Effect of bio-fertilizer (EMA) and nutrient solution (Al-Jamia) on the yield traits for two cultivars of broad bean (Vicia faba L.)

Wafaa Mohammed Lifta Al-Tamimi* Ahmed Mohammed Lahmood
Al-Furat Al-Awsat Technical University, Al-Mussaib Technical College, Babylon province, Iraq.

ABSTRACT

A field experiment was conducted during the winter season of (2017) in one of the farmers' fields in Abi Gharq district, 10 km northwest of Babylon province. The experiment was designed according to The Randomized Complete Block Design (RCBD), in the order of split-split plots, where the two cultivars of broad bean (Hab Luz De oton from Spanish origin and Extra Hative a Graine from Italian origin) represents the main plots, which are symbolized by (V1, V2). As for the sub-plots, it included four concentrations of bio-fertilizer (EM0 control treatment, EM1 100, EM2 200, EM3 300 ml.10 m^2), and the sub-sub plots included three concentrations of the nutrient solution (Al-Jamia) (F0 control treatment, F1 5, F2 10 $ml.L^{-1}$). the experiment included 24 treatments, with three replicates, the results were as follows:

The Italian cultivar (V2) was significantly excelled on the Spanish cultivar (V1) in the traits, the number of days for flowering 50%, the length of the pod, the number of green pods, the number of green seeds per pod, the weight of 100 seeds (g), the total yield of green seed, the percentage of protein which gave the highest values amounted to (29.00 days, 18.89 cm, 13.93 $pods.plant^{-1}$, 5.09 $seeds.pods^{-1}$, 158.75 g, 2496.75 $kg.dunum^{-1}$, and 27.11%), respectively. Fertilization with bio-fertilizers also excelled and the EM3 treatment gave the highest values for the traits of the number of days for flowering 50% amounted to (75.83 days), the length of the pod (19.23 cm), the number of green pods (16.52 $pods.plant^{-1}$), the number of green seeds per pod (5.31 $seeds.pods^{-1}$), the total yield of green seed (2,657.67 $kg.dunum^{-1}$), the percentage of protein (28.89%). The spraying with the F2 level also significantly excelled by giving it the highest values for the traits of the number of days for flowering 50% (74.42 days), the length of the pod (20.99 cm), the number of green pods (16.25 $pods.plant^{-1}$), the number of green seeds per pod (5.40 $pods.plant^{-1}$), The total yield of green seed yield (2758.63 $kg.dunam^{-1}$), percentage of protein (30.11%). While the results of the interaction between the factors of the study did not show any significant differences between the treatments.

*Research paper from Ph.D. thesis for the first author.

تأثير المخصب الحيويEMaوالمحلول المغذي الجامعة في صفات الحاصل لصنفين من الباقلاء.L *Vicia faba*

وفاء محمد لفتة التميمي* احمد محمد لهمود
الكلية التقنية المسيب، جامعة الفرات الاوسط التقنية, محافظة بابل, العراق.

الخلاصة

نفذت تجربة حقلية خلال الموسم الشتوي لسنه (2017) في احد حقول المزارعين في ناحية ابي غرق على بعد 10 كم شمال عرب محافظة بابل ، تم تصميم التجربة وفق تصميم القطاعات الكاملة المشاة R.C.B.D وبترتيب الالواح المنشقة Split split plots اذ مثلت الالواح الرئيسية على صنفين من الباقلاء وهما (Hab Luz De oton اسباني المنشأ(V1) و Extra Hative a Graine (V2) ايطالي المنشأ) ، اما الالواح الثانوية فشملت على اربع تراكيز للمخصب الحيوي EMa وهي (EM0 معاملة القياس، EM1 100 مل.10م2، EM2 200 مل.10م^2 ، EM3 300 مل.10م^2) ، والالواح تحت الثانوية شملت ثلاث تراكيز من المحلول المغذي الجامعة هي (F0 معاملة المقارنة ، F1 5 مل . لتر $^{-1}$ و F2 10 مل . لتر $^{-1}$). اذ شملت التجربة على 24 معاملة وبثلاث مكررات وكانت النتائج كما يلي:-

اذ تفوق الصنف الايطالي V2 معنويا على الصنف الاسباني V1 في الصفات عدد الايام لتزهير 50% ،طول القرنة ، عدد القرنات الخضراء ،عدد البذور الخضراء لكل قرنة ، وزن 100(غم) بذرة، حاصل البذور الخضراء الكلي ،النسبة المئوية للبروتين واعطى اعلى القيم بلغت (29.00 يوم ، 18.89 سم ، 13.93 قرنة نبات$^{-1}$ ،5.09 بذرة .قرنة$^{-1}$ ،158.75 غم ،2496.75 كغم.دونم$^{-1}$ و 27.11 %) على التوالي ،كما تفوق التسميد بالمخصبات الحيوية واعطت المعاملة EM3 اعلى القيم لصفات عدد الايام لتزهير 50% (75.83 يوم) ،طول القرنة (19.23 سم)، عدد القرنات الخضراء (16.52 قرنة.نبات$^{-1}$)،عدد البذور الخضراء لكل قرنة(5.31 بذرة.قرنة$^{-1}$)، حاصل البذور الخضراء الكلي(2657.67 كغم.دونم$^{-1}$) ،النسبة المئوية للبروتين (28.89%) ،كما تفوق الرش بالمستوى السمادي F2 معنويا واعطى اعلى القيم في صفات عدد الايام لتزهير 50%(74.42يوم) ،طول القرنة(20.99 سم) ، عدد القرنات الخضراء(16.25 سم) ،عدد البذور الخضراء لكل قرنة(5.40 بذرة قرنة$^{-1}$)، حاصل البذور الخضراء الكلي(2758.63 كغم.دونم$^{-1}$)،النسبة المئوية للبروتين(30.11%) .بينما لم تظهر نتائج التداخل بين عوامل الدراسه وجود اي فروقات معنويه تذكر بين المعاملات .

*البحث مستل من اطروحة الباحث الاول.

1. INTRODUCTION

Broad bean (Vicia faba L.) is considered one of the important crops of the Fabaceae family in many countries of the world, especially North African countries, which ranks second in terms of its economic importance after the Poaceae family, it is considered one of the plants adapted to cold climatic conditions (Hassan, 2002). Beans are cultivated for dried and fresh green seeds. The seeds also contain many important nutrients, especially proteins, carbohydrates, oils, mineral salts, and vitamins (wanted et al., 1989). It is also used as animal feed and green fertilizer, and its cultivation is not stressful for soils, because it works to fix the atmospheric nitrogen by the presence of Root nodules in its roots, which benefit from it in its various stages of development (Al-Tamimi, 1998). Broad bean crop and its productivity are affected by many environmental, nutritional, and genetic factors (cultivar). Due to the growing world population and the absence of an equal increase in food production, especially vegetables, all of this prompted researchers to develop cultivars with high productivity and nutritional value (Cieslarova et al., 2012). These cultivars require the availability of nutrients in the soil, where fertilization is one of the most important crop service operations that leads to increase production because it regulates physiological processes inside the plant, especially when fertilizing with macro and micronutrients (Abu Dahi, 1989). Foliar spraying is considered a fertilization method that significantly improves growth rates and works well in cases where plants have less efficient ability to absorb nutrients for various reasons such as high levels of salts and pathological infections etc. (Mengel and Kirby, 1987). Bio-fertilizers are also considered a modern fertilization technique that is added in several ways, including treating the seeds with them or adding them directly to the soil or with irrigation water or spraying them on the plant. The beneficial organism of the plant, the most important of which are fungi (Mychorriza) and lactic acid bacteria, which have an important role in improving the traits of plant growth in addition to their role in analyzing organic substances and inhibiting the activity of pathogens in the soil and yeasts that contain enzymes and hormones that encourage cell division and actinomyces containing antibiotics and fungi containing organic enzymes as well as their role in increasing phosphorous availability by secreting Phosphatase. It also coexists with Root nodules for nitrogen fixation (Woodward, 2003). This study aims to study the effect of cultivar, bio-fertilizers (EMA), and foliar spraying on the traits of vegetative growth for Broad bean.

2. MATERIALS AND METHODS

The experiment was conducted in one of the farmers' fields in Abi Gharq district, 10 km northwest of Babylon province, during the winter season (2017). Samples were taken from the field soil at a depth (0-30 cm) to study some of the physical and chemical traits for the field soil before proceeding with the cultivation process as shown in Table (1). The soil was prepared for cultivation by plowing, with two

perpendicular plows, the soil was then smoothed and leveled, Diammonium phosphate (DAP) and its fertilizer ratio (0, 46, 18) were then added only in one batch, with the rate of (25 kg/dunum) spread on the ground before planting and mixing the fertilizer with the soil. The land of the experiment was divided into three sectors, with a rate of 24 experimental units in each sector, and the sub-waterways were arranged harmoniously. The field was planted on 10/15/2017, with a rate of three seeds in each pit, the area of the experimental unit amounted to (7.5 m 2). The area of the cultivated field is a dunum, and the cultivation was done on the lines, the distance between one line and another is 50 cm and between one pit and another is 25 cm (Farhan, 2012). After the germination process is complete, thinness is conducted to one plant per pit. The service operations included the control of the weeds manually and several times throughout the period the crop remained in the field and the process of pest control, where the Acetoprid pesticide was used with a rate of (0.5 $ml.L^{-1}$) to control black and green aphids and Ortus pesticide with a rate of (5%, 1 $ml.L^{-1}$) to control the Aceria tulipae. The irrigation process occurred immediately after planting and the irrigation continued according to the need of the plant. The experiment was conducted using the Randomized Complete Block Design (RCBD), in the order of split-split plots, where the experiment included three factors, the first factor: it included two cultivars of broad beans, namely (Hab Luz De oton from Spanish origin and Extra Hative a Graine from Italian origin) represent in the main plots, which are symbolized by (V1, V2). As for the sub-plots, it included four concentrations of bio-fertilizer (EM0 control treatment, EM1 100, EM2 200, EM3 300 ml.10 m2), and the sub-sub plots included three concentrations of the nutrient solution (Al-Jamia) (F0 control treatment, F1 5, F2 10 ml.L-1) produced locally by the agricultural consulting office of the college of Agriculture, University of Basra that containing the following elements (nitrogen 7%, phosphorus 5%, potassium 7%, magnesium 5. 0%, potassium humate 5 .0% + minor elements) for Three periods through spraying start with the age of one month and one month between sprayings.

Table 1: Physical and chemical traits of the soil of the experiment.

Traits		Units	Value
pH		-----	7.99
EC		$dS.m^{-1}$	3.12
Organic matter		$g.kg^{-1}$	8.2
Available ions	Nitrogen Availability	$mg.kg^{-1}$	41.00
	Phosphorous Availability		17.00
	Potassium Availability		170.00
Boron		$g.kg^{-1}$	0.45
Sand			37.1%
silt			53.2%
Clay			9.7%
Texture		**Silty loam**	

* Physical and chemical tests were conducted in the laboratories of the Department of Soil and Water Resources, College of Agriculture, Al-Qasim Green University.

Studied traits

10 plants were randomly chosen at harvest from each experimental unit and the following traits were studied:

The number of days from cultivating to 50% flowering

It was calculated when 50% of the flowering of plants appears in the experimental unit.

ISSN 2072-3875

The average length of the pod (cm)

It was measured by tape measure by measuring the length of ten pods as average.

The average number of green pods (pod.plant^{-1})

It was calculated as the average number of pods in the ten harvested plants.

The average number of green seeds(seed.pod^{-1})

It was calculated after extraction of the seed from the pods of the plant, calculating the number of seeds and then dividing the number of seeds by the number of pods in the plant.

The average weight of 100 green seeds (g)

It was calculated by taking a random sample of green ripe seeds.

Total seed yield (kg. dunum^{-1})

It was calculated based on the average plant yield of each experimental unit and based on plant density then converted to (kg. dunum^{-1})

Percentage of protein in seeds

It was calculated with Mikrotechna praha Amino Acid Analyzer T339.

3. RESULTS AND DISCUSSION

1- The number of days from cultivating up to 50% flowering

Table (2) indicates that there were significant differences between the cultivars, where the Italian cultivar (V2) has excelled on the Spanish cultivar (V1) by giving it the lowest average number of days from cultivating up to 50% flowering for the broad bean crop amounted to (79.00 days), while the Spanish cultivar gave the highest average amounted to (80.83 days). These results agree with (Al-Jubouri, 2014; Al-Barri, 2012). As for spraying with bio-fertilizer (EMA), where the EM3 level has excelled by giving it the lowest average number of days amounted to (75.83 days) compared to the other levels, while the non-spraying with EM0 gave the highest average number of days amounted to (83.67 days). The results of Table (2) also showed that there was a significant effect between the spraying levels with nutrient solution (Al-Jamia), where the F2 level has excelled by giving it the lowest average number of days from cultivating up to 50% flowering amounted to (74.42 days), while the control treatment (F0) gave the highest average number of days amounted to (86.29 days). This result agrees with (Al-Zubaidi, 2014; Hadhili and Al-Jubouri, 2016). As for the interaction, the results in Table (2) indicate that there was no significant effect for the bi-interaction between the cultivar and the bio-fertilizer (V * EM) and the bi-interaction between the cultivar and Al-Jamia nutrient solution (V * F) during the two growing seasons. The results indicated that there was a significant effect of bi-interaction between the bio-fertilizer and Al-Jamia nutrient solution (EM * F). The combination of EM3F2 has excelled by giving it the lowest number of days amounted to (71.17 days), while the combination EM0F0 gave the highest average amounted to (89.50 days). The results also showed that there were no significant differences in triple interactions between the study factors (V * EM * F).

 ISSN 2072-3875

Table 2: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the number of days from cultivating up to 50% flowering for the broad bean crop.

Cultivars	Biofertilizer (EMA)	Al-Jamia nutrient solution			Average
	EM	F0	F1	F2	
V1	EM0	90.00	84.67	78.33	84.33
	EM1	88.00	81.33	78.00	82.44
	EM2	87.33	79.00	73.00	79.78
	EM3	83.33	74.67	72.33	76.78
V2	EM0	89.00	83.00	77.00	83.00
	EM1	85.00	79.33	75.00	79.78
	EM2	86.00	77.33	71.67	78.33
	EM3	81.67	73.00	70.00	74.89
Average		86.29	79.04	74.42	
LSD 0.05	**Al-Jamia nutrient solution =0.717**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		87.17	79.92	75.42	80.83
V2		85.42	78.17	73.42	79.00
LSD 0.05		**NS**			**1.006**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		89.50	83.83	77.67	83.67
EM1		86.50	80.33	76.50	81.11
EM2		86.67	78.17	72.33	79.06
EM3		82.50	73.83	71.17	75.83
LSD0.05		**1.433**			**1.057**

2- The average length of the pod (cm)

Table (3) shows that the Italian cultivar (V2) has excelled significantly in the trait of the length of the pod on the Spanish cultivar (V1) by giving it the highest average amounted to (18.89 cm), while the Spanish cultivar gave the lowest value of the length of the pod amounted to (16.94 cm). This agrees with (Al-Saleem, 2017; Al-Jubouri, 2014). As for the effect of bio-fertilizer (EMa) on the length of the pod, The results showed that the treated plants with the EM3 level recorded the largest length of pod amounted to (19.23 cm), while the control treatment (EM0) gave the lowest average length of the pod amounted to (16.52 cm). while the nutrient solution (F2) has significantly excelled on the rest of the Al-Jamia nutrient solution by giving it the highest length of pod amounted to (20.99 cm). while the non-spraying treatment with Al-Jamia nutrient solution (F0) gave the lowest average for this trait amounted to (13.80 cm). These results agree with (Zidane, 2018; Al-Saleem, 2017). The results of Table (3) show that there were no significant effects for all triple and bi-interactions treatments.

ISSN 2072-3875

Table 3: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the length of the pod (cm) for the broad bean crop.

Cultivars	**Biofertilizer (EMA)**	**Al-Jamia nutrient solution**			**Average**
	EM	**F0**	**F1**	**F2**	
V1	EM0	12.20	16.67	18.83	15.90
	EM1	12.70	17.40	19.17	16.42
	EM2	13.10	18.23	20.83	17.39
	EM3	13.60	19.47	21.07	18.04
V2	EM0	13.80	17.77	19.83	17.13
	EM1	14.10	19.57	21.83	18.50
	EM2	15.10	20.60	22.87	19.52
	EM3	15.80	21.97	23.50	20.42
Average		13.80	18.96	20.99	
LSD 0.05	**Al-Jamia nutrient solution =0.598**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		12.90	17.94	19.98	16.94
V2		14.70	19.98	22.01	18.89
LSD 0.05		**NS**			**0.314**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		13.00	17.22	19.33	16.52
EM1		13.40	18.48	20.50	17.46
EM2		14.10	19.42	21.85	18.46
EM3		14.70	20.72	22.28	19.23
LSD0.05		**NS**			**0.873**

3- The average number of green pods (pod.plant^{-1})

Table (4) shows that the highest value for this trait amounted to (15.93 pod.plant^{-1}) for the Italian cultivar (V2), which significantly excelled on the Spanish cultivar (V1), which gave the lowest values for the number of pods amounted to (13.93 pod.plant^{-1}). These results agree with (Al-Saleem, 2017; Rabie and El-Emam, 2015). The results of the effect of spraying with EMA were significant, where the EM3 level has significantly increased by giving it the highest average number of pods amounted to (16.52 pods.plant^{-1}). While the control treatment (EM0) gave the lowest average for this trait amounted to (13.51 pods.plant^{-1}). This result agrees with (Al-Juburi, 2014; Kalaiarasi and Sivakumar, 2014). Spraying with Al-Jamia nutrient solution was significantly excelled, where the Al-Jamia nutrient solution (F2) gave the highest value amounted to (16.25 pods.plant^{-1}), while the control treatment (F0) gave the lowest value of the number of pods amounted to (12.13, 13.49 pods.plant^{-1}). This result agrees with (Zidane, 2018; Al-Salim, 2017). The results of Table (4) show that there were no significant effects for all triple and bi-interactions treatments.

ISSN 2072-3875

Table 4: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the number of green pods (pod.plant^{-1}) for the broad bean crop.

Cultivars	**Biofertilizer (EMA)**	**Al-Jamia nutrient solution**			**Average**
	EM	**F0**	**F1**	**F2**	
V1	EM0	11.67	12.92	13.22	12.60
	EM1	12.65	13.62	14.80	13.69
	EM2	12.74	14.44	15.66	14.28
	EM3	13.44	15.70	16.33	15.16
V2	EM0	13.78	14.20	15.29	14.42
	EM1	14.11	15.85	17.29	15.75
	EM2	13.67	15.55	17.75	15.66
	EM3	15.84	18.16	19.66	17.89
Average		13.49	15.06	16.25	
LSD 0.05	**Al-Jamia nutrient solution =0.490**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		12.62	14.17	15.00	13.93
V2		14.35	15.94	17.50	15.93
LSD 0.05		**NS**			**1.963**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		12.72	13.56	14.26	13.51
EM1		13.38	14.74	16.05	14.72
EM2		13.20	15.00	16.71	14.97
EM3		14.64	16.93	18.00	16.52
LSD0.05		**NS**			**0.531**

4- The average number of green seeds (seed.pod^{-1})

Table (5) indicates that there was significant effect between the cultivars during the two growing seasons, where the Italian cultivar (V2) has excelled by giving it the highest average number of seeds in pod amounted to (5.09 seeds.pod^{-1}), while the Spanish cultivar gave the lowest average amounted to (4.40 seeds.pod^{-1}). These results agree with (Osman et al., 2013; Rabie and El-Emam, 2015). plants treated with EM3 gave the highest number of seeds in the pod amounted to (5.31 seeds.pod^{-1}). while the control treatment (EM0) recorded the lowest value amounted to (4.25 seed.pods^{-1}). these results agree with (Kalaiarasi and Sivakumar, 2014). The spraying with the Al-Jamia nutrient solution increased the number of seeds in the pod. Table (5) indicates that there was a significant effect among the spraying treatments withAl-Jamia nutrient solution, where the F2 level has excelled by giving it the highest average number of seeds per pod amounted to (5.40 seeds.pod^{-1}). As for the control treatment (F0), it gave the lowest average number of seeds per pod amounted to (3.74 pods.pod^{-1}) this result agrees with (Al-Saleem, 2017; Alag, 2015). Table (5) indicates that there was no significant effect on the bi-interaction between the cultivar and the bio-fertilizer (V * EM) for both seasons during the study. The bi-interaction between the cultivar and the bio-fertilizer (V * EM) also gave a significant effect to this trait, where the bi-interaction between the cultivar and Al-Jamia nutrient solution (V2F2) has excelled by giving it the highest number of seed per pod amounted to (6.05 seeds.pod^{-1}) While the control (V1F0) gave the lowest average for this trait amounted to (3.58 seeds.pod^{-1}). The bi-interaction between the organic fertilizer and Al-Jamia nutrient solution (V * EM) was significant, where the EM3 F2 treatment has excelled by giving it the highest value amounted to (6.24 seeds.pod^{-1}) While the EM0F0 treatment gave the lowest average for this trait amounted to (3.51 seeds.pod^{-1}). The triple interaction

 ISSN 2072-3875

between the study factors (V * EM * F) did not lead to significant effect.

Table 5: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the number of green seeds (seed.pod^{-1}) for the broad bean crop.

Cultivars	Biofertilizer (EMA)	Al-Jamia nutrient solution			Average
	EM	F0	F1	F2	
V1	EM0	3.24	3.80	4.44	3.83
	EM1	3.81	4.93	4.36	4.37
	EM2	3.52	4.72	4.84	4.36
	EM3	3.74	6.00	5.36	5.03
V2	EM0	3.78	4.92	5.34	4.68
	EM1	3.90	4.90	5.57	4.79
	EM2	3.86	5.78	6.21	5.28
	EM3	3.90	5.77	7.11	5.59
Average		3.74	5.10	5.40	
LSD 0.05	**Al-Jamia nutrient solution =0.290**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		3.58	4.87	4.75	4.40
V2		3.86	5.34	6.05	5.09
LSD 0.05		**0.410**			**0.228**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		3.51	4.36	4.89	4.25
EM1		3.85	4.92	4.97	4.58
EM2		3.69	5.25	5.53	4.82
EM3		3.82	5.89	6.24	5.31
LSD0.05		**0.579**			**0.253**

5- The average weight of 100 green seeds (g)

Table (6) indicates that there was significant effect between the cultivars during the two growing seasons, where the Italian cultivar (V2) has excelled by giving it the highest average weight of 100 green seeds amounted to (158.75 g), while the Spanish cultivar gave the lowest average amounted to (155.13 g). These results agree with (Ibrahim et al., 2016; Al-Saleem, 2017). Table (6) indicates that there was a difference between spraying treatments with (EMA) in the weight of 100 green seeds (g), where the control treatment (EMO) has excelled by giving it the highest average of this trait amounted to (162.34 g) which did not differ significantly from the EM1 plants which gave (160,540 g), while the plants treated with EM3 achieved the lowest average amounted to (151.52 g). The spraying with Al-Jamia nutrient solution led to a significant effect on this trait, where the non-sprayed plants (control treatment) FO achieved the highest average for this trait amounted to (163.16 g). while plants treated with F2 level gave the lowest average amounted to (148.97 g) for the trait of the weight of 100 seeds (g). These results agree with (Al-Zubaidi, 2014; Al-Issawi, 2010). The bi-interaction between the cultivar and the bio-fertilizer (V * EM) led to the absence of a significant effect on the factors during the study for the first and second seasons. The bi-interaction between the cultivar and Al-Jamia nutrient solution (V * F) and the bi-interaction between the bio-fertilizer and Al-Jamia nutrient solution (EM * F) caused the absence of a significant effect for the trait of the weight of 100 seeds (g) and the triple interaction between the cultivar, the bio-fertilizer, and Al-Jamia nutrient solution (V) * EM * F) did not lead to significant effect.

ISSN 2072-3875

Table 6: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the weight of 100 green seeds (g) for the broad bean crop.

Cultivars	Biofertilizer (EMA)	Al-Jamia nutrient solution			Average
	EM	F0	F1	F2	
V1	EM0	167.67	160.27	151.57	159.83
	EM1	165.90	161.37	149.07	158.78
	EM2	157.07	153.47	145.20	151.91
	EM3	154.93	151.93	143.07	149.98
V2	EM0	171.67	167.07	155.80	164.84
	EM1	168.73	163.13	155.07	162.31
	EM2	159.60	157.80	146.97	154.79
	EM3	159.70	154.50	145.00	153.07
Average		163.16	158.69	148.97	
LSD 0.05	**Al-Jamia nutrient solution =1.357**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		161.39	156.76	147.23	155.13
V2		164.93	160.63	150.71	158.75
LSD 0.05		**NS**			**0.518**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		169.67	163.67	153.68	162.34
EM1		167.32	162.25	152.07	160.54
EM2		158.33	155.63	146.08	153.35
EM3		157.32	153.22	144.03	151.52
LSD0.05		**NS**			**1.442**

6- The total yield of green seed (kg.dunum^{-1})

The Italian cultivar (V2) has excelled on the Spanish cultivar (V1) as shown in Table (7) by giving it the highest yield of green seed amounted to (2496.75 kg.dunum^{-1}), while the Spanish cultivar (V1) gave the lowest yield amounted to (2021.69 kg.dunum^{-1}). This agrees with Ibrahim et al., 2016; Al-Bouhamd, 2017). As for the second factor in the study, the results indicate the superiority of treatment with bio-fertilizer (EM3) by giving it the highest total yield of green seed amounted to (2657.67 kg.dunum^{-1}) while the non-spraying treatment with EM0 gave the lowest value for the total yield of green seed amounted to (1905.22 kg.dunum^{-1}). These results agree with (Al-Dawdi and Al-Jabouri, 2014). The spraying with Al-Jamia nutrient solution gave a significant effect to this trait, where the F2 treatment was significantly excelled by giving it the highest total yield of green seed for this trait amounted to (2758.63 kg.dunum^{-1}), while the control treatment (F0) gave the lowest average amounted to (1566.17 kg.dunum^{-1}). This result agrees with (Alag, 2015; Al-Fahdawi, 2012; Al-Salim, 2017). The bi-interaction between the cultivar and the bio-fertilizer (V * EM) did not lead to a significant effect during the two seasons of the study. While the bi-interaction between the cultivar and Al-Jamia nutrient solution (V * F) led to a significant effect for the trait of the total yield of green seed, the V2F2 combination has excelled by giving it the highest average for this trait amounted to (3187.17 kg.dunam^{-1}), While the V1F0 combination gave the lowest average amounted to (1465.75 kg.dunam^{-1}). As for the bi-interaction between the bio-fertilizer and Al-Jamia nutrient solution (EM * F), the results of the two tables indicate a significant effect of the study season, The combination EM3F2 has excelled by giving it the highest average amounted to (3360.17 kg.dunum^{-1}), while the EM0F0 combination gave the lowest average amounted to (1461.83 kg.dunum^{-1}).

ISSN 2072-3875

Table 7: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the total yield of green seed (kg.dunum^{-1}) for the broad bean crop.

Cultivars	Biofertilizer (EMA)	Al-Jamia nutrient solution			Average
	EM	F0	F1	F2	
V1	EM0	1305.33	1618.67	2004.00	1642.67
	EM1	1595.67	2279.33	2075.00	1983.33
	EM2	1406.33	2187.67	2436.67	2010.22
	EM3	1555.67	2991.33	2804.67	2450.56
V2	EM0	1618.33	2334.67	2550.33	2167.78
	EM1	1730.33	2370.67	2982.67	2361.22
	EM2	1642.00	2837.67	3300.00	2593.22
	EM3	1675.67	3003.00	3915.67	2864.78
Average		1566.17	2452.88	2758.63	
LSD 0.05	**Al-Jamia nutrient solution =172.23**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		1465.75	2269.25	2330.08	2021.69
V2		1666.58	2636.50	3187.17	2496.75
LSD 0.05		**243.570**			**85.059**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		1461.83	1976.67	2277.17	1905.22
EM1		1663.00	2325.00	2528.83	2172.28
EM2		1524.17	2512.67	2868.33	2301.72
EM3		1615.67	2997.17	3360.17	2657.67
LSD0.05		**344.461**			**151.930**

7- Percentage of protein in seeds (%)

Table (8) shows a significant effect for the cultivars included in the study, where the Italian cultivar (V2) has excelled by giving its highest value for this trait amounted to (27.11%) compared to the Spanish cultivar (V1), which gave the lowest value for the percentage of protein in seeds amounted to (25.43%). This result agrees with (Al-Jabouri, 2014; Al-Saleem, 2017). The spraying with bio-fertilizer (EMa) had a significant effect on the average percentage of protein in seeds, where the EM3 treatment gave the highest average amounted to (28.89%) compared to the control treatment (EM0), which gave the lowest average for this trait amounted to (23.56%). These results agree with (Al-Jubouri, 2014). The spraying with Al-Jamia nutrient solution had a significant effect on the average percentage of protein in the seeds, where the F2 treatment has excelled on the rest of the treatments by giving it the highest average for this trait amounted to (30.11%) compared to the control treatment that gave the lowest amounted to (21.31%). This result agrees with (Al-Zubaidi, 2014; Al-Saleem (2017). The bi-interaction between the cultivar and the bio-fertilizer (V * EM) and The bi-interaction between the cultivar and Al-Jamia nutrient solution (V * F) gave a significant effect for this trait during the two seasons of the study. The bi-interaction between the bio-fertilizer and Al-Jamia nutrient solution (V * EM) also increased the average percentage of protein in the seeds, where the combination EM3F2 achieved the highest value amounted to (33.32%), while the combination EM0F0 gave the lowest value amounted to (19.80%), the triple interaction between (V * EM * F) did not have a significant effect among the study factors.

ISSN 2072-3875

Table 8: Effect of cultivars, spraying with bio-fertilizer (EMA), Al-Jamia nutrient solution, and their interactions on the percentage of protein in seeds (%) for the broad bean crop.

Cultivars	**Biofertilizer (EMA)**	**Al-Jamia nutrient solution**			**Average**
	EM	**F0**	**F1**	**F2**	
V1	EM0	19.19	23.45	25.47	22.71
	EM1	19.45	25.33	28.43	24.40
	EM2	20.61	28.90	30.28	26.59
	EM3	22.19	29.45	32.41	28.02
V2	EM0	20.41	24.43	28.40	24.42
	EM1	22.34	25.63	29.41	25.79
	EM2	22.70	30.42	32.25	28.46
	EM3	23.56	31.52	34.23	29.77
Average		21.31	27.39	30.11	
LSD 0.05	**Al-Jamia nutrient solution = 0.560**	**Triple interaction = NS**		**Interaction between cultivar and Bio fertilizer (EMA) = NS**	
V1		20.36	26.78	29.15	25.43
V2		22.25	28.00	31.07	27.11
LSD 0.05		**NS**			**0.959**
Biofertilizer (EMA) × Al-Jamia nutrient solution					Average
EM0		19.80	23.94	26.94	23.56
EM1		20.89	25.48	28.92	25.10
EM2		21.65	29.66	31.26	27.52
EM3		22.88	30.49	33.32	28.89
LSD0.05		**1.127**			**0.719**

From the above, it is clear from the results of tables (2-8) that the Italian cultivar V2 was significantly excelled compared to the Spanish cultivar (V1) in all traits of the yield and its components, which are (number of days from planting to 50% flowering, length of the pod, number of pods in the plant, number of seeds per pod, weight 100 seeds, yield of Green seed and total yield of green seed (kg.dunum^{-1}). This is due to the difference between the two cultivars in their genotype and the extent to which they are affected by environmental conditions, where the genotype has a significant effect on the traits of the crop and its components (Ibrahim et al, 2016; Al-Salim, 2017). It is also clear from the results of the same tables to the presence of a significant increase in the traits of the yield and its components for the broad bean plant as a result of the treatment with EMA. Perhaps this is because the weight of the seed is inversely related to the trait of the number of seeds per pod, so the more seeds per pod increases, the greater the competition between them on nutrients, thus leads to an increase in the number of seeds, so the weight of a single seed decreases (Verkerke and Dekhujzen, 1986). Perhaps the reason is due to the role of the biofertilizer in increasing the components of the total and individual yield as a result of the treatment with the bio-fertilizer (EMa) and improving the absorption of water from the soil, as well as its role in collecting the soil grains. bio-fertilizers contribute to raising the production of plant hormones such as gibberellins, cytokinins and indole acid (IAA), which have an important role in regulating and improving the traits of growth and this reflects positively on the traits of yield and components of the plant, or the biofertilizer increases the surface area of the root system, as well as its role in facilitating Nutrients availability and transporting it to the pods that are the final sink for them, which leads to an improvement in the

 ISSN 2072-3875

quantity of yield and its components. This type of fertilizer works to supply several necessary vitamins in addition to the secretion of some growth regulators, which is reflected in raising the efficiency of the nutritional plant. All of this is reflected positively on the components of the yield, and adding these fertilizers to the soil increases the number of other beneficial microorganisms, thus works to form an integrated ecosystem in increasing the productivity of the yield (Higa and Sangakara, 1994; Al-Jubouri and Al-Dawoodi, 2017). Thus obtaining soil rich in beneficial organisms in addition to secreting antibiotics that inhibit the growth of some pathogenic microbes to the plant and supplying the soil with abundant numbers of beneficial microorganisms that compete with pathogenic microbes and inhibit their activity and plant infection, thus increase the yield and its components and obtaining high production (Javaid and Suhab 2010; Zaki And Abdel-Halim, 2007; Phillips, 2009). The results of the tables from (2-8) also indicate a significant increase in the traits of its yield and its components. Perhaps the reason is due to the fertilizer combination for a nutrient solution (Al-Jamia) containing potassium, which has an effective role in the division of the living cells for the plant and then works to encourage the growth of Meristematic tissues, thus it leads to an increase in the efficiency of photosynthesis, which reflects positively on the properties of the yield and its components (Al-Nuaimi, 1999). In addition to the fact that the fertilizer combination contains a boron component, it led to a direct effect for this element on the growth of the reproductive parts, where the reproductive parts need high levels of boron in order to grow naturally where the boron acts as a chemical director that works to grow the pollen tube through the reproductive tissue toward the ovary, this It directly affects the success of the fertilization process in flowering and seed formation. Therefore, the anther of the flowers will increase their liveliness by providing sufficient boron, and therefore this will be positively reflected in the increase in the number of seeds per pod as shown in Table (4). These results are in agreement with (Obaid and Jasim, 2014; Al-Zubaidi, 2014).

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 ISSN 2072-3875