Original Article

Influence Of Foliar Application Of Fenugreek And Licorice Root Extract On Growth And Yield Of Onion Plants (Allium Cepa L.)

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Abstract

This experiment was carried out at the horticulture fields of technical college of Akre, on onion plants during season (2021-2022), to study the effect three factor the first one using three levels of fenugreek (0.0, 5.0 and 10.0 g l^{-1}), and second factor using three levels of licorice root extract (0.0, 4.0 and 8.0 g l^{-1}) on growth and yield of onion. The results showed the plants treated with 10.0 g l^{-1} of fenugreek extracted had significantly influenced on plant height, fresh leaves weight, bulb weight, and total yield. While, foliar spraying of licorice root extract at level 8.0 g l^{-1} significantly increased plant height, bulb length, bulb diameter, bulb weight, and total yield. In addition, the interaction between among the two factors studied, indicated that the plants which sprayed with 5.0 g l^{-1} fenugreek interacted with 8.0 g l^{-1} of licorice root extract gave the highest value of bulb diameter, bulb weight, and total yield. It appears that using those levels gave the best growth and yield results on onion plants. Further research is needed to investigate whether the higher concentrations than used in this research will give the better parameters

Keywords: onion, fenugreek, licorice root extract, vegetative growth, and yield.

INTRODUCTION

Onion (Allium cepa L.) is one of important vegetable crops on account of its value for local consumption and exportation commodity. Onion is a biennial herbaceous plant and consider as winter season crops **(Hasan, 2011)**. It is rich in minerals such as phosphorus, calcium, magnesium, iron, manganese and carbohydrate. It also contains protein, vitamin C, vitamin B6, and antioxidants **(Ware, 2017)**. In Iraq, onions are cultivated as a commercial vegetable crop. The overall area under cultivation in Iraq in 2020 was around 4567donum, with a total production of 10727 tons and 2348.8 kg donum^{-1} **(Central Statistical Organization, 2020)**. Every day, the onion is used as a condiment, either as the mature bulb in salad and other meals, or as the green leaves **(Khan et al., 2011)**. Because onions are widely utilized in so many culinary dishes, and they have a significant domestic market. The flavor and pungency of onions are favored due to the volatile oil "allyl propyl disulphide," which is present in onions.

The use of plant extracts and spraying on plants has become a safe means instead of manufactured chemical compounds because these extracts contain some nutrients or some growth regulators, which has a positive impact on the vital and physiological activities in the plant **(Mathur &Muther, 2005).**

The seeds of the fenugreek plant are considered a store of many effective compounds, as they contain protein substances 22.80 %, reducing sugars 7.76 %, plant oils 6.25 %, which have a medical effect in treating human diseases, volatile oils 1.04 %, vitamins, minerals and fibers 5.19 %, and gelatinous materials 26.20 %. **(Haouala et al., 2008)**. As for the most important active compounds found in fenugreek seed extract, they are alkaloids (basic organic nitrogenous substances), the most important of which are Trigonellene (C_7H_7NO2) and Choline ($C_5H_{14}NO$), and the latter is involved in the metabolism **(Talas, 2008)**. As for the most important secondary components such as Diosgenin (**De & De, 2003)**, flavones glycosides **(Han, et al., 2001)**. These compounds may represent an important source of carbon if they are sprayed on plants, especially since they are similar to growth regulators in their action **(Mycormick et al., 2009)**. Fenugreek seeds contain many nutrients, including iron, copper, zinc, manganese, potassium, and others **(Musa et al., 1999)**. **Salman & Mahamed (2016)** observed that spraying of fenugreek seed extract with 10 ml l^{-1} had significantly enhanced plant height and yield of chard plant.

Licorice roots extract are rich in many essential minerals, flavonoids and natural antioxidants **(Morsi et al., 2008)**. In addition, licorice roots extract contains amino acid, protein, tannins, lignin's, choline, starch, phytosterols, different types of vitamins such as B1, B2, B3, B6, C, E, biotin, folic acid, pantothenic acid, many mineral nutrients like potassium,

phosphorus, magnesium, calcium, sodium, aluminum, cobalt, zinc, silicone and stannous **(Arystanova et al., 2001)**. Many author reports the significant effects of Licorice root extract with foliar application on the growth and chemical composition of several plants **(Babilie et al., 2105)** on onion, and **(Al-Obady, 2015)** on tomato.

Many literatures referred to the effectiveness of plant extracts in the growth of many crops, where the natural product that was consisting of fenugreek, tea and rosemary was effective in improving crops and protection them from diseases **(Hochenhull et al., 2007).** Spraying the onion plants or soaking seeds with licorice extract gave the highest leaf area **(Al-Mersumy &Al-Sahaaf, 2001).** Furthermore, spraying cucumber plant with the same extract increased the leaf area and the number of branches and the total content of chlorophyll pigment in the leaves **(Hussein, 2002).** Spraying the carnation plants with licorice extract at concentration of 3 g l^{-1} led to increase lengths of plants, stem diameter and increasing the longevity of leaf and cut flowers of carnation **(Muhammed-Sharif, 2002).**
This research was aimed to limit the effect of fenugreek and licorice root extract on growth and yield traits of onion.

MATERIALS AND METHODS

This experiment was carried out in the fall season (2021-2022) at the horticulture fields of technical college of Akre to study the response of onion cultivar namely (White Grano), to three concentrations of fenugreek extract (0, 5, and 10 g l^{-1}) and three concentration of licorice root extract (0, 4, and 8 g l^{-1}) in terms of vegetative growth and yield of onion. Date of seed sowing was in 1st November, they plant directly in each hole 2-3 seeds. Seed and the emergence of the first fact leaves will be reduced to one plant in each hole. They will a number of plants in the experimental unit (50) plants. The drip irrigation system will be used in this experiment. Agricultural practices were similarly carried out to each experimental unit as followed by farmers in the area (weeding, control and irrigation).

Fenugreek extract sprayed three times, the first one at stage of 3-4 true leaves after 21 days from seed sowing and another was after 10 days from the first spraying. The licorice root extract sprayed also three times. The first was done after 25 days from seed sowing and the second, third stage was after 10 days from the first spraying.

The soil of the field will be prepared with a two-plowing about 30-40 cm deep. Then after softening land will be divided into ridge of 75 cm width and 5 m in length at 10 cm apart. These experiment will be consist of (9) treatments (3×3=9 treatment) implicated in a Randomized Complete Block Design (RCBD). Each treatment was replicated three times and each replicate was represented by one ridges. The data has been analyzed by using the computer through the **SAS (2007),** and the means comparison was done by Duncan's Multiple Ranges Test (DMRT) below the probability level 5 %.
For data collection five plants will be select randomly from each experimental unit to measure:

1-Vegetative growth characteristic:

1. Plant Height (cm)
2. Neck diameter (mm)
3. Leaves Number per Plant (leaf $plant^{-1}$)
4. Fresh leaves Weight (g $Plant^{-1}$)

2-Yield characteristic:

1. Bulb length (cm)
2. Bulb diameter (cm)
3. Average of bulb Weight (g)
4. Total Yield (t ha^{-1}).

RESULTS

1. Plant height (cm)

The result in **Table (1)** showed that spraying fenugreek extract on onion plants with a concentration 10.0 g l^{-1} caused a significant increased in plant height which reached 58.06 cm respectively, compared with control. On the other hand, increase concentrations of licorice root extraction significantly increase plant height from 48.23 to 53.56 and 57.98 cm for 0.0, 4.0, and 8.0 g l^{-1} compared with control.

The interaction between concentrations fenugreek and licorice root extract affected significantly this characteristic, the highest increase 63.48 cm for the interaction 0.0 g l^{-1} fenugreek and 8.0 g.l^{-1} licorice root. Whereas, the least values of height reached 39.39 cm for both 0.0 g l^{-1} fenugreek and licorice root extract as control.

Table (1). Effect of foliar application of fenugreek, Licorice root extract and their interaction on plant height (cm).

Fenugreek ($g\ l^{-1}$)	Licorice root extract ($g\ l^{-1}$)			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	39.39^{e}	48.13^{de}	63.48^{a}	50.33^{b}
5.0	43.65^{de}	59.26^{a-c}	51.23^{cd}	51.38^{b}
10.0	61.64^{ab}	53.30^{b-d}	59.24^{a-c}	58.06^{a}
Mean effect of Licorice root extract	48.23^{b}	53.56^{a}	57.98^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT.

2. Number of leaves plants (leaf plant^{-1})

The result in **Table (2)** showed that plants sprayed with any concentration of fenugreek and licorice root extract studied did not cause any significant difference in the number of leaves per plant. Also the interaction between the concentrations of fenugreek and licorice root extract indicated that there were no significant differences between the treatments.

Table (2) Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on number of leaves per plants (leaf plant^{-1}).

Fenugreek ($g\ l^{-1}$)	Licorice root extract ($g\ l^{-1}$)			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	10.13^{a}	11.13^{a}	10.87^{a}	10.71^{a}
5.0	11.17^{a}	11.80^{a}	11.20^{a}	11.39^{a}
10.0	11.07^{a}	11.27^{a}	11.13^{a}	11.16^{a}
Mean effect of Licorice root extract	10.79^{a}	11.40^{a}	11.07^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT

3. Fresh leaves weight (g)

The results in **Table (3)** noticed that the increased concentrations of fenugreek sprayed on onion plants to 5.0 and 10 g l^{-1} caused a significantly increase of fresh leaves weight to 77.39 and 77.27 g respectively, compared with 56.15 g for control. Whereas, using any treatments of studied spray licorice root extract did not affect significantly on this trait.

The interaction between the concentrations of Fenugreek and Licorice root extract affected significantly this characteristic, the highest value of fresh leaves weight reached 81.53 g when the plants treated with 5 g l^{-1} Fenugreek and 0.0 g l^{-1} licorice root extract, whereas the lowest leaves fresh weight reached 45.86 g for both 0.0 g l^{-1} as a control.

Table (3). Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on Fresh leaves weight (g)

Fenugreek ($g\ l^{-1}$)	Licorice root extract ($g\ l^{-1}$)			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	45.86^{d}	57.59^{cd}	65.01^{bc}	56.15^{b}
5.0	81.53^{a}	76.30^{ab}	74.34^{ab}	77.39^{a}
10.0	73.37^{ab}	79.91^{a}	78.51^{ab}	77.27^{a}
Mean effect of Licorice root extract	66.92^{a}	71.27^{a}	72.62^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT

4. Neck diameter (mm)

The results in **Table (4)** revealed that using fenugreek extracts did not have significant effects on neck diameter of onion plants. Whereas licorice root extracts at concentration 4.0 g l^{-1} caused a significant increase in neck diameter to 18.01 mm compared with control which reached 16.45 mm.

The result showed that plants sprayed with fenugreek with 0.0 g l^{-1} concentration interacted with 4.0 g l^{-1} Licorice root extract gave a significantly highest value 18.80 respectively, whereas the lowest values 15.46 mm recorded with the interaction between 5.0 g l^{-1} fenugreek and 0.0 g l^{-1} licorice root extract respectively.

Table (4). Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on Neck diameter (mm)

Fenugreek (g l^{-1})	Licorice root extract (g l^{-1})			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	16.30^{ab}	18.80^{a}	17.35^{ab}	17.48^{a}
5.0	15.46^{b}	16.91^{ab}	17.67^{ab}	16.68^{a}
10.0	17.59^{ab}	18.32^{a}	18.01^{ab}	17.98^{a}
Mean effect of Licorice root extract	16.45^{b}	18.01^{a}	17.68^{ab}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT.

5. Bulb length (cm)

The results in **Table (5)** showed that using any concentrations of fenugreek extract for sprayed onion plants did not have a significant effect on the bulb length. While licorice root extract at concentrations 8.0 g l^{-1} caused a significant increase in this characteristic reached 6.39 cm compared with control reached 5.91 cm.

The interaction between fenugreek and licorice root extract gave the highest significant value of bulb length reached 6.80 cm at concentration 10 g l $^{-1}$ interacted with 0.0 g l^{-1} in comparison with the least value 5.38 cm were plant treated with 5.0 g l^{-1} fenugreek and 0.0 g l^{-1} licorice root extract.

Table (5). Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on Bulb length (cm).

Fenugreek (g l^{-1})	Licorice root extract (g l^{-1})			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	5.56^{cd}	6.42^{ab}	6.56^{ab}	6.18^{a}
5.0	5.38^{d}	6.11^{a-d}	6.23^{a-c}	5.91^{a}
10.0	6.80^{a}	5.71^{b-d}	6.39^{a-c}	6.30^{a}
Mean effect of Licorice root extract	5.91^{b}	6.08^{ab}	6.39^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT.

6. Bulb diameter (cm)

The results in **Table (6)** showed that used any concentrations of fenugreek extract for sprayed onion plants did not have a significant effect on the bulb length. While licorice root extract at concentrations 8.0 g l^{-1} caused a significant increase in this characteristic reached 7.29 cm respectively, compared with control reached 6.42 cm.

The interaction between the concentration of fenugreek and licorice root extract caused significant increase in bulb diameter, when plants sprayed any concentration of fenugreek interacted with 8.0 g l^{-1} for licorice root extract.

Table (6). Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on Bulb diameter (cm).

Fenugreek (g l^{-1})	Licorice root extract (g l^{-1})			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	6.09^{c}	6.57^{a-c}	7.25^{a}	6.63^{a}
5.0	6.20^{bc}	7.10^{ab}	7.33^{a}	6.87^{a}
10.0	6.97^{a-c}	6.35^{a-c}	7.30^{a}	6.87^{a}
Mean effect of Licorice root extract	6.42^{b}	6.67^{b}	7.29^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT.

7. bulb weight (g)

The result in **Table (7)** demonstrated that increased fenugreek concentration sprayed on the onion plants to 10 g l^{-1} caused to increase bulb weight significantly 173.54 g, while the control treatment recorded 149.92 g. the bulb weight also significantly increased when plants sprayed with 8.0 g l^{-1} licorice root extract reached 180.16 g when compared with control which gave 145.40 g.

The dual interaction between fenugreek and licorice root extract, the results showed that the highest significant value reached 187.37 g was observed that plants sprayed with 5.0 g l^{-1} fenugreek interacted with 8.0 g l^{-1} licorice root extract when compared with control which reached 104.08 g.

Table (7). Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on bulb weight (g).

Fenugreek ($g\ l^{-1}$)	Licorice root extract ($g\ l^{-1}$)			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	104.08^{b}	170.21^{a}	175.46^{a}	149.92^{b}
5.0	147.01^{a}	159.72^{a}	187.37^{a}	164.70^{ab}
10.0	185.12^{a}	157.84^{a}	177.66^{a}	173.54^{a}
Mean effect of Licorice root extract	145.40^{b}	162.59^{ab}	180.16^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT.

8. Total yield (t ha^{-1})

The data in **Table (8)** indicated that the increased fenugreek concentration sprayed on the onion plants to 10 g l^{-1} caused to increase total yield significantly 20.37 t ha^{-1}, while the control treatment recorded 17.59 t ha^{-1}. The total yield also significantly increased when plants sprayed with 8.0 g l^{-1} licorice root extract reached 21.14 t ha^{-1} when compared with control which gave 17.06 t ha^{-1} g.

The dual interaction between fenugreek and licorice root extract, the results showed that the highest significant value reached 21.98 t ha^{-1} was observed that plants sprayed with 5.0 g l^{-1} fenugreek interacted with 8.0 g l^{-1} licorice root extract when compared with control which reached 12.21 t ha^{-1}.

Table (8). Effect of Foliar Application of Fenugreek, Licorice Root Extract and their interaction on Total yield (t ha^{-1})

Fenugreek ($g\ l^{-1}$)	Licorice root extract ($g\ l^{-1}$)			Mean effect of Fenugreek
	0.0	4.0	8.0	
0.0	12.21^{b}	19.97^{a}	20.58^{a}	17.59^{b}
5.0	17.25^{a}	18.74^{a}	21.98^{a}	19.32^{ab}
10.0	21.72^{a}	18.52^{a}	20.86^{a}	20.37^{a}
Mean effect of Licorice root extract	17.06^{b}	19.08^{ab}	21.14^{a}	

Means with same letter for each factor and interactions are not significantly different at 5% level based on DMRT.

DISCUSSIONS

Increasing fenugreek concentrations sprayed on plants to 10 g l^{-1} caused an increase in plant height, bulb weight, and total yield, compare to control as shown in Tables (1, 7, and 8). Additionally, increased concentrations of fenugreek sprayed on plants to 5 and 10 g l^{-1} caused a significantly increase of fresh leaves weight as shown in Table (3).

These results can be explained as a result the reason for the effect of spraying fenugreek seed extract on improving vegetative growth indicators may be due to the fact that it contains some nutrients, which affected the improvement of the nutritional status of the plant **(De & De, 2003)**. This was reflected positively on the physiological and biochemical processes and thus helped to increase carbohydrate compounds **(Oncina et al., 2000)** or the reason is attributed to the fact that they contain some chemical compounds, especially steroids that stimulate vegetative growth **(Alwan et al., 2010)** or that they contain cytokinin growth regulator, which leads to an increase in the division of cells forming meristematic tissues, and then an increase in the number and size of leaf cells **(Hilal, 2011),** which is reflected positively in increasing plant height, leaves fresh weight, mean bulb weight and total yield. The result was in conformity with the finding of **(Abbas, 2011)** on Lavandulu officinalis L. plants, (**Dawood et al., 2012)** sunflower plants.

The plant height significantly increased when plants sprayed with both concentration of licorice root extracted at 4.0 and 8.0 g l^{-1} when compared with control as shown in Table (1). Whereas neck diameter significantly increase when plants sprayed licorice root extract at 4 g l^{-1} compared with control as shown in Table (4). Additionally, the sprayed onion plants with 8.0 g l^{-1} licorice root extract caused a significantly increased in bulb length, bulb diameter, bulb weight, total yield, when compared with control, as shown in Tables (5, 6, 7, and 8)

These results can be explained as a result licorice extract similar to behavior of GA_3 in stimulating physiological and biochemical process in plant, or maybe contained mevalonic acid that improve the vegetative growth as a result of stimulating the enzymes that necessary to convert complex compounds into simple compounds, and exploited in the processing of the energy required for plant growth (**Al-mehemdi et al., 2011).** Or maybe attributed as a results Licorice extract in its turn, contains many minerals such as potassium, phosphorus, magnesium, iron, and other growth stimulants as well as saccharides that are absorbed by the leaves during spraying which increase growth activities and consequently increase vegetative growth **(Al-Sahaf & Al-Marsoumi, 2001).** Turbines, such as Glycyrrihysic acid, are of those growth stimulants. In addition, magnesium plays a role in increasing foliage growth, cell division, and biological plant activities (**Moses et al., 2002)**. The increase in the total yield of plants can be returned to the increase of vegetative growth resulting from the increase of the direct concentration of the extract used as spraying on the total vegetative, including the increase in plant height and neck diameter. All of this was reflected in the led to enhance in the yield components including the

character of the bulb length, bulb diameter, mean bulb weight and total yield. These natural compounds have the potentiality as alternatives to chemical fertilizers and growth regulators in improving growth and production of onion plants being harmless to health and to the environment (**Babilie et al., 2015)**. The results of present study agreed with results when compared to previous studies. **(Al- Marsoumi & Al-Sahaaf, 2001)** on onion plants, and **(AL-Jebouri et al., 2010)** on cucumber plants.

CONCLUSION

To conclude, the results gained from this experiment exposed that **Allium cepa L**. plants positively responded to fenugreek and licorice root extract. The use of fenugreek at a concentration of 8.0 g l^{-1} and 10.0 g l^{-1} of licorice root extract improve most of the growth and yield characteristics on onion plants. And the best interaction between study factors is 5.0 g l^{-1} fenugreek interacted with 8.0 g l^{-1} of licorice root extract lead to increase more studied parameters. It appears that using that level gave the best growth and yield results on onion plant. Further research is needed to investigate whether the higher concentrations than used in this research will give the better parameters.

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