Response of biological and organic fertilizers on the growth, yield and quality of bean plants

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Abstract

A field experiment was conducted during the winter season 2021-2022 to study the response of one cultivars of broad bean (Spani et al) to bio-fertilization at four levels (0, bacterial, fungal, and manure together) and organic fertilizer (decomposing sheep waste) at three levels (0, 4, 8)ton ha^{-1}, and the factorial experiment was conducted according to a randomized complete block design (R.C.B.D). As for the bio-fertilization, the level (the two fertilizers together) was excelled for all due to the presence of significant differences between the treatments in the vegetative, fruiting and qualitative growth. Except for the trait of the number of bacterial nodes, the (bacterial) inoculum excelled, giving the highest mean for the studied trait, amounting to 51.02 plant nodes, while the treatment (the two fertilizers together) gave the lowest average, amounting to 44.53 plant $nodes^{-1}$. As for the organic fertilization (sheep waste), the treatment (8 $tons.ha^{-1}$) was excelled on the rest of the treatments with significant differences in trait of ,The number of root nodes, the number of pods, and the weight of 100 seeds gave the highest averages (87.15 cm, 2044.64 cm2, 48.85 nodes $plant^{-1}$, 12.86 pods $plant^{-1}$, 231.98 g), respectively. As for the bi-interaction between the organic and bio-fertilizations, the combination (the two fertilizations together * 8 $tons.ha^{-1}$) excelled, for the trait percentage of protein in grains amounted to (29.13%, 4.36%, 27.27%), respectively.

introduction

Broad bean crop, whose scientific name *is Vicia faba*, belongs to the Fabaceae family and its original home is China, as it was distinguished by giving it the highest production of the broad bean crop. Broad bean is considered an "economic" crop that is included in people's nutrition because it has several advantages, including that it contains protein at an average of (20-36)% (Aziz, 2016) and (Jasim and Obaid, 2014) and carbohydrates at an average of (40-46)% (Khalil et al., 2016). Its seeds also contain many amino acids, at an average ranging from (0.55-1.06)%, fiber, and nutrients such as iron and zinc, in addition to antioxidants, some phenolic compounds, and vitamins such as vitamin A and C (Alwan et al., 2019). In addition to antioxidants and some phenolic compounds (Labba et al., 2021).The total global crop of broad beans was 4,210 $tons.ha^{-1}$) (FA O, 2020), while its average production in Iraq was 731.90 kg ha^{-1} (Central Statistical Organization, Directorate of Agricultural Statistics 2020), This clearly indicates a low productivity of the crop per unit area in Iraq, and for this reason the researchers went in several directions for the purpose of increasing productivity, including relying on imported cultivars with high productivity and tolerant to the conditions of the country or the use of modern techniques in fertilization, including the addition of bio- fertilizers, because of their important role in supplying the plant with major and minor nutrients, as well as ensuring plant protection against infection with pathogens. It also increases the plant's ability to withstand environmental stresses such as salinity and drought, in addition to its importance in improving soil structure by secreting sticky compounds that increase its cohesion and water conservation (Dubov 2013). Oskiera et al. (2015) found that fungal and bacterial biofertilizers increase the availability of nutrients in the soil and reduce the use of chemical fertilizers, thus reducing environmental pollution and increasing the

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efficiency of roots in absorbing water and nutrients. (Costa,et al 2014) also found that Rhizobium bacteria fix atmospheric nitrogen inside the root nodes, where these bacteria rupture the epidermal cells of the root hairs and live with them in a symbiotic life with the Broad bean.The plant supplies them with carbohydrates. Al-Eidani (2019) also found that the use of organic fertilizers for the Broad bean crop at different concentrations gave the highest mean for the following characteristics compared to the control treatment (plant height, number of branches, leaf area, dry weight), and the results were (161.6 cm, 7.89 branches. Plant^{-1}, 107.37 cm3 and 49.39 g) respectively. As for the organic fertilizers added to the soil, they are less dangerous to the environment than other types of fertilizers, especially chemical fertilizers, and the nutrients are completely released, because the release is done slowly by microorganisms that work to liberate the elements from the organic matter, transforming it into mineral elements available for the plant, which enhances its growth better (Kamal, 2016) The study aims to:

1- Determine the best level of organic fertilization to obtain the best vegetative, fruiting and qualitative growth.

2- Determine the best level of biofertilization to obtain the best vegetative, fruiting and qualitative growth.

3- Determining the best bi-interaction between organic and bio-fertilization to obtain the highest average of vegetative, fruiting and specific traits of broad bean plants.

MATERIALS AND METHODS

Experiment location

A field experiment was conducted during the winter season of the year 2021-2022 in the fields of a farmer in the district of Al-Mahaweel (15 km north of Babylon), with the aim of studying the response of two cultivars of broad bean *(Vicia faba L*. (Spanish and Turkish) to biofertilization, both fungal and bacterial, and organic fertilizer (completely degraded sheep waste).).

Experimental soil analysis

Five soil samples were taken from the experiment at a depth of (0-30) cm. They were mixed well and the laboratory sample was extracted from it. Impurities were removed from it. It was air-dried and ground to be sent to the laboratory of the Soil Department, College of Agriculture, Al-Qasim Green University, in order to know some of its physical and chemical properties as shown in the table. (1).

Table (1): Some physical and chemical properties of the experimental soil.

units	Values	Traits
	7.2	PH
	3.60	EC
mg.kg^{-1}	22.66	N available
mg.kg^{-1}	13.69	P available
mg.kg^{-1}	150.40	K available
g.kg^{-1}	6.83	organic matter
g.kg^{-1}	461	sand %
g.kg^{-1}	360	silt %
g.kg^{-1}	179	clay%
	Sand sility	texture

Experimental design and transactions:

The experiment was designed with Randomized Complete Block design (R C B D) according to factorial order, with three replicates, and it contains three factors:

The first: two cultivars in the broad beans (Spanish, Turkish), which were obtained from the Agricultural Research Department / Baghdad.

The second: fertilization with organic manure (decomposing sheep waste) at three levels (0, 4, 8) ton.ha^{-1}. It was added to the experimental soil before planting and according to the plan.

Third: Biofertilization with four levels (without fertilization, bacterial, fungal, and the two fertilizers together shows the components of the used biofertilizer. Thus, the number of treatments for one replicate was (3×4) = 12 experimental units, and since the experiment had three replicates Therefore, the number of experimental units in the experiment = 36 experimental units distributed randomly in the three replicates.

Preparation and implementation of the experiment

The experimental land was prepared by plowing it with a mold board plow with a depth of 25 cm, followed by the process of smoothing the soil with disc harrows, then it was leveled well and the necessary waterways were opened and the experimental land was divided into three sectors, leaving a distance between each two sectors by 2 meters for the waterways to watch and record data for the researcher .The area of each experimental unit (3×3) = 9 square meters. In each experimental unit, 4 marrows of 3 m length were planted. Planting took place in the upper third of furrow, leaving distances between the experimental units of 1.5 m to ensure that fertilizer additions did not mix between the experimental units. A distance of 1.5 m was left between the experimental units. 25 cm between one plant and another, and 75 cm between one plant and another, so the plant density is equal to 53.333 plants ha^{-1}

Agriculture and serving broad bean crop

Phosphate fertilizer (P_2O_5) was added at an amount of 120 kg p2O5 when preparing the soil in one batch. Nitrogen was added in the form of urea (N 46%) at a rate of 100 kg H-1 in two batches, the first after 30 days of germination and the second after 30 days of the first batch**.(Ali,H,2007)**Organic fertilizer (sheep waste completely decomposed before planting and in amounts according to the research plan was added during soil preparation).The seeds of the broad bean of the two cultivars were sown after soaking them for 12 hours on 10/16/2021 without additions. In the case of dealing with biological (bacterial) fertilizer, the seeds were soaked in a liquid containing Rhizobium bacteria, the genus Rhizobium, and sown immediately afterwards (15 kg of seeds per liter One of the above bacteria infusion) which was obtained from the Agricultural Research Department of the Ministry of Science and Technology / Baghdad.Two seeds were placed in one pit. In the case of fertilizing the seeds with bio-fertilizer (fungal), the seed should be placed with 10 gm of fungus-laden peat moss in one pit.The grafting process was carried out after two weeks of germination, then the thinning of the extra plants was carried out, and one plant was kept in one pot, after excluding the diseased, weak and delayed plants.All crop servicing operations were conducted from irrigation and weeding whenever needed, and organic fertilizer (sheep waste) was added according to the research plan (0,4,8) tons ha^{-1}.

studied traits

traits of vegetative growth

The content of chlorophyll in the leaves:

This was measured by the Spad device on five leaves for each of the ten plants taken randomly.

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- The number of root nodes in the plant (plant node^{-1})

After flowering, the roots were extracted from the soil accurately, and a stream of light water was directed on them. The average number of nodes was calculated for ten plants randomly taken from the inner lines (after excluding the guard lines) for each experimental unit. close to the roots.Then the roots were extracted by hand and with great care, and the nodes were collected by a sharp blade, and the average was obtained by dividing the total number of nodes by the randomly taken plants (10 plants).(khalf allah,2000)

Weight of 100 seeds (gm):

The weight of 100 dry seeds was calculated randomly from the yield of ten plants taken randomly for each experimental unit.

Total yield of dry seeds (ton.ha^{-1}):

The crop was left on the plant until it dries and was harvested in stages to avoid opening the pods and excessive seeds. The seeds were weighed for the ten randomly taken plants and divided by 10. The average was extracted multiplied by the plant density (53.333), so the total yield was obtained.

Qualitative traits:

Nitrogen Percentage in grain (%):

Calculated by following the Semi-micro kjeldal method to estimate nitrogen and determine protein percentage as in the following equation:

Protein percentage on dry weight basis = percentage of nitrogen in grain X 6.25 (AOAC, 1980).

Results and discussion

Chlorophyll content (SPAD)

Table (2) shows the level (8 tons.ha^{-1}) excelled on organic fertilization significantly, giving the highest average of 48.12 spad for the trait, while the comparison equation gave the lowest average of 39.88 spad for the trait. While the level (the two composters together) of biofertilization was significantly excelled, giving the highest mean of the trait, which reached 53.19 spad. While the control treatment (without fertilization) gave the lowest mean for the trait, which amounted to 37.03 spad. As for the interaction between (organic fertilization x biofertilization), where the combination (the two fertilizers together x 8 tons.ha^{-1}) significantly excelled by giving it the highest mean of 58.41 spad, while the combination (without fertilization x 0 tons.ha^{-1}) gave the lowest average of 33.91 spad for the trait.The reason for the increase achieved in the chlorophyll content in the leaves of broad bean plant to add biofertilizer may be due to the activation of a large number of enzymes, including those responsible for building chlorophyll.Including bacteria, especially Rhizobium spp. It performs an important work in the soil, where it decomposes organic matter into simpler substances that the plant can absorb and benefit from, and increases the movement of mineral elements (storage and release), in addition to transporting water, fixing nitrogen, releasing phosphorus from complex compounds, and making it easy for the plant to absorb as well. from many other mineral elements (Tilak et al., 2018).The increase in chlorophyll content may be due to the addition of organic fertilizers, which have a major role in providing nutrients, especially the nitrogen element, which is actually included in the composition of the chlorophyll molecule, mainly with four nitrogen atoms, and thus the chlorophyll content will increase in the case of adding organic fertilizer. (Abdolkarim, 2012).

Table (2) Effect of cultivars, addition of biological and organic fertilizers, and their double and triple interactions on the characteristic of chlorophyll content in bean

interaction organic x bio

average biofertilizer	8 ton.ha-1	4 ton.ha-1	0 ton.ha-1	organic / bio
37.03	40.64	37.06	33.91	without fertilizing
40.44	43.69	40.79	36.86	bacterial
45.07	49.73	45.15	40.33	fungal
53.19	58.41	52.65	48.41	bacterial+fungal
	48.12	43.91	39.88	average
1.363	2.360			L.S.D

The number of root nodes in the plant (plant node^{-1})

Table (3) shows that the organic fertilization treatment (8 tons.ha^{-1}) was significantly excelled on the rest of the treatments by giving it the highest average for the trait amounted to 48.85 plant nodes^{-1}, while the control treatment (0 tons.ha^{-1}) gave the lowest average for the trait amounted to 36.93 plant nodes $^{-1}$.As for the bio-fertilization, the (bacterial inoculum) treatment was significantly excelled on the rest of the bio-inoculum by giving it the highest average of 51.02 nodes.plant^{-1} , while the control treatment (without fertilization) gave the lowest average of 34.15 nodes plant^{-1}. As for the bi-interaction between the two organic and organic fertilizers, the combination (bacterial * 8 ton.ha^{-1}) was significantly excelled by giving it the highest average of 58.03 nodes.plant $^{-1}$, while the combination (without fertilization * 0 ton.ha^{-1}) gave the lowest average. 30.32 nodes plant^{-1}.It is possible to explain the increase in root nodes when adding biofertilization, because it is a medium that encourages the growth and increase of microorganisms to coexist with the plant, in addition to the fact that legumes are leguminous plants that already have bacterial nodes, so the nodes increase in the plant, which in turn fixes nitrogen, improves the growth of roots, and increases their ability to absorb water and materials food (Khudair, 2018),It was also found (Rabah, 2021) that the number of root nodes in the broad bean also increased with the addition of biofertilizer, reaching 51.20 nodes, plant^{-1}, while the comparison treatment gave the lowest average, reaching 34.93 nodes. Plant^{-1}. It was also found (Salah uddin et al., 2009) that the number of The root nodes formed by the mung bean plant by adding organic fertilizer increased, reaching 21.67 nodes, plant^{-1}, compared to the comparison treatment, which gave the lowest average number of root nodes, which amounted to 17.82 nodes.plant-1.Also, the results obtained by (Bhavya et al., 2017) agreed with the findings of the research. The increase in the number of root nodes when

they added bio and organic fertilizer to the broad bean amounted to 25.17 nodes plant^{-1}, while the comparison treatment gave the lowest averages for the trait amounted to 21.29 nodes plant-1 and also agreed Research results with findings (Rasool, Singh, 2016)

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Table (3) the effect of cultivars, biological and organic fertilizers and their interactions on the average number of nodes Root in bean (nodule plant-1)

interaction organic x bio

average biofertilizer	8 ton.ha-1	4 ton.ha^{-1}	0 ton.ha^{-1}	organic / bio
34.15	37.87	34.25	30.32	without fertilizing
51.35	59.03	51.59	43.44	bacterial
40.90	46.17	40.59	35.94	fungal
44.53	52.34	43.24	38.02	bacterial+fungal
	48.85	42.35	36.93	average
1.472		interaction:2.550		L S D

Weight of 100 seeds (g)

Table (4) shows the effect of organic fertilization, as the level (8 tons.ha^{-1}) outperformed the rest of the levels significantly by giving it the highest average for the trait amounted to 231.98 g, while the control treatment gave the lowest average for the trait amounted to 189.97 g.As for the effect of biofertilization, the treatment (the two manurees together) was significantly excelled on the rest of the treatments, as it gave the highest mean for the trait amounted to 249.32 g, while the control treatment gave the lowest average for the trait amounted to 179.62 g.As for the interaction between (biofertilization x organic fertilization), the combination (the two fertilizers together x 8 tons.ha^{-1}) significantly excelled by giving it the highest mean for the trait amounting to 283.51 g, while the combination (without fertilizer x 0 tons.ha^{-1}) gave the lowest average for the trait amounting to 170.26 g. The results also agreed with the researcher above that there were significant differences when using bio-fertilizer amounted to 128.83 gm, compared to not adding it, which amounted to 119.59 gm.We can explain that when adding bio-fertilizers, it increases the availability of available nitrogen for the plant, and increases the plant hormones that delay aging, and then increase the duration of seed filling, which leads to an increase in their weight. and he agreed with the results of Dhari and Al-Baldawi (2017) by obtaining an increase in the weight of 100 seeds by adding organic fertilizer. This can be explained by the fact that the organisms present in the added organic fertilizers secrete substances that encourage and stimulate plant growth, such as hormones and growth regulators, which positively affects plant growth, specifically the speed of food transfer from source to source. The estuary, and thus collects the largest amount of protein in the grain, which increases its weight.

Table (5) the effect of cultivars, the addition of biological and organic fertilizers and their bilateral and triple interactions on the characteristic of the total yield (ton H-1) of the bean crop.

interaction organic x bio

average bio	8 ton.ha-1	4 ton.ha-1	0 ton.ha-1	organic / bio
179.62	190.12	178.48	170.26	without fertilizing
193.68	210.62	192.53	177.89	bacterial
217.74	243.69	214.53	194.99	fungal
249.32	283.51	247.71	216.76	bacterial+fungal
	231.98	208.31	189.97	average
4.825	8.322			L.S.D

Total grain yield (tons ha^{-1})

It is clear from the organic table (5) that the treatment 8 tons.ha^{-1} excelled by giving it the highest average for the trait amounted to 8.454 tons.ha^{-1}, while the control treatment gave 0 tons.ha^{-1} the lowest averages amounting to 4.858 tons.ha^{-1} and thus there was an increase for the trait of the total yield It reached 57.46%.As for the addition of bio-fertilizer, the treatment (the two fertilizers together) was characterized by giving it the highest average for the trait amounted to 10.173 tons.ha^{-1}, while the control treatment (without fertilization) gave the lowest average for the total yield trait amounting to 3.808 tons.ha^{-1}. Thus, there was a significant increase in the trait between the two treatments amounting to 30.61%. As for the interaction between organic and bio-fertilization, the combination (two fertilizations together × 8 tons.ha^{-1}) was characterized by the highest mean of 12.640 tons.ha^{-1}, while the combination (without fertilization × 0 tons.ha^{-1}) gave the lowest averages for the studied trait amounted to 2.926 tons.ha^{-1}. Thus

Nitrogen content in grains (%)

Table (6) that the organic fertilization level (8 tons.ha^{-1}) significantly excelled on the rest of the levels by giving it the highest average for the trait amounted to 3.98%, while the level (0 tons.ha^{-1}) gave the lowest averages for the trait amounted to 3.46%.As for the bio-fertilization, the level (the two fertilizers together) was significantly excelled by giving it the highest average of the trait amounted to 4.08%, while the level (without fertilization) gave the lowest average of the trait amounted to 3.35%.As for the interaction between (organic fertilization x bio-fertilization)The combination (two fertilizations together x 8 tons.ha^{-1}) was significantly distinguished by giving it the highest mean of the trait amounted to 4.48%, while the combination (without fertilization x 0 tons.ha^{-1}) gave the lowest mean of 3.15%

Qualitative traits

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Table (6) The effect of cultivars, the addition of biological and organic fertilizers, and their double and triple interactions on the characteristic of the nitrogen content of the bean crop

interaction organic x bio

average bio	8 ton.ha-1	4 ton.ha-1	0 ton.ha-1	organic / bio
3.35	3.55	3.37	3.15	without fertilizing
3.57	3.80	3.55	3.38	bacterial
3.83	4.10	3.82	3.57	fungal
4.08	4.48	4.04	3.74	bacterial+fungal
	3.98	3.69	3.46	average
0.05426	N.S			L.S.D

References

1- Al-Tamimi, Wafaa M. L 2020. Response of two bean varieties to bio-fertilizer and nutrient solution spraying. PhD thesis. Musayyib Technical College. Al-Furat Al-Awsat Technical University. Iraq.

2-Khudair, Dalia Salman 2019. Response of some bean cultivars to biological and chemical fertilization. Master Thesis. faculty of Agriculture. Al-Qasim Green University.

3- Khalil, N. A, Al-Mutwali A., M. M. Sh., and Wajih Abd Al-Azim Al-Murshidi, (2015), Crops of Cereals and Legumes, Faculty of Agriculture, Cairo University, p. 186.

4-Rabah, Wissam Abboud. 2021. The effect of bio health fertilizer application dates and different percentages of mineral fertilizer recommendation on the growth and yield of bean sprouts. Master Thesis . Al-Qasim Green University. faculty of Agriculture.

5-Dhari, Sarah Ihsan and Muhammad Hathal Kazem Al-Baldawi, (2017), Response of different bean cultivars to organic fertilizers of plant origin, Iraqi Journal of Agricultural Sciences 48 (4): 1148

6-Aziz, Wijdan Saadi. 2016. Effect of spraying seaweed extracts on the growth and yield of two cultivars of broad bean (*Vicia faba* L.). Tikrit University Journal of Agricultural Sciences 16 (1): 81-87.

7- Alwan, Esraa Imad, Abdul-Rahim Sultan Muhammad and Karim Saeed Al-Obeidi. 2019. The effect of adding humic acid to the soil and spraying with Algaeo marine extract on the characteristics of two cultivars of broadpeas (vicia faba L.). Kirkuk University Journal of Agricultural Sciences. 10 (4): 30_40 .

8- Al-Eidani, Abeer Muhammad (2019), Effect of spraying with organic fertilizer and borden on seed yield and components of broad bean crop (Vicia Fabal)., Master's thesis, Al-Musayyib Technical College, Al-Furat Al-Awsat Technical University, Iraq.

9-Abdlkrarim.K.2012.Study effect of biological manure and chemicals nitrogen fertilizer applicati Under Irrigation management in ientil far Ming on physiochemical properties of soil. J.Basic. Appl.Sic;Res.2(7):6483-6487.

10-Bhavya.k,R.S.Reddy and S.Triveni.2017. Influence of Carrier and licluid in Rhizobial biofertilizer l.) on Aodulation nitrogenase activity and yield in mungbeen crop by fifferent method of applications int .J.Pare App.Bigsci 5(4):1666-1670.

11-Costa,p.p, Granada C.E. ,Ambrosi A,moreira F. ,Sonza R. ,passos J.F .M ., ArrudaL and passaglia LMP, 2014.A.model to explain plant growth promotion traits:Amul

tivariate analysis of 2,211 bacterial isolates .plos one 9:e116020

12-Dubova.l.,A.Senberga,I .Alsina.2015.the Effect of di=oulde inoculation on the broad beans (vicia fabal.)yield .agricultural Sciences (cr.p sciences , animal sciences). Research for Rural Dev.vol ,1:34-39.

13-F.A.O.2020. Food and Agriculture organization of the United Nation. FAO stat.

14-Jasim,Al.Hussain and Amir Sadim odaid , 2014 effect of foliar fertilizers spray,boron and their interaction on broad bean(vicia fabal)yield,Scientific papers series horticul ture . 13(1):271-276.

15-Labba,I .C .M .,frokiaer ,H ., & Sandberg ,A .S .2021 . Nutritional and antinutritional composition of Fava bean (vicia faba L .) . Varinor cultivars .Food Research in tcrnation al , 140 .103

16-Nishita, G.and N.C.Joshi.2010. Growth and yield responsc of chick pea (cicer Arietinum)to seed inoculation with Rhizobium sp.Nature and Sciencc. 17(9):232-236.

17-Oskiera,M.,S.Magdalena and B.Grzegorz.2015.mdecular identification of trichodermen strains collected to develop plant growth- promoting and biocontrol agents.journal Horticultural al.vd.23(1):75-86.

18-Rasool, S.and Singh.2016. Effect of Bio fertilizers and phos Phorus on growth and yield of Lentil(Cullnaris L.)Int. Adv.Agric SCi.and Tech.3(7)35-42.

19-Salah uddin ,md .,A.k.m.Ruhul Amin ,md .jafoar ullah and md Asaduzzman .2009.interaction effect of vquicty and different fertilizer on the growth and yield of summer mungbean .American-Eurasion J.AGRO. 2(3):180-184.

20-Tilak KVBR,Rauganayakinn,monoharachari C.2018 synergistic effects of plant- growth promoting rhizo bacteria and Rhizobium on nodulation and nitrogen fixation by pigeonpea Europ j soil SCI.57:67-71.

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