Plant Archives Vol. 19, Supplement 1, 2019 pp. 339-343 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF BIO- AND CHEMICAL FERTILIZERS ON GREEN PODS YIELD OF SOME BROAD BEAN CULTIVARS

Dalia Salman Khudair and Ali Hussein Jasim
College of Agriculture, Al - Qasim Green University, Iraq
Email ajasim11@gmail.com

Abstract

A field experiment was carried out at 2017/2018 growth season in Babylon / Saddat al-Hindia in loam clay soil to study the effect of two levels of bio-fertilizer (control and seed inoculation with bio-fertilizer) and three levels (0, 40 and 80 kg.ha^{-1}) of chemical fertilizers NPK (19-19-19) on green yield of three broad bean cultivars (Local, Rico and Luzdi). Randomized complete block design with four replications was used. The seeds were soaked in water for 24 hours before planting and then inoculation with bio-fertilizer and then cultivated at 20/10/2017 in hills 25 cm apart on both sides of ridges 75 cm apart. The results showed that Local variety was superior in pods number.plant^{-1}, pod length and green pod yield (18.65 pods, 20.8 cm and 13.483 tons.ha^{-1}), respectively. Rico cultivar gave the highest number seeds.pod^{-1}(6.3 seeds). Bio-fertilizer gave highest number of pods.plant^{-1}, seeds.pod^{-1}, pod length and green pods yield (19.14 pods, 6.3 seeds, 20.2 cm and 12.672 t.ha^{-1}), respectively compared to control treatment. Chemical fertilizer at the level of 80 kg.ha^{-1}gave highest number of pods.plant^{-1}, seeds.pod^{-1}, pod length and green pods yield (19.20 pods, 6.4 seeds, 20.9 cm and 13.998 t.ha^{-1}) respectively compared to control. The interactions showed significant effect, and bio- fertilizer with 80 kg.ha^{-1}chemical fertilizer to local cultivar gave the highest number of seeds.pod^{-1} and green pods yield (6.9 seeds and 16.153 t.ha^{-1}) respectively, while the same interaction with Luzde cultivar gave high pods.plant^{-1} (21.25).

Keywords: broad bean cultivars, bio-fertilizer, chemical fertilizer

Introduction

Broad bean (*Vicia faba* L.) is a major source of protein and energy for many world's population in Asia, Africa and Latin America, so increasing productivity is one of the most important agricultural policy objectives of these countries. Genetic variability among genotypes is one of the most important determinants of growth and productivity of most crops, including broad beans well as other factors (Al-Issawi, 2010). The productivity of agricultural crops were improved in quantity and quality in most regions of the world, and it has been found that 50% of the increases in productivity of cereals and leguminous crops was due to the use of commercial fertilizers (Bashour *et al*., 2007). The addition of bio-fertilizer with reducing of chemical fertilizers is necessary to reduce the cost with maintaining the increase in quantity and quality of the product. Far *et al*. (2014) in Iran when studying three varieties of broad bean (Algerian, Barakat and Shami) with bio-fertilizer (Rhizobium), found that Barakat variety was the best in all studied parameters. Meena *et al*. (2015) in India studied four levels of bio-fertilizer (control, Rhizobium, PSB and Rhizobium + PSB), and found that the combination of Rhizobium + PSB gave significant increase in plant pods number, pod seed number and biological yield. Zonuz *et al.* (2014) In Iran found that the addition of bio-fertilizer with nitrogen after germination led to increase filled pods number in the unit area. Hence the idea of the experiment was to study the effect of incorporating seeds with bio-fertilizers and codifying the addition of chemical fertilizer on green pods yield of three broad bean cultivars.

Materials and Methods

A field experiment was carried out during 2017/2018 growth season in Babylon-Siddat Al-Hindia in loam clay soil (Table 1) to study the response of three broad bean cultivars (Local, Rico and Luzde) to two levels of bio-fertilizer (control and seed incorporated) and three levels of chemical fertilizer (control, 40 and 80 kg.ha^{-1}). Randomized complete blocks design was used with four replicates was used. The seed were soaked in water 24 hours and then planting or inoculation with bio-fertilizer and then planted on 20/10/2018 in hills 25 cm apart on both sides of ridges 75 cm apart. The chemical fertilizer (19-19-19 + TE) NPK treatments were added before planting in line 10 cm down of seed line. At full pods filling, ten plants from the inner plant lines from each experimental unit were marked to determine the average plant pod number, pod length, seeds per pod. Green pods per plant was determine from the plants in two inner lines (After the exclusion of terminal plants and dividing the total on the number of plants), and from it the total green pod yield were determined.

Table 1 : Some characteristics of field soil before planting

Character	value
Organic matter g.kg^{-1}	1.55
Sand (g.kg^{-1})	240
Silt (g.kg^{-1})	425
Clay (g.kg^{-1})	335
Soil texture	clay loam
pH	7.8
Available N mg.kg^{-1}	50.3
Available P mg.kg^{-1}	10.4
Available K mg.kg^{-1}	210
Available Ca mg.kg^{-1}	1200
Ec dS.m^{-1}	1.2

Results and Discussion

Number of pods.plant^{-1}

Table (2) shows that the varieties differed in this trait, local and Luzde cultivars were superior by giving 18.65 and 18.45 compared to Rico cultivar (17.15). This was due to the different genotypes of the varieties and their susceptibility to surrounding conditions (El-Habbasha *et al*., 2007). Bio-fertilizer caused significant increase in plant pods number (19.14) compared to control (17.02) with an increase percent of 12.5%. This may be due to the fact that bio-fertilizer encourage plant growth (Jasim and Khudair, 2018) and increase the net process of photosynthesis which reduces the competition between flowers and newly grained pods, thus reflected in increasing pods number (Shiboob, 2000). This result was consistent with Mirdad (2014). Chemical fertilizer increased the number of corns significantly compared to control, without difference between 40 and 80 levels. This was at legume plants need phosphorus more than other plants to ensure better growth and productivity (Gitari and Mureith, 2003). This results was agreed with Qasim *et al*. (2009). The availability of nutrients such as nitrogen and phosphorus caused increases the strength of growth and photosynthesis, which leads to increase plant pods number (Kothari, 2002). Phosphate fertilizer caused good root development and this promotes vegetative growth and increase plant leaf area and branches number (Jasim and Khudair, 2018), which reflected in increasing plant pods number. The interactions between factors caused significant effect and the addition of bio- and chemical fertilizers at 80 kg.ha^{-1} gave the highest plant pods number, and this is consistent with Rasool and Singh (2016) who indicated that addition of bio-fertilizer should be accompanied with the addition of phosphorus. Luzde cultivar with bio-fertilizer and 80 kg.ha^{-1} chemical fertilizer gave the highest plant pods number (21.25) compared to the same cultivar without fertilizers (14.18) with an increase percentage of 49.85%.

Table 2 : Effect of variety, bio- and chemical fertilizers on plant pods number.

variety	Bio-fertilizer	Chemical fertilizer (kg.ha^{-1})			Variety* bio-fertilizer
		0	40	80	
Local	control	15.70	18.93	20.41	18.34
	with	18.00	18.71	20.14	18.95
Luzdi	control	14.18	18.33	18.53	17.01
	with	17.55	20.85	21.25	19.88
Ricko	control	14.40	16.75	16.00	15.72
	with	17.40	19.45	18.90	18.58
Average of chemical fert.		16.20	18.84	19.20	
LSD $_{0.05}$		Chemical =1.218 interaction=2.985			1.723
The interaction of variety * chemical fertilizer					average of var.
Local		16.85	18.82	20.27	18.65
Luzdi		15.86	19.59	19.89	18.45
Ricko		15.90	18.10	17.45	17.15
LSD $_{0.05}$		2.110			1.218
The interaction of bio- * chemical fertilizer					average of bio-
control		14.76	18.00	18.31	17.02
with		17.65	19.67	20.10	19.14
LSD $_{0.05}$		1.723			0.995

Pod Length (cm)

Table (3) shows that cultivars were differed in pod length and Local variety was superior (20.8 cm) compared to the other two cultivars and Rico cultivar gave the lowest pod length (18.9 cm) with an increase percentage of 9.7%. The difference in the performance of the cultivars was due to differences in genetics and genotype response due to the environment. Bio-fertilizer caused significant effect by increasing pod length to (20.2 cm) compared to control (19.4 cm). This was due to the fact that bio-fertilizer provide the plant with plant hormones like, such as gibberellins, which contributes to increase pod cells division and elongation (Badr *et al*., 2014). This is consistent with Shafeek *et al.* (2004), Nishita and Joshi (2010). Chemical fertilizer also increased the length of pod without differences between 40 and 80 levels, while control treatment gave the lowest length. This is consistent with Marschner (1995).The interaction between the cultivars and bio-fertilizer had a significant effect and Local cultivar with bio-fertilizer gave 21.1 cm while Rico cultivar without bio fertilizer gave the lowest length 18.5 cm with an increase percentage of 14.2%. The interaction between cultivars and chemical fertilizer caused significant effect and Local cultivar with 80 and 40 kg.ha^{-1} gave 21.6 and 21.3 cm, while Rico cultivar without chemical fertilizer gave the lowest pod length (17.7 cm). The interaction between the addition of bio- and chemical fertilizer

caused significant effect and reached its highest level when adding bio- fertilizer with 80 kg.ha^{-1} chemical fertilizer reached 21.1 cm, while control treatment gave the lowest length (18.3 cm). Local cultivar with bio- and 40 kg.ha^{-1} chemical fertilizer gave the highest length (22.3 cm), while the Rico cultivar with control treatment gave the lowest length of 17.2 cm with an increase percentage of 29.7%.

Table 3 : Effect of variety, bio- and chemical fertilizers on pod length (cm)

variety	Bio-fertilizer	Chemical fertilizer (kg.ha^{-1})			Variety* bio-fertilizer
		0	40	80	
Local	control	18.950	20.325	22.150	20.475
	with	19.800	22.300	21.150	21.083
Luzdi	control	18.625	19.450	20.125	19.400
	with	18.525	19.725	22.182	20.144
Ricko	control	17.200	18.550	19.625	18.458
	with	18.200	20.000	20.050	19.417
Average of chemical fert.		18.550	20.058	20.880	
LSD $_{0.05}$		Chemical =0.4501 interaction= 1.1025			0.6365
The interaction of variety * chemical fertilizer					average of var.
Local		19.375	21.312	21.650	20.779
Luzdi		18.575	19.587	21.154	19.772
Ricko		17.700	19.275	19.837	18.938
LSD $_{0.05}$		0.7796			0.4501
The interaction of bio- * chemical fertilizer					average of bio-
control		18.258	19.442	20.633	19.444
with		18.842	20.675	21.127	20.215
LSD $_{0.05}$		0.6365			0.3675

Number of Seeds Per Pod

Table (4) shows that cultivars were significantly differ in seeds number.pod^{-1} and Rico cultivar gave the highest seed number (6.3), while Luzde cultivar gave the lowest number (5.99) with an increase percentage of 5.7%. This result was agreed with Abdelmula and Abuanja (2007). Bio-fertilizer caused significant effect by increasing seeds number.pod^{-1}to 6.33 compared to control (6.06). This was due to the fact that bio-fertilizer provide available nitrogen to the plant as well as hormones-like substances, (Badr *et al*., 2014). This is consistent with Ara *et al.* (2009) and Rasooland Singh (2016) who found that pod seeds number was correlated with adding bio-fertilizer. Chemical fertilizer also caused an increases in pod seeds number, and the level of 80 kg.ha^{-1} gave the highest number (6.4) compared to control treatment (6.03) with an increase percentage of 6.15%. This was due to potassium that increases enzymes activity and transporting from source to sink (Taiz and Zeiger, 2006), and nitrogen and phosphorous as major nutrient. This result was agreed with El-Shouny (2001).The interaction between the cultivars and bio-fertilizer caused significant effect and Local cultivar with bio-fertilizer gave the highest number6.55, while Luzde cultivar without bio fertilizer gave the lowest number 5.87 with an increase percentage of 11.6%. This result was agreed with Ara *et al.* (2009). The interaction between cultivars and chemical fertilizer caused significant effect and Local cultivar with 80 kg.ha^{-1} gave the highest number compared to other two cultivars with control. The interaction between the addition of bio- and chemical fertilizer at 80 kg.ha^{-1} to Local cultivar gave highest pod seeds number (6.95), while the same cultivar without fertilizers gave the lowest number (5.75).

Table 4 : Effect of variety, bio- and chemical fertilizers on seeds number.pod^{-1}

variety	Bio-fertilizer	Chemical fertilizer (kg.ha^{-1})			Variety* bio-fertilizer
		0	40	80	
Local	control	5.750	5.875	6.250	5.958
	with	6.475	6.275	6.900	6.550
Luzdi	control	5.900	5.575	6.125	5.867
	with	5.950	6.175	6.200	6.108
Ricko	control	6.125	6.500	6.400	6.342
	with	6.000	6.400	6.550	6.317
Average of chemical fert.		6.033	6.133	6.404	
LSD $_{0.05}$		Chemical =0.2683 interaction= 0.6571			0.3794
The interaction of variety * chemical fertilizer					average of var.
Local		6.113	6.075	6.575	6.254
Luzdi		5.925	5.875	6.163	5.988
Ricko		6.063	6.450	6.475	6.329
LSD $_{0.05}$		0.4647			0.2683
The interaction of bio- * chemical fertilizer					average of bio-
control		5.925	5.983	6.258	6.056
with		6.142	6.283	6.550	6.325
LSD $_{0.05}$		0.3794			0.2190

Yield of Green Pods (ton.ha-1)

Table (5) showed that cultivars caused significant effect on green pod yield and Local cultivar was superior by giving 13.483 t.ha^{-1} compared to other two cultivars, while Rico cultivar gave the lowest yield (10.789 t.ha^{-1}) with an increase percentage of 25%. This was due to its differing in plant pods number (table 2) and then differing in yield (Badr *et al*., 2013). Adding bio- fertilizer caused an increases in green pods yield to 12.672 t.ha^{-1} compared to control treatment (11.292 t.ha^{-1}) that due to bio-fertilizer by increasing available nutrient and hormones like substances (Nishita and Joshi, 2010). This result was in line with Mirdad (2014). Chemical fertilizer caused an increase in green pod yield and the level of 80 kg.ha^{-1} gave the highest yield of 13.998 t.ha^{-1}, while control treatment gave the lowest rate (9.577 t.ha^{-1}) with an increase percentage of 46.2%. This result was due to increasing plant pods number (Table 2) which reflected in increasing yield. This result

was agreed with Elkhatib (2009). The interaction between cultivars and bio-fertilizer caused significant effect and Local cultivar with bio-fertilizer was superior by giving 14.330 kg.ha^{-1}, while Rico without bio-fertilizer gave the lowest green pods yield (10.194 kg.ha^{-1}) with an increase percentage of 40.6%. This was agreed with Moinuddin *et al.* (2014). The interaction between cultivars and chemical fertilizer caused significant effect and Local cultivar with 80 kg.ha^{-1} was superior and gave highest green pods yield 15.394 kg.ha^{-1}, while Rico with control treatment gave the lowest green pods yield (8.546 kg.ha^{-1}) with an increase percentage of 80.1%. The interaction between the factors caused significant effect on green pod yield and Local cultivar with bio-fertilizer and 80 kg.ha^{-1} chemical fertilizer gave the highest green pod yield (16.153 t.ha^{-1}), while Rico cultivar without fertilizers gave the lowest green pods yield of 7.976 t.ha^{-1} with an increase percentage of 102.5%. This result was agreed with Ezzat *et al.* (2005).

Table 5 : Effect of variety, bio- and chemical fertilizers on green pods yield (t.ha^{-1})

variety	Bio-fertilizer	Chemical fertilizer (kg.ha^{-1})			Variety* bio-fertilizer
		0	40	80	
Local	control	9.988	13.287	14.635	12.636
	with	12.010	14.827	16.153	14.330
Luzdi	control	8.486	11.368	13.279	11.044
	with	9.889	12.912	14.107	12.303
Ricko	control	7.976	10.274	12.333	10.194
	with	9.116	11.554	13.484	11.385
Average of chemical fert.		9.577	12.370	13.998	
LSD $_{0.05}$		Chemical =0.3039 interaction= 0.7444			0.4298
The interaction of variety * chemical fertilizer					average of var.
Local		10.999	14.057	15.394	13.483
Luzdi		9.188	12.140	13.693	11.673
Ricko		8.546	10.914	12.908	10.789
LSD $_{0.05}$		0.5263			0.3039
The interaction of bio- * chemical fertilizer					average of bio-
control		8.817	11.643	13.415	11.292
with		10.338	13.098	14.581	12.672
LSD $_{0.05}$		0.4298			0.2481

Conclusion

It could be concluded that Local cultivar was the best compared with Luzde and Rico cultivars, and seed inoculation with bio fertilizer increased plant pods number and yield of green pods yield. Soil fertilized with 40-80 kg.ha-1 was sufficient to high yield of green pods.

References

Abdelmula, A.A. and Abuanja, I.K. (2007). Genotypic responses, yield stability, and association between characters among some of Sudanese faba bean (*Vicia faba* L.) genotypes under heat stress. Conference on International Agricultural Research for Development, October 9-11.

Al-Issawi, Y.J.A. (2010). Effect of leaf nutrition by boron and zinc on growth and yield of six varieties of broad bean (*Vicia faba* L.). Ph.D. - Field Crop Science - Faculty of Agriculture - University of Baghdad.

Ara, N.; Rokonuzzaman, M. and Hasan, M.N. (2009). Effect of Bradyrhizobium and Azotobacter on growth and yield of mungbean varieties, J. Bangladesh Agric. Univ. 7(1): 7–13.

Badr, E.A.; Asal, M.W. and Gehan, A. (2013). Effect of sowing dates and biofertilizer on growth attributes, yield and its components of two faba bean (*Vicia faba L.*) cultivar. World Applied Sciences Journal 28 (4): 494-498.

Badr, E.A.; Amany, A.B.; Gehan, A.A. and Asal, M.W. (2014). Response of Sweet Lupin (*Lupinus Albus* L.) to Spraying with Molybdenum, Bio and Nitrogen fertilizer on Seed yield and quality. Middle East Journal of Agriculture Research, 3(2): 363-367.

Bashour, E.; El-Foley, M.; El-Sayegh, A.; Anak, D.; Abou El Haq, H.; Dobles, N.B. and Ahmed, N. (2007). Directory of Fertilizers in the Near East, FAO, Rome. Pp. 9.

El-Habbasha. S.F.; Hozayn, M. and Khalafallah, M.A. (2007). Integration effect between phosphorus levels and biofertilizers on quality and quantity yield of faba bean (*Vicia faba* L.) in newly cultivated sandy soils. Res J Agric Biol Sci., 3: 966-971.

Elkhatib, H.A. (2009). Growth and yield of common bean (*Phaseolus Vulgaris* L.) in response to rhizobium inoculation, nitrogen and molybdenum fertilization. Alex. Sci. Exch. J., 30 (2): 319-332.

El-Shouny, K.A.; Abdel-Gawad, A.A.; El-Gind, A.M. and Sorour, H.A. (2001). Studies on phosphatic fertilization and irrigation of mung bean .ii- Individual effect of phosphatic fertilization, water regime and irrigation system on yield and quality. Arab Univ. J. Agri. Sci. Ain Shams Univ. Cairo. 9(1): 213-223.

Ezzat, Z.M.; Khalil, K.M. and Khalil, A.A. (2005). Effect of natural potassium fertilizer on yield, yield components and seed composition of lentil in old and new reclaimed lands. Egypt. J. Applied Sci., 20: 80-92.

Far, A.J.; Nejada, T.S. and Mojadam, M. (2014). The effect of different methods of rhizobium bacteria inoculation on biological nitrogen fixation in broad bean, Int. J. Pl. Animal and Environ. Sci., 4 (2): 346-352.

Gitari, J.N. and Mureith, J.G. (2003). Effect of phosphorus fertilization on legume nodule formation and biomass production in Mount Kenya Region. East. Afr. Agri. J., 9: 183-187.

Jasim, A.H. and Khudair, D.S. (2018). Effect of bio- and chemical fertilizers on vegetative growth of broad bean cultivars . Ann. West Univ. Timisoara, ser Biology, 21(2): 221-230

Kothari, M.L. (2002). Effect of modes and levels of molybdenum application on grain yield protein content and nodulation of chickpea grown on loamy sand soil. Commun. Soil Sci. Plant Anal., 33(15): 18-23.

Marschner, H. (1995). Mineral nutrition of higher plants (2nd ed). Academic Press, London.

Meena. J.S.; Verma, H.P. and Pancholi, P. (2015). Effect of fertility levels and biofertilizers on growth and yield of cowpea on sandy loam soil of Rajasthan. Asian J. Soil Sci., 10(1): 55-58.

Mirdad. Z.M. (2014). Improving productivity, npk uptake and water use efficiency of snap bean in sandy soil, Pak. J. Agri. Sci., 51(3): 548-554.

Moinuddin, T.A.; Dar, S.; Hussain, M.M.A.; Nadeem, H.M.; Idrees, M.; Naeem, A. (2014). Use of N and P Biofertilizers Together With Phosphorus fertilizer Improves growth and physiological attributes of chickpea, Global Journal of Agriculture and Agricultural Sciences, 2 (3): 168-174.

Nishita, G. and Joshi, N.C. (2010). Growth and yield response of chick pea (*Cicer Arietinum* L.) to seed inoculation with Rhizobium sp. Nature and Science, (9): 232-236.

Qasim S.M.; Farrukh, S.M., Khan, H.Z. and Anjum, S.A. (2009). Performance of soybean (*Glycin max* L.) under different phosphorus levels and inoculation. Pak. J. Agri. Sci., 46(4): 1-5.

Rasool, S. and Singh, J. (2016). Effect of Bio-fertilizers and Phosphorus on Growth and Yield of Lentil (*Lens culinaris* L.). Int. J. Adv. Agric. Sci. and Tech., 3(7): 35-42.

Shafeek, M.R.; Faten, S.; Abdel-Al and Aisha, H.A. (2004). The productivity of broad bean plant as affected by chemical and/or natural phosphorus with different bio-fertilizer. J. Agric. Sci. Mansoura Univ., 29 (5): 2727-2740.

Shiboob, R.M. (2000). Effects of nitrogen fertilizer levels and bio-fertilizer types on growth, yield and quality of common bean (*Phaseolus vulgaris* L.). M. Sci. Thesis, Fac. Agric., Alex. Univ., Egypt.

Taiz, L. and Zeiger, E. (2006). Plant Physiology, 4th ed., Sinauer Associates, Sunderland, 2006.

Zonuz, A.F.; Baghp, G.K. And Gasemia (2014). Effects of combined use of bio-fertilizers and chemical fertilizers at different stages on physiological and morphological characters of navy bean. Indian J. Fund. and App. Life Sci., 4 (3): 423-427.