significant effect which had 101.92 gm.plant^{-1} compared to H1B0 which gave recorded 87.37 gm.plant^{-1}, H2N2 treatment had significant effect with 100.42 gm.plant^{-1} compared to H1N0 which recorded 88.28 gm.plant^{-1}, B3N2 treatment was significant effect which recorded 103.80 gm.plant^{-1}, compared to B0N0, which gave 86.53 gm.plant^{-1}, The triple interaction treatment H2B3N2, had significant effect with 106.60 gm.plant^{-1}, which did not differed significantly from H2B3N1 treatment compared to H1B0N0, which had 84.13 gm.plant^{-1}.

Measurement of Total Chlorophyll Content in Leaves (mg.g^{-1} fresh weight)

The results in Table 6 show That H2 hybrid had significant effect in total chlorophyll concentration in the leaves with 9.575 mg. g^{-1} fresh weight compared to H1 hybrid which had 8.635 mg. g^{-1} fresh weight. Bacterial biofertilizer treatment B1 had significant effect with 9.388 mg. g^{-1} fresh weight, which did not differed significantly from B3 compared to B0, which had 8.779 mg. g^{-1} fresh weight. The treatment of foliar spraying with Magnesium and Calcium N2 had significant effect with 9.846 mg. gm^{-1} fresh weight compared to N0, which had 8.439 mg. gm^{-1} fresh weight . The second interaction treatment H2B1 had significant effect with 9.935 mg. g^{-1} fresh weight, which did not differed significantly from H2B3 treatment compared to H1B0 which had 8.461 mg. g^{-1} fresh weight. H2N2 had significant effect with

10.072 mg. gm^{-1} fresh weight compared to H1N0 which had 7.902 mg. gm^{-1} fresh weight, B1N2 had significant effect with 10.221 mg. g^{-1} fresh weight, which did not differed significantly from B3N2 treatment compared to B0N0 which had 7.842 mg. g^{-1} fresh weight. The triple interaction treatment H2B1N2 had significant effect with 10.590 mg. gm^{-1} fresh weight, which did not differed significantly from H2B3N2 compared to H1B0N0 which had 6.619 and 7.501 mg. gm^{-1} fresh weight.

Table (4): Effect of bacterial biofertilizers and spraying with Magnesium and Calcium and the interaction between them on Leaf area index of sweet corn hybrids for the Spring season 2022.

Hybrids	**Foliar Spraying**	**Bacterial Bio Fertilizer**				**H*N**
		B0	**B1**	**B2**	**B3**	
H1	N0	2.564	2.827	2.864	2.863	2.779
	N1	2.694	2.827	2.908	2.909	2.835
	N2	2.827	2.837	2.927	3.038	2.907
H2	N0	2.707	2.730	2.818	3.207	2.866
	N1	2.739	2.909	3.293	3.370	3.078
	N2	3.112	3.117	3.293	3.391	3.228
						Means N
B*N	N0	2.635	2.778	2.841	3.035	2.822
	N1	2.716	2.868	3.101	3.140	2.956
	N2	2.969	2.977	3.110	3.214	3.068
						Means H
H*B	H1	2.695	2.830	2.899	2.937	2.840
	H2	2.852	2.918	3.135	3.323	3.057
	B Means	2.774	2.874	3.017	3.130	
LSD 5%						
H	**B**	**N**	**H *B**	**H*N**	**B*N**	**H*B*N**
0.0775	0.0741	0.0642	0.0982	0.0836	0.1283	0.1773

The results refer to that the Bacterial biofertilization had a significant effect on plants growth of sweet corn hybrids with half recommended of the fertilizer, which could be attributed to the relationship between different microorganisms and the role of the stimuli they secrete on the growth of microbial species and colonizing plants **(Fukami *et al*. 2016; Spaepen *et al*. 2008)**.

The mechanisms of various Plant growth-promoting rhizobacteria bacteria differed, which could be effect accumulatively or sequentially, which include the excretion of phytohormones produced by

Table (5): Effect of bacterial biofertilizers and spraying with Magnesium and Calcium and the interaction between them on dry weight of shoots (g. plant^{-1}) of sweet corn hybrids for the Spring season 2022.

Hybrids	Foliar Spraying	Bacterial Bio Fertilizer				H*N
		B0	B1	B2	B3	
H1	N0	84.13	88.90	85.73	94.33	88.28
	N1	88.60	91.67	88.43	97.47	91.54
	N2	89.37	98.00	97.37	101.00	96.43
H2	N0	88.93	91.37	91.00	95.67	91.74
	N1	91.33	94.60	94.00	103.50	95.86
	N2	92.13	99.97	103.00	106.60	100.42
						Means N
B*N	N0	86.53	90.13	88.37	95.00	90.01
	N1	89.97	93.13	91.22	100.48	93.70
	N2	90.75	98.98	100.18	103.80	98.43
						Means H
H*B	H1	87.37	92.86	90.51	97.60	92.08
	H2	90.80	95.31	96.00	101.92	96.01
	B Means	89.08	94.08	93.26	99.76	
LSD 5%						
H	B	N	H *B	H*N	B*N	H*B*N
1.247	1.308	1.133	1.709	1.445	2.266	3.119

Table (6): Effect of bacterial biofertilizers and spraying with Magnesium and Calcium and the interaction between them on The total chlorophyll content in leaves (mg. gm^{-1} fresh weight) of sweet corn hybrids for the Spring season 2022.

Hybrids	Foliar Spraying	Bacterial Bio Fertilizer				H*N
		B0	B1	B2	B3	
H1	N0	7.501	7.922	7.781	8.405	7.902
	N1	8.655	8.746	8.138	8.003	8.385
	N2	9.228	9.852	9.544	9.850	9.619
H2	N0	8.183	9.536	9.076	9.109	8.976
	N1	9.524	9.679	9.697	9.808	9.677
	N2	9.586	10.59	9.622	10.492	10.072
						Means N
B*N	N0	7.842	8.729	8.428	8.757	8.439
	N1	9.089	9.213	8.917	8.906	9.031
	N2	9.407	10.221	9.583	10.171	9.846
						Means H
H*B	H1	8.461	8.840	8.487	8.753	8.635
	H2	9.098	9.935	9.465	9.803	9.575
	B Means	8.779	9.388	8.976	9.278	
LSD 5%						
H	B	N	H *B	H*N	B*N	H*B*N
0.1354	0.2342	0.2028	0.2934	0.2424	0.4056	0.5525

bacteria, especially indole acetic acid, gibberellins and cytokinins **(Spaepen *et al*. 2008)**, Which in turn increases the rates of absorption of water and minerals by the plants, thus contributing to the growth and elongation of roots and increasing the branching of root hairs **(Dardanelli *et al*., 2008; Sadiq, 2022)**, *Azospirillum brasilense* increases the fixation of atmospheric nitrogen on the plant, making the plant more active and more growth, as the rates of photosynthesis improve, water content increases and the size of the plant increases. plant and reduce carbon accumulation in plant leaves due to increased metabolism **(Pankievicz *et al*., 2015; Salman, 2014)** which is reflected in the dry whight **(Al-Hassani *et al*. 2018)**. Phosphate compounds processed by *Pseudomonas fluorescens* bacteria could be play an important role in the physiological processes inside the plant and stimulate the adventitious and fibrous roots to grow and the transfer of carbohydrates from the leaves to other parts of the plant to be used in energy production and building processes, so the plant needs phosphorus in large quantities as a second largest element after nitrogen **(Pereira *et al.,* 2020)**. As well as fixing nitrogen as a sustainable alternative to chemical nitrogen fertilizers, and phosphorous is a source of living energy needed to carry out the process of nitrogen fixation and increases of its efficiency **(Al-Samarrai *et al.,* 2018)**. The use of plant growth promoting rhizobacteria contributes to an increases in the concentration of ready elements such as nitrogen, phosphorous and potassium in the soil, thus an increases in the elements absorbed by the plants, which is positively reflected in supporting plant growth. The significant differences in the foliar spray treatments could be due to the importance of Magnesium, which is included in the composition of the chlorophyll molecule **(Aljuboori, *et al.,* 2006)**, which is the center of the photosynthesis process. and photosynthesis and enhances the regulation of the movement of sugars within the plant **(Cakmak & Yazici, 2010)**, Calcium fertilization also regulates the osmotic and ionic processes in cells and has an effect on plant growth **(White & Broadley, 2003)** and the importance of Magnesium and Calcium together during the stages of growth **(Gaj *et al.,* 2018)**. The differences in the interaction coefficients between the treatments of bio-bacterial fertilizers and the spraying with elements of Magnesium and Calcium in plant growth indecators for hybrid plants is explained by the role of the phytohormones nitrogen and phosphorous provided by the microorganisms of the plant, which contribute to increasing the efficiency of carbon metabolism and increasing its outputs represented in improving vegetative growth and then activating the transmission of these outputs with the help of Magnesium and Calcium, as well as an increase in the absorbed amounts of nutrients **(Al-Marsumy & jarallah, 2019; White & Broadley, 2003**), and the interaction between bacterial fertilization and the genotype of each plant and each plant variety differs **(Lana *et al*., 2012)**. The combined experiment factors had a role in improving the vegetative growth and health status of the plant, which increased the resistance environmental conditions and stress conditions rather, it worked to increase of number of leaves and leaf area with quantities of nutrients, which positively affected on total chlorophyll content in leaves which led to an increase dry matter in plant **(Al-Sarragi & Aljuboori, 2022)**. Environmental factors had effected on the growth of hybrids, and the difference in the genetic response to the characteristicsof the plant growth according to the influence of the environment in which that hybrid is planted **(Aljuboori et al., 2019; Okab & Abed, 2022)**, while the differences in the studied qualities of the hybrids of sweet corn may be due to the genetic difference between the two hybrids (American and Dutch origin) **(Hallauer, 1990; Al-Hilfy & Al-Temimi, 2017)**, and this indicates the importance and necessity of introducing and selecting different hybrids and generalizing the cultivation of the superior ones suitable for the conditions of cultivation in Iraq, pending the development of local varieties or hybrids.

We conclude that both sweet corn hybrids responded to the interactions of bacterial bio fertilizers and spraying with Magnesium and Calcium, which showed significant results in vegetative growth indicators.

CONCLUSION

Sweet corn hybrids had responded to the interaction treatment of biofertilizers (*Azospirillum brasilense* and *Pseudomonas fluorescens*) and spraying with magnesium and calcium at a concentration of 50 mg.L^{-1} in the measured vegetative growth characteristics, *Azospirillum brasilense* had a role in fixing the biological nitrogen, which led to an increase the concentration of chlorophyll in the plant.

REFERENCES

1. Abbas, M. , Hashim A. & Mohamed S. (2021). Ameliorative effects of calcium sprays on yield and grain nutritional composition of maize (Zea mays L.) cultivars under drought stress. *Agriculture,* 11(4): 285-298.
2. AL-Hassani, M. H. O. (2015). *Response of sweet corn (Zea mays L.var saccharata) to planting dates and biofertilizer spraying*. PhD dissertation. faculty of Agriculture. Baghdad University. Iraq.
3. Al-Hassani, A.A., Al-Salmani H.K. & Al-Ani A.S.H. (2018). Effect of humic acid levels and bio and nitrogen fertilizers on some growth characteristics and yield of maize (Zes mays L.). *Iraqi Journal of Soil Sciences*, 18(1):122-137.
4. Al-Hilfy, I. H. H. & Al-Temimi A. H. M. (2017). Response of some synthetic maize cultivars to mineral, organic and bio fertilizer. *The Iraqi Journal of Agricultural Sciences*, 48(7) –2763-2771.
5. Al-juboori, A. w. A., Ismail E. N., & Alwan K. A. (2019). molecular and morphological indicators (QUTHA) Cucumis melo planted in Iraq. *Iraqi Journal of Agricultural Sciences*, 50 (3):835- 841.
6. Al-juboori, M. K., Barzanji A. M. J. & Thamer M. G. (2006). Effect foliar spraying with magnesium salts chlorophyll content through different stages of potatoes growth. *The Iraqi Journal of Agricultural Sciences*, 37(4): 17-26.
7. Al-Marsumy, O. I. D. & Jarallah A. K. A. (2019). Effect of magnesium application on phosphorus use efficiency (PUE) of some phosphate fertilizers and on magnesium and phosphorus uptake by maize (Zea may l.). *Iraqi Journal of Agricultural Sciences*, 50 (5) :1302-1312.
8. Al-Merawi, A. A., Aljarah, N. S. & Matny O. N. (2013). Control of Charcoal disease on broadbean using Azospirillum brasilense and bokashi. *The Iraqi Journal of Agricultural Sciences*, 44(4): 474-479.
9. Al-Sahoki, M. & Waheeb K. M. (1990). *Applications in The Design and Analysis of Experiments,* Ministry of Higher Education and Scientific Research, University of Baghdad, pp: 488.
10. Al-Samarrai, I. K. & Al-Tamimi F. M. S. (2018). *Soil Microbiology Concepts and Applications*. The Republic of Iraq. Ministry of Higher Education and Scientific Research. Diyala University. pp: 516.
11. Al-Sarragi, L. Z. &. Aljuboori A. W. A. (2022). Effect of Bio-fertilizers and Boron Spray on Growth and Yield of Onion. *NeuroQuantology*, 20(6): 6788-6795.
12. Al-Shamma, U. H. & Al-Shahwany A. W. (2014). Effect of mineral and bio-fertilizer application on growth and yield of wheat *Triticum aestivum* l. *Iraqi Journal of Science,* 55 (4A): 1484-1495.
13. Aslam, M. R., Muhammad M., Zahoor A., Sajjad A., Muhammad R., & Muhammad U. H. (2018). Effect of foliar applied magnesium sulphate and irrigation scheduling on quality and yield of maize hybrid. *Pakistan Journal of Agricultural Research*, 31(2): 173-179.

14. Cakmak, I. & Yazici A. M. (2010). Magnesium: a forgotten element in crop production. *Better Crops*, 94(2): 23-25.
15. Chu, T.N., Le Van B. & Minh H. (2020). Pseudomonas PS01 isolated from maize rhizosphere alters root system architecture and promotes plant growth. *Micro organisms*, 8(4): 471.
16. Dardanelli, M. S., Córdoba F. J. F., Espuny M. R., Carvajal M. A. R., Díaz M. E. S., Serrano A. M. G., Okon Y. & Megías M. (2008). Effect of Azospirillum brasilense coinoculated with rhizobium on Phaseolus vulgaris flavonoids and nod factor production under salt stress. *Soil Biology And Biochemistry*, 40(11):2713-2721.
17. El-Gizawy, N. K. B. & Mehasen S. A. S. (2009). Response of faba bean to bio, mineral phosphorus fertilizers and foliar application with zinc. *World Applied Sciences Journal*, 6(10): 1359-1365.
18. Fukami, J., Nogueira M. A., Araujo R. S. & Hungria M. (2016). Accessing inoculation methods of maize and wheat with Azospirillum brasilense. *AMB express*. 6(1):3-16.
19. Gaj, R., Budka A., Górski D., Borowiak K., Wolna- Maruwka A. & Bąk K. (2018). Magnesium and calcium distribution in maize under differentiated doses of mineral fertilization with phosphorus and potassium. *Journal of Elementology*, 23(1): 137-150.
20. Hallauer, A. R. (1990). Methods used in developing maize inbreds" *Maydica*, 35(1): 1-16.
21. Hassan, A. (2004). *The Production of Secondary and Non-Traditional Vegetables, Part 3*. The Arab House for Publishing and Distribution. Cairo, pp. 424.
22. Lana, M. C., Dartora J., Marini D.& Hann J. E. (2012). Inoculation with Azospirillum, associated with nitrogen fertilization in maize. *Revista Ceres*, 59(3):399-405.
23. Okab, S. I. & Abed, Z. A. (2022). Effect of nitrogen fertilizers on growth and yield traits of maize. *Iraqi Journal of Market Research and Consumer Protection*, 14(2): 40-49.
24. Pankievicz, v., do Amaral F. P., Santos K., & Schueller M., (2015). Robust biological nitrogen fixation in a model grass-bacterial association. *The Plant Journal*, 81(6):907-19.
25. Pereira, N.C.M., Galindo F.S., Gazola R. P. D,. Dupas E., Rosa P. A. L., Mortinho E. S. & Teixeira Filho M.C.M. (2020). Corn yield and phosphorus use efficiency response to phosphorus rates associated with plant growth promoting bacteria. Front. *Journal of Environmental Sciences*. 8(40): 1-12.
26. Sadiq, M. S. (2022). Effect of soaking with gibberellic acid and inoculation with Glomus mosea and Azospirillum brasilense on growth and flowering of Lilium spp. Using alternative irrigation with salinized water. University of Baghdad. College of Agricultural and Engineering Sciences. Horticuiture and Landscape Department. Iraq. Pp128
27. Salman, S.D. (2014). Role of bio fertilizers in some the biochemical and phsylogical parameters of wheat under salt stress. *The Iraqi Journal of Agricultural Sciences*, 45(8): 854-864.
28. Spaepen, S., Dobbelaere S., Croonenborghs A. & Vanderleyden J. (2008). Effects of Azospirillum brasilense indole-3-acetic acid production on inoculated wheat plants. *Plant and Soil*, 312(1): 15-23.
29. White P. J. & Broadley M. R. (2003). Calcium in plants. *Annals of Botany*, 92(4): 487-511.