Plant Archives Vol. 20, Supplement 2, 2020 pp. 1651-1653 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

THE EFFECT OF HUMIC FULVIC ACID AND LICORICE (*GLYCYRRHIZA GLABRA*) EXTRACT ON GROWTH AND YIELD OF OKRA (*ABELMOSCHUS ESCULENTUS* L.)

Naser Habeeb Mhaibes and Falah Hasan Issa*
Agriculture College, Al-Muthanna University, Iraq.
*Corresponding Author Email:falah70hasan@gmail.com

Abstract

A field-based experiment was conducted during the 2018-2019 cropping season to evaluate the response of okra *Abelmoschus esculentus* L. to a bio fertilizer for three concentration of licorice extract (L_1 5 , L_2 7.5 and L_3 10 g /Litter)and control L_0 (distill water) relative to number of times sprayed from 2ml.L^{-1} humic fulvic acid (H_0 sprayed by distill water, H_1 twice and H_2 third time). The treatments were assigned to experimental plots following a randomized complete block design (RCBD) and each treatment was treated in three replicates, the least significance difference (LSD) at 5% error rate was to compare significance means. The results of the experiment showed The treatment of L_3 exceeded spraying with licorice root extract at a concentration of 10 g.L^{-1} was superior on number of shoots, leaves area, Dry vegetative weight, root length and total yield (10.89 shoots. plant^{-1}, 0.788m^2, 137.29g, 38.32cm, 13.7 ton. h^{-1}) respectively. The results also showed that H_2 treatment was elevated three times by humic spray on all measured indicators (10.73shoots. plant^{-1}, 0.814 m^2, 137.92g, 40.76 cm, 14.572ton. h^{-1}), the superiority was in the significant effect of interaction treatment humic fulvic acid and licorice extract H_2L_3 on all measured indicators.

***Keywords*:** Bio-fertilizers, Mycorrhiza, okra, fertilizing materials, licorice extract.

Introduction

Okra (*Abelmoschus esculentus* L.) was an important role in meeting human needs of carbohydrates, protein, fats, minerals and vitamins (Abd El-Kader *et al*., 2010), it contains vitamins A , C, and a source of calcium, iron, and niacin (Oliveira *et al*., 2014), and has a high nutritional value as its fruits contain protein, 16.17%, 2.07% fat, 60.90% carbohydrates, 326.93% energy, and contains an important elements such as zinc 51 ppm, iron 371 ppm, and calcium 107 ppm (Hussain *et al*., 2010). It is also an important source of the fiber industry. In addition, its seeds provide high-quality biofuels and gum from the fruits can be used in food coats (Alegbejo *et al.,* 2008). Due to the increase in the world's population, which must increase the productivity of agricultural crops using modern scientific techniques, especially the use of biological fertilizers, which are known as Bio-Technology. Natural farming is one of the most important advanced agricultural technologies. The optimal use of microorganisms and their biological activity in the soil is an environmentally safe alternative to the availability of essential nutrients for the plant compared to chemical fertilizers, therefore many countries of the world are interested in promoting the biotic production of crops, which is characterized as clean food free from the remaining negative effects of chemical fertilizers (Al-Amiri, 2011). Given the importance of this crop, the cultivated areas increased significantly in Iraq, the study aimed to use organic fertilizers to show its effect on the morphological, physiological and fruit characteristics of okra, and the possibility of reducing added chemical fertilizers to reduce production costs and preserve the environment.

Material and Methods

The experiment was conducted at the Agricultural Research of Experiment Station - affiliated to the Faculty of Agriculture, Al-Muthanna University for the summer agricultural season 2019. The experiment was carried out as a global experiment according to the design of the complete random sectors (R.C.B.D.) and with three replication, The experiment included two variables and their interaction as follows: First Factor: licorice extract : (0, 5, 7.5 and 10 g.L^{-1}) And there code (L_0, L_1, L_2 and L_3) respectively, The second factor is how often to spray the liquid humic fulvic acid fertilizer 2ml.L^{-1}: twice (H_1), third time (H_2) and without spraying (H_0) and the third factor. Okra seeds were planted on 2/4/2019 with 4 seeds per hole, then diluted to one plant .The distance was 25 cm between plants. All service operations of the crop were performed. Humic fulvic spraying was carried out twenty days after planting and repeated throw two weeks after the first spray. licorice extract was sprayed two weeks after the completion of the humic fulvic spray process. The characteristics of the number of shoots were studied per Plant, leaves area (m^2), dry weight of vegetative total (g), root length (cm), total yield (ton. h^{-1}).

Result and Discussion

Number of shoots per plant

L_3 treatment was achieved with the highest average of number of shoots reached 10.89 shoots compare with ether treatments such as L0,T1 and T2 (6.86, 8.31, 9.51 shoots) respectively. The reason is that the licorice root extract contain amino acids and nutrients, which are important for the plant and higher concentrations of the extracts alone, which has increased the growth of growth hormones such as cytokinin, the main reason for the increase in plant shoots (Issa *et al*., 2009), these amino acids, minerals and enzymes are important for the production of growth hormones such as cytokinins, which promote axillary buds, as well as the role of boron in the regulation and production of IAA in the plant of oxidation by inhibiting oxidation processes which increase its concentration in the plant. **(**Srivastava and Gupta, 1996). H_2 treatment was achieved with the highest average of number of shoots reached 10.73shoots compare with ether treatments such as H_0 and H_1 (6.94 and 9.00 shoots) respectively, Perhaps it is attributed to the presence of humic acid on the elements K and Fe, which play an important role

in the processes of biological metabolism, such as K has the ability to stimulate more than 85 enzymes, including transport, oxidation and reduction enzymes, which have a significant impact on the growth and development of the plant in addition to importance of iron in the process of photosynthesis and building dry matter (Al-Naimi, 2000). The interaction analysis between humic acid and licorice extract were no significant difference between them in the number of shoots.

Table 1 : The effect of humic acid, licorice extract and their interaction on the number of shoots per plant.

Humic Fulvic acid	licorice extract				Rate of Humic Fulvic acid
	L_3	L_2	L_1	L_0	
H_o	8.87	7.49	6.41	5.00	6.94
H_1	11.29	9.93	8.02	6.77	9.00
H_2	12.51	11.11	10.49	8.80	10.73
Rat of licorice extract	10.89	9.51	8.31	6.86	
$L.S.D._{0.05}$	H= 0.271		L= 0.313		HL= 0.542

Leaves area per plant (m^2.Plant^{-1})

The results (Table 2) revealed that L_3 treatment (0.788 m^2 per plant) was superior to control (0.595 m^2 per plant) in leaves area with an increase of 32.4%, may be due to the licorice extract containing important nutrients such as magnesium, phosphorous, iron, zinc, copper and cobalt (Musa *et al*., 2003). Moreover, foliar of humic acid were significant on leaves area such that H_2 treatment was superior to give the highest leaves area (0.814 m^2 per plant), this may be because the humic acid had a significant impact on most of the studied growth measurements because of its effect on providing the plant with nutrients involved in vital activities and thus increasing growth (Abdel-Mawgoud *et. al*., 2007). The interaction between licorice extract and humic acid showed had no significant on leaves area character.

Table 2 : The effect of humic acid , licorice extract and their interaction on leaves area per plant (m^2. Plant^{-1}).

Humic Fulvic acid	licorice extract				Rate of Humic Fulvic acid
	L_3	L_2	L_1	L_0	
H_o	0.650	0.587	0.516	0.450	0.551
H_1	0.791	0.743	0.669	0.621	0.706
H_2	0.923	0.865	0.754	0.713	0.814
Rat of licorice extract	0.788	0.732	0.646	0.595	
$L.S.D._{0.05}$	H= 0.0182		L= 0.0210		HL= N.S

Dry vegetative weight per plant (g)

The results presented in Table 3 show that L_3 had the highest dry vegetative weight per plant 137.29 g, which was significantly higher than for the other treatments , this may be due to the inclusion of liquorice root extracts on mineral elements (N, Fe, Zn, Mg, Cu) that an important role in growth vegetative (Al-Tamimi, 2018). Treatment L_3 licorice extract 10 g/L significantly gave the highest value of dry weight to the vegetative total (137.29 g), that maybe licorice roots were rich of many essential minerals, flavonoids and natural antioxidants (Morsi *et al.,* 2008). The interaction analysis between licorice extract and humic acid application that the lowest dry vegetative weight was 102.47 g in L_0H_0, whereas the highest dry vegetative weight was 147.13g in L_3H_2.

Table 3 : The effect of humic acid, licorice extract and their interaction on dry vegetative weight per plant (g).

Humic Fulvic acid	licorice extract				Rate of Humic Fulvic acid
	L_3	L_2	L_1	L_0	
H_o	129.76	107.34	109.84	102.47	112.35
H_1	134.96	125.91	125.34	117.14	125.84
H_2	147.13	137.99	135.72	130.85	137.92
Rat of licorice extract	137.29	123.75	123.63	116.82	
$L.S.D._{0.05}$	H= 5.254		L= 6.067		HL= N.S

Length of root (cm)

The treatment L_3 was highest on length of root (38.32cm) compare with L_0, L_1 and L_2 (32.58, 34.44 and 35.68 cm). This was due to the presence of licorice on chemicals that contributed to elongation and cell division, Licorice root extract, and vitamins Which enters into the enzymatic accompaniments that have an important role in the processes of oxidation and reduction and intervention in metabolic processes in the plant causing their division and expansion (Tamimi, 2018). H_2 was significantly higher in root length reached 40.76 cm when L_0 was given a lower average of root length 29.06 cm. the reason may be humic acid has increased some of elements necessary nutrients, such as zinc, which is necessary to formation of Auxin which important in the growth and development of roots. Interaction between licorice extract and humic acid has exceeded the combination L_3H_2 gave the highest average 45.24cm while control treatment L_0H_o gave 27.70cm for both combinations treatments.

Table 4 : The effect of humic acid, licorice extract and their interaction on length of root (cm).

Humic Fulvic acid	licorice extract				Rate of Humic Fulvic acid
	L_3	L_2	L_1	L_0	
H_o	31.52	28.54	28.50	27.70	29.06
H_1	38.21	36.96	34.80	33.80	35.94
H_2	45.24	41.54	40.03	36.23	40.76
Rat of licorice extract	38.32	35.68	34.44	32.58	
$L.S.D._{0.05}$	H= 1.018		L= 1.176	HL= 2.037	

Total yield (tan .h^{-1})

In Table 5 the L_3 was significantly higher in total yield character reached (13.700 ton.h^{-1}) compare with ether treatments, the reason is that licorice extract treatment has an important role in improving vegetative growth rate by increasing the leaves area (Table 2) Which reflected positively on total yield ,this agree with Issa *et al.,* (2018). H_2 treatment was significantly higher in total yield than H_0 and H_1 reached (14.572, 8.995 and 12.950 ton.h^{-1}) respectively. The reason for the superiority is attributed to the increase number of shoots (Table 1) leaves area in plants (Table 2) and dry vegetative weight per plant (Table 3). This result is agree with Al-Moussawi (2016). The combination of L_3H_2 Gave higher total yield (15.974 ton.h^{-1}) while the L_0H_0 gave the lowest number (7.054 ton.h^{-1}).

Table 5 : The effect of humic acid, licorice extract and their interaction on total yield (tan.h^{-1}).

Humic Fulvic acid	Licorice extract				Rate of Humic Fulvic acid
	L_3	L_2	L_1	L_0	
H_o	10.498	9.821	8.605	7.054	8.995
H_1	14.629	13.582	12.330	11.257	12.950
H_2	15.974	14.634	14.571	13.109	14.572
Rat of licorice extract	13.700	12.679	11.835	10.473	
$L.S.D._{0.05}$	H= 0.298		L= 0.344	HL= 0. 595	

Conclusion

We conclude from the research the possibility of using licorice extract (10 g. L^{-1}) with spraying with humic fulvic acid (2vml. L^{-1}) for three times gave the best results for vegetative growth and yield of okra.

References

Abd El-Kader, A.A.; Saaban, S.M. and Abd El-Fattah, M.S. (2010). Effect of irrigation levels and organic compost on okra plants (*Abelmoschus esculentus* L.) grown in sandy calcareous soil. Agriculture and Biology Journal of North America, 1: 225-231.

Abdel-Mawgoud, A.M.R.; El-Greudy, N.H.M.; Helmy, Y.I. and Singer, S.M. (2007). Responses of tomato plants to different rates of humic based fertilizer and NPK fertilization. J. Applied Sci. Research, 3(2):169-174.

Al-Amiri, N.J.K. (2011). Response of tomato grown under greenhouse conditions for organic and biological fertilizers. PhD thesis. Department of Horticulture and Gardening Engineering. College of Agriculture. University of Baghdad. Ministry of Higher Education and Scientific Research, Republic of Iraq.

Alegbejo, M.; Ogunlana, M. and Banwo, O. (2008). Survey for incidence of okra mosaic virus in northern Nigeria and evidence for its transmission by beetles. Spanish Journal of Agricultural Research, 6: 408-411.

Al-Musawi, S.T. (2016). Response of some bean varieties by spraying with IAA, boron, proline to To reduce the fall of flowers. Master Thesis. Department of Field Crops - Faculty of Agriculture. Al-Muthanna University. Iraq.

Al-Naimi, S.N.A. (2000). Principles of Plant Nutrition (translated), second edition, Dar Directorate Books for printing and publishing, Mosul, Iraq.

Al-Tamimi, H.H.H. (2018). Response of some faba bean cultivars to local organic hormones and compare it with imported agrtion. Master Thesis, Faculty of Agriculture, Muthanna University.

Hussain, J.; Ur-Rehman, N.; Khan, A.L.; Hamayun, M.; Hussein, S.M. and Shinwar, Z.K. (2010). Proximate and essential nutrients evaluation of selected vegetables species from Kohat region, Pakistan. Pak. J. Botany, 42(4): 2847-2855.

Issa, F.H.; Lamloom, H.O. and Harby, H.H. (2018). Effect of liquorice extract, yeast suspension and boron on growth and yield of three cultivars of bean (*Vicia faba* L.). Int. J. Agr. Stat. Sci., 15(1):311-315.

Issa, F.H.; Sadik, Q.S. and Al-Kaabi, E.A. (2009). Effect of Kinitin and alar on plant hormones concentration during tuber formation of potatoes. Conference of the Institute of Genetic Engineering. University of Baghdad, 9.

Morsi, M.K.; El-Magoli, B.; Saleh, N.T.; El-Hadidy, E.M. and Barakat, H.A. (2008). Study of antioxidants and anticancer activity licorice *Glycyrrhiza glabra* extracts. Egyptian J. Nutr. and Feeds, 2(33): 177-203.

Musa, T.N.; Abdul Hadeethi, A.J. and Nasser, K.A. (2002). Study of some components of the local licorice root powder *Glycyrrhiza glabra*. Iraqi Journal of Agricultural Sciences, 34(4): 23-28.

Oliveira, A.P.; deSilva, O.P.R.; daSilva, J.A.; Silva, D.F.; daFerreira, D.T.A.; de Pinheiro, S.M.G. (2014). Produtividade do quiabeiro adubado com esterco bovino e NPK. Revista Brasileira de Engenharia Agrícola e Ambiental, 18: 989-993.

Srivastava, P.C. and Gupta, U.C. (1996). Essential trace elements in crop production. In : P.C. Srivastava, U.C. Gupta, eds. Trace Elements in Crop Production. New Delhi, India: Oxford & IBH Publishing Cop. Pvt. Ltd., 73–173.