Annals of West University of Timişoara, ser. Biology, 2016, vol. 19 (2), pp.199-206

EFFECT OF ORGANIC AND CHEMICAL SOIL FERTILIZERS AND THEIR INTERACTIONS WITH FOLIAR FERTILIZER ON SOME VEGETATIVE GROWTH OF FENUGREEK

Ali H. JASIM*, Ayad H. ALI, Sulaf A. LILO

Agriculture College, Al-Qasim Green University
**Corresponding author's e-mail address: ajasim@gmail.com*
Received 8 August 2016; accepted 5 December 2016

ABSTRACT

The experiment was conducted on the extension experiments farm in Babylon during the growing season 2013 - 2014 to study the effect of 5 soil fertilization treatments [control, 200 kg.ha^{-1} of NPK (18-18-0) , 4 and 8 t.ha^{-1} of compost of poultry], and its interaction with 4 treatments of foliar fertilizers [control, spray urea 1 g / liter, spraying humic acid 2 ml.l^{-1} and spray polimet 2 ml.l^{-1}] on growth and yield of fenugreek. Randomized complete block design (RCBD) with three replications was used. Seeds are sown on lines (30 cm apart) in 21.10.2013 and the experimental unit contained 6 lines. After a week of germination the seedlings were thinned to 10 cm apart. Soil fertilizers were added as side dressing and the foliar fertilizers were added twice in 15/1 and 01/02/2014. The results showed that chemical fertilizer was superior significantly compared to other treatment in plant height, number of leaves, leaf area and wet and dry weight, while poultry (8 t.ha^{-1}) was superior compared to control in branches number and wet weight. Urea spray was superior in plant height, leaves no. and soft weight. Polimet spray was superior compared to control in branches.plant^{-1}. The interaction between the soil and spraying fertilizers had a significant effect in increasing plant height, branches no., leaves no., leaf area and wet and dry weight.

KEY WORDS: *chemical and organic fertilizer, humic, polimet, urea*

INTRODUCTION

Fenugreek (*Trigonella foenum - graecum* L.) is herbaceous annual plant belong to legume family. Fenugreek seeds contain proteins (25-36% of the dry weight of the plant), and a range of vitamins (Mehrafarin *et al,* 2011). And contains different amounts of nutrients most important like iron, calcium, phosphorus, potassium and other mineral elements (Ali *et al,* 2012). Soil and plant management influenced plant growth and used to increase the quantity and quality of the crop yield, foremost of which adding fertilizer, whether chemical or organic, has increased the trend toward adding organic fertilizer to alleviate pollution and environmental damage which caused by chemical fertilizers. Some studies have shown that the spraying humic acid led to improve plant vegetative growth, and that foliar fertilizer as a way complementary to soil fertilize can give a quick cure for the lack of the elements, and supplied in sufficient quantity during the seed formation period (Shah *et al,* 2007; Jasim, 2007; Jasim & Obaid, 2014; Jasim, 2015). Studies have shown that spraying foliar fertilizer led to increase chickpea yield and its components compared to control (El-Habbasha *et al*, 2012). Nitrogen plays an important

role in growth and production yield of fenugreek, as it leads to increased growth and the number of branches. In spite of planting and production this crop in Iraq since old time before, but its cultivation is still experiencing a lot of problems (Mehta *et al,* 2012; Rahimi *et al,* 2012). Therefore this experiment had been conducting to study the effect of soil fertilization with metal and organic fertilizer and its interactions with foliar fertilizer, and the possibility of replacing organic fertilizer instead of metal fertilizer as soil fertilizer with promotion of additional foliar fertilizers.

MATERIALS AND METHODS

A field experiment carried out during the winter season of 2013-2014 in the extension farm (in sand clay loam, table 1) at Al-mhnanwiya (8 km north west Hilla / Babylon/Iraq) to study the effect of soil and foliar fertilization and their interactions on growth and yield of fenugreek. An factorial experiment was carried out according to randomized complete block design with three replications, which included two factors, the first included four treatments of soil fertilization (control, fertilizer with NPK 200 $kg.ha^{-1}$as recommended fertilizer, 4 and 8 $t.ha^{-1}$ of poultry manure, and the second factor included four spraying fertilizer treatments (control, 2 $ml.l^{-1}$ of urea, 1 $g.l^{-1}$ of liquid humus acid, 2ml. l^{-1} of polimet). After plowing and leveling the soil, divided into three replicates each of it contained 16 experimental units (3*2 m) and 1m between each to another. Each experimental units contained 10 lines (30 cm apart and 2m long). Local variety of fenugreek seeds were seeded in 21/10/2013. Irrigation and hand weeding were done as needed. Soil fertilization was done before seeding according treatments and the spraying was conducted in 2nd and 17th January according to treatments up to full wet until the first drop from the plant. Measurements were taken upon vegetative growth on 12 Feb. and 28 April, included plant height, number of leaves, number of branches, leaf area, wet and dry weight and chlorophyll in leaves.

The statistical analysis conducted by the statistical program (Edition) Gen stat, according to the design practice. The averages were compared according to less significant difference ($LSD_{0.05}$) (Steel & Torrie, 1981).

TABLE 1. Physical and chemical properties of the experimental soil

trait	value	trait	value
sand	176 $g.kg^{-1}$	Available N	73.2 $mg.kg^{-1}$
silt	484 $g.kg^{-1}$	Available P	12.8 $mg.kg^{-1}$
clay	340 $g.kg^{-1}$	Available K	276 $mg.kg^{-1}$
texture	Silty clay loam	Ec	3 $dS.m^{-1}$
Organic matter	1.6 $g.kg^{-1}$	pH	7.14

RESULTS AND DISCUSSIONS

Table 2 shows that the addition of soil fertilizer led to significant increase of plant height compared to control (18.7 cm), without a significant differences between the chemical (24.03 cm) and organic fertilizer treatments 8 and 4 $t.ha^{-1}$ (23.97 and 23.37 cm respectively). This increase in plant height by adding chemical fertilizer may be due to the role of nitrogen in building up amino acids that is necessary for growth as it enters in the composition of protein, which promotes cell division, as well as lead to increase the activity GAs inside plant tissues,

which is working in increasing cells elongation (Lucas *et al,* 2008), and this is consistent with (Rahimi *et al,* 2012) who found a significant increase of bean plant height with increasing nitrogen levels. And also due to the role of phosphorus in increasing plant height, this is consistent with (Hashemabadi, 2013) that the addition of phosphate led to increase plant height. From table 2 appeared that foliar fertilizers caused an increase in plant height compared to control, and urea spraying gave the highest plant height (23.25 cm) without significant differences compared to humic acid and polimet (22.52 and 22.53 cm respectively). This increase in plant height when spraying urea may be due to the role of nitrogen, which leads to increase formation of amino acids and protein synthesis, which promotes cell division, and then reflected in increasing plan height. These results are consistent with Zandi *et al.* (2011) and Mehta *et al.* (2012), who concluded that increased levels of nitrogen fertilizer caused a significant increase in the average plant height. The interaction between adding soil and foliar fertilizers had a significant effect in increasing plant height compared to control (17.4 cm), and reached its maximum height (25.2 cm) when adding chemical fertilizer * spraying of urea.

Table (3) shows that adding soil fertilizer led to increase the number of branches per plant significantly compared to control, and the treatment of 8 $t.ha^{-1}$ poultry manure gave the highest number of branches (20.80), which was not differ significantly with chemical fertilizers (19.86). This may be due to the role of organic matter in releasing of the nutrients as nitrogen that is necessary for the elongation, division, growth and development of the plant and the role of organic fertilizers in improving the vital properties of the soil and increase the readiness of the absorption of most of the major and minor elements, which will reflect positively in the overall activity of the plant and increase the number of branches (Sarkar *et al,* 2004), this results consistent with Patel *et al*. (2010) on fenugreek. Also it may be due to the role of organic matter in increasing the depth and complexity of plant root system, which reflect positively in the increasing number of branches (Singh & Agarwal, 2001), and this is consistent with Naimuddin *et al*. (2014) on fenugreek, and Singh & Vijayalakshmi (2013) on beans. The reason may be due to the role of organic matter in the well-equipped for major elements and some trace elements and then improve growth and increase the process of photosynthesis in plants, which leading to increase branches in plant (Abu Seeda, 1999).

Table (3) shows also that spraying nutrients led to increase the number of branches and polimet gave the highest number of branches (19.27), which was not significantly differ with spraying urea or humic (18.18 and 18.87, respectively), while control gave the lowest rate of branches number (17.40). The increases when spraying polimet is due to cytokinin which leads to break the apical dominance and increased the branches (Stirk *et al*, 2008). This was consistent with Sabh & Shallan (2008) on broad bean. The interaction between adding soil and foliar fertilizers had a significant effect in increasing the number of branches per plant and all interaction were superior compared to control that gave the lowest average number (13.50). The interaction of 8 $t.ha^{-1}$ poultry manure × spray urea gave the highest branches (21.70).

TABLE 2. Effect of soil and foliar fertilizers on plant height (cm)

Soil fertilizers	Foliar fertilizers				Average of soil fertilizers
	control	urea	Humic acid	polimet	
control	17.40	19.33	18.80	19.27	18.70
Chemical	24.20	25.20	23.60	23.13	24.03
Poultry manure 4 t	22.07	24.00	23.60	23.80	23.37
Poultry manure 8 t	23.40	24.47	24.07	23.93	23.97
Average of foliar f.	21.77	19.33	18.80	19.27	
$LSD_{0.05}$	AB=2.851		A, B= 1.426		

TABLE 3. Effect of soil and foliar fertilizers on branches.plant^{-1}

Soil fertilizers	Foliar fertilizers				Average of soil fertilizers
	control	urea	Humic acid	polimet	
control	13.50	15.03	15.63	15.80	14.99
Chemical	18.77	20.20	20.80	19.67	19.86
Poultry manure 4 t	17.67	15.77	19.00	20.07	18.12
Poultry manure 8 t	19.67	21.70	20.03	21.53	20.80
Average of foliar f.	17.40	18.18	18.87	19.27	
$LSD_{0.05}$	LSD AB= 2.857			LSD A , B= 1.429	

Table (4) showed that the addition of soil fertilizers led to a significant increase in plant leaves number and the chemical fertilizer gave the highest number of (28.50), which did not differ significantly from (4 and 8 t.ha-1) Poultry manure (26.70 and 27.93), while differed significantly from the control that gave the lowest number (21.92). This is consistent with (Raj & Thakral. 2008). Spray nutrients had no significant effect on the number of leaves per plant, but it tend to increase. The interaction between soil and foliar fertilizers caused a significant effect compared to control (20.73) and chemical fertilization with spraying polimet was superior (29.0).

Table (5) shows that soil fertilizers led to increase leaf area significantly compared to control (369.8 cm^2), and chemical fertilizer gave the highest average (473.1 cm^2), which did not differ significantly from 4 and 8 $t.ha^{-1}$ of poultry manure (459.6 and 462.3 cm^2). This increase by chemical fertilizer due to the role of nitrogen in increasing the activity of GAs within plant tissue, which caused cells elongation and expansion (Lucas *et al*, 2008). This is consistent with Rahimi *et al* (2012) and Rotaru (2010). The increases in leaves area by poultry manure was consist with Ahmed *et al.* (2012). On the other hand table (5) showed that foliar spraying did not have a significant effect in plant leaf area. The interaction between soil and foliar fertilizers had a significant effect in increasing leaf area compared to control (333.7 cm^2), and the highest value obtained from chemical fertilizer * spraying urea (488.0 cm^2).

Table (6) shows that soil fertilizers led to increase plant vegetative wet weight and 8 $t.ha^{-1}$ poultry manure gave highest weight (31.86 g) which was not differ significantly for chemical fertilizers (31.71 g), while control gave the lowest weight (25.23 g). This was due to its effect in increasing plant height (table 2), branches number (table 3), plant leaves number (table 4) and plant leaf area (table 5). Spray nutrients did not have a significant effect on fresh

weight. The interaction between soil and foliar fertilizers caused a significant effect compared to control. Higher vegetative plant fresh weight obtained from soil chemical fertilizer × spraying humic acid (33.14 g) followed by chemical or chicken manure × spraying of urea (32.91 and 32.88 respectively), while control gave the lowest value (21.89 g).

Table 7 shows that all soil fertilizing treatments led to a significant increase in plant dry weight, compared to control (3.452 g), and the highest plant dry weight obtained from chemical fertilizers (4.418 g), which did not differ significantly for the treatment of 8 $t.ha^{-1}$ of poultry manure but showed significant differences compared to 4 $t.ha^{-1}$ poultry manure (4.128 g). This is due to the role of nutrients in the processing required for the growth, which reflected in increasing growth indicators such as plant height, number of branches, number of leaves (Tables 2, 3, 4), which represents an increase of fresh weight (table 6). This result was consistent with (Godara *et al,* 2012). Adding organic fertilizer increased dry weight by its role in improving the qualities of soil physical, chemical and biological (Batra, 2004). Organic fertilizers analysis and it released organic acids and nutrients that absorbed by the roots during plant growth period, and then reflected in increasing growth (Kumar *et al,* 2009; Ianovici, 2016). Adding sufficient quantities of organic fertilizer did not affect the nutrients supply only, but it improve soil characteristics and increase plant roots (Ramesh *et al,* 2006). Foliar spraying did not have a significant effect on plant dry weight. The interaction between soil and foliar fertilizers caused a significant effect compared to control and the interaction of soil fertilizers with or without foliar spraying led to increase plant dry weight significantly. The interaction of chemical fertilizer with foliar spraying of humic acid was superior (4.633 g), while control gave the lowest average of dry weight (3.310 g).

TABLE 4. Effect of soil and foliar fertilizers on plant leaves number

Soil fertilizers	Foliar fertilizers				Average of soil fertilizers
	control	urea	Humic acid	polimet	
control	20.73	22.33	21.83	22.80	21.92
Chemical	27.67	29.17	28.17	29.00	28.50
Poultry manure 4 t	26.07	27.13	26.93	26.67	26.70
Poultry manure 8 t	27.43	28.23	27.73	28.33	27.93
Average of foliar f.	25.47	**26.72**	26.17	26.70	
$LSD_{0.05}$	LSD AB= 5.343		LSDA , B= 2.672		

TABLE 5. Effect of soil and foliar fertilizers on leaf area (cm^2)

Soil fertilizers	Foliar fertilizers				Average of soil fertilizers
	control	urea	Humic acid	polimet	
control	333.7	386.7	379.7	379.0	369.8
Chemical	464.3	488.0	472.7	467.3	473.1
Poultry manure 4 t	435.3	466.0	458.3	478.7	459.6
Poultry manure 8 t	465.7	464.0	460.7	459.0	462.3
Average of foliar f.	424.8	451.2	442.8	446.0	
$LSD_{0.05}$	LSD AB= 87.35		LSD A,B=43.67		

TABLE 6. Effect of soil and foliar fertilizers on vegetative plant fresh weight (g)12/2

Soil fertilizers	Foliar fertilizers				Average of soil fertilizers
	control	urea	Humic acid	polimet	
control	21.89	26.25	26.67	26.10	25.23
Chemical	31.84	32.91	33.14	28.95	31.71
Poultry manure 4 t	26.74	28.22	28.57	28.19	27.93
Poultry manure 8 t	30.92	32.88	31.54	32.09	31.86
Average of foliar f.	27.85	30.07	29.98	28.83	
$LSD_{0.05}$	*LSD AB= 6.021*		*LSD A , B=3.011*		

TABLE 7. Effect of soil and foliar fertilizers on vegetative plant dry weight(g)12/2

Soil fertilizers	Foliar fertilizers				Average of soil fertilizers
	control	urea	Humic acid	polimet	
control	3.310	3.413	3.563	3.520	3.452
Chemical	4.360	4.270	4.633	4.497	4.418
Poultry manure 4 t	4.023	4.253	4.137	4.097	4.128
Poultry manure 8 t	4.337	4.397	4.067	4.180	4.245
Average of foliar f.	4.008	4.083	4.100	4.051	
$LSD_{0.05}$	LSD AB= 0.4069		LSD A , B= 0.2034		

CONCLUSIONS

It could be concluded that spraying each of urea, humic acid or polimet promote growth of fenugreek compared to control. Application of chemical fertilizer or poultry manure were more effective. Poultry manure 4-8 $t.ha^{-1}$ was good substitute for chemical fertilizer. Spraying humic acid with soil chemical fertilizer or urea with poultry manure were the best.

REFERENCES

- Abu Seeda M. 1999. Potential benefits and hazard of land application of sludge: A review proc. Seminar and use of chemical fertilizers and environment 17-21 Dec. 301-323.
- Ahmed A.G.; Ebtsam A. EL-Housini M.S. Hassanein, Zaki N. M. 2012. Influence of organic and bio-fertilizer on growth and yield of two fenugreek cultivars grown in sandy soil. *Aust. J. Basic and Appl. Sci.*, 6(10): 469-476.
- Ali M. A., Abu Sayeed M., Alam M. S., Yeasmin M. S., Khan A. M., Muhammad I. I. 2012. Characteristics of oils and nutrient contents of *Nigella sativa* L. and fungreek seeds. *Bull. Chem. Soc. Ethiop*. 26(1): 55-64 .
- Batra L. 2004. Dehydrogenate Activity of Normal, Saline and Alkali Soils under Different Agricultural Management Systems. *J. Ind. Soc. Soil Sci.,* 52: 160-163.
- El-Habbasha S.F., Amal G. Ahmed, Mohamed M. H. 2012. Response of some chickpea cvs to compound foliar fertilizer under sandy soil conditions. *J. App. Sci. Res.,* 8(10): 5177-83.
- Godara A.S., Gupta U.S., Singh R., Mehta R.S. 2012. Effect of different combinations of organic and inorganic nutrient sources on productivity and profitability of fenugreek. I*nt. J. Seed Spices* 2(2):34-37.

- Hashemabadi D. 2013. Phosphorus fertilizers effect on the yield and yield components of faba bean. *Ann. Bio. Res,* 4(2):181-184.
- Ianovici N. 2016. *Taraxacum officinale* (Asteraceae) in the urban environment: seasonal fluctuations of plants traits and their relationship with meteorological factors. *Acta Agrobotanica***.** DOI: 10.5586/aa.1677
- Jasim A.H., Obaid A.S. 2014. Effect of foliar fertilizers spray, boron and their interaction on broad bean yield. Scientif*ic Papers. Series B, Horticulture.* LVIII: 271-276.
- Jasim A.H. 2007. Effect of foliar fertilization on growth and yield of broad bean*. Alanbar J. Agric. Sci.,* 5(2):177-182.
- Jasim A.H., 2015. Effect of soil sulfur fertilizer and some foliar fertilizers on growth and yield of broccoli in saline soil. *Annals of West University of Timisoara. ser. Biology,* XVIII (2):123-130.
- Kumar A., Hooda R. S., Yadav H. P., Chugh L. K., Kumar M., Gera R. 2009. Compensating nutrient requirement in pearl millet-wheat cropping system through manures and bio-fertilizers in semi- arid regions of Haryana. *J. Agric. Sci*. 79: 767-771 .
- Lucas M, Daviere JM, Rodrıguez-Falcon M, Pontin M, Iglesias-Pedraz JM, Fankhauser C, Blazquez MA, Titarenko E, Prat S. 2008. A molecular framework for light and GA control of cell elongation. *Nature* 451: 480–484.
- Mehrafarin A., Badi H.N., Noor G., Zand E., Rezazadeh S. 2011. Effects of environmental factors and methanol on germination and emergence of Persian Fenugreek. *Afr. J. Agric. Res*., 6(19):4631-4641.
- Mehta R.S., Patel B.S., Bhagirathram. 2012. Yield and nutrient uptake of fenugreek as influenced by nitrogen, phosphorus and bio-fertilizer. *Ann. Agric. Res.*, 33 (1&2): 45-52.
- Naimuddin O. P., Lal A. G., Kant K., Sharma Y. K., Ali. S. F. 2014. Response of fenugreek to organic manures and rhizobium inoculation. *J. Spices and Aromatic Crops*, 23 (1): 110–114.
- Patel B.S., Patel S. G., Patel S. P., Amin A. U. 2010. Integrated nutrient management in fenugreek. *J. Spices and Aromatic Crops*, 19 (1 & 2): 68–70.
- Rahimi A., Rdlaghari KH., Kelidari AB. 2012. Effects of different rates of nitrogen and phosphorus on morphological traits of bean in Yasouj region. *Int. J. Agri-Sci.,* 2(2):161-166.
- Raj H., Thakral K.K. 2008. Effect of chemical fertilizers on growth, yield of funnel. *J. Spices and Aromatic Crops*,17(2):134-9
- Ramesh P., Singh M., Panwar N. R., Singh A. B., Ramana S. 2006. Response of pigeon pea varieties to organic manures and their influence on fertility and enzyme activity of soil. *Ind. J. Agric. Sci.,* 76: 252-254.
- Rotaru V. 2010. The effects of phosphorus application on soybean plants under suboptimal moisture conditions. *Lucrări Ştiinţifice*, 53:27-30.
- Sabh A.Z., Shallan M.A. 2008. Effect of organic fertilization of broad bean by using different marine macro-algae in relation to the morphological characteristics and chemical constituents of the plant. *Aust. J. Basic and App l. Sci.,* 2(4):1076-1091.
- Sarkar M., Pramanik M., Faruk G.M., Ali M.Y. 2004. Effect of green manures and levels of nitrogen on some growth attributes of transplant aman rice. *Pakistan J. Biol. Sci.,* 7: 739-742.
- Shah S.H., Ahmad I., Samiullah S. 2007. Response of *Nigella sativa* to foliar application of GA and kinetin. *Biol. Plantarum,* 51(3):563-66.
- Singh A., Vijayalakshmi A. 2013. Residual effect of integrated nutrient management with farmyard manure, coir pith and press mud compost on cluster. *I.J.S.N.,* 4(3):405-407.
- Singh R., Agarwal S. K. 2001. Growth and yield of wheat as influenced by levels of farmyard manure and nitrogen. *Indian J. Agronomy*. 46 (3): 462-467.
- Steel R.G.D., J.H. Torrie. 1981. *Principles and producers of statistics: A Biometrical Approach*. 2nd ed. Mc-Grow-Hill, New York.

- Stirk W.A., Novák O., Václaviková K., Tarkowski P., Strnad M., van Staden J. 2008. Spatial and Temporal Changes in Endogenous Cytokinins in Developing Pea Roots. *Planta*, 227: 1279-1289.
- Zandi P., Shirani – Rad A.H., Daneshian J., Bazkar –Khatibani. 2011. Agronomic and morphologic analysis of Fenugreek under nitrogen fertilizer and plant density via factor. *Afr. J. Agric. Res.*, 6 (5):1134-1140.