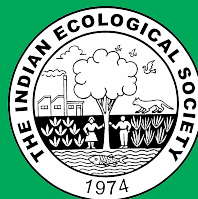


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# Effect of Spraying Extract of Fenugreek Seed and Chelated Iron on Vegetative and Flowering Growth of Petunia (*Petunia hybrida* L.)

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**Abstract:** The experiment was conducted in a cooled house at College of Agriculture / Basra University for growing season 2020 to study the effect of spraying with soaked fenugreek seeds and chelating iron on vegetative and flower growth, root system traits and leaf content of elements of petunia. Use three concentrations of fenugreek seed extract 0, 4, and 8 g L<sup>-1</sup> and three concentrations of chelated iron 0, 35, 70 g L<sup>-1</sup> and the interaction between them, The treatment with fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> iron concentration of 70 mg L<sup>-1</sup> significantly superior in all vegetative, flowering and root system traits and NPK in leaf. The interaction between the two factors indicated that concentration was 8 mg L<sup>-1</sup> of fenugreek seed extract and chelated iron at a concentration of 70 mg L<sup>-1</sup> was superior in most of the studied traits.

**Keywords:** Fenugreek seed extract, Chelated Iron, *Petunia hybrida*

*Petunia jussies* belong to the Petunioldeae family, which traces its country origin to South America, where it originated in southern Brazil and Argentina. Petunias spread in gardens are *P. hybrida* from *P. axillarisa* \* *P. lutegrifolia*, with the original number of chromosomes  $x = 7$  (Stehmann et al 2009). Petunia has a wild stem reaching a height of 60 cm, the leaves are simple oval, and the flowers are sporadic with different colors, large or small, with full edges, the seeds are very small, and there are 5-10 thousand seeds per gram (Reis et al 2002). There are several methods to improve the growth of the petunia plant, including treatment with plant extracts as alternatives to chemical fertilizers and commercial plant growth regulators with its negative effects on the environment and human health, including fenugreek seed extract that contains folic acid and proteins and consists of a group of amino acids, the most important of which are lysine, leucine, histidine, arginine, tryptophan, aspartic acid and glutamic acid, It Hussain (2013) showed that fenugreek seed extract had a significant effect on the number of the total leaves, the leaf area, the percentage of dry matter in Vegetative growth, the length and diameter of the stalk flower, the vase life, carbohydrates, nitrogen, phosphorous and potassium, (Lazim et al 2013) observed that spraying fenugreek seed extract at a concentration of 2 g L<sup>-1</sup> on *Antirrhinum majus* L led to an increase in the plant height, the number of branches, the dry weight of the root system, the increase in the number of florets in inflorescences and the inflorescences diameter and the number of days required for the opening of the flower bud and the formation of

inflorescences .The dry weight of the vegetative increased. Iron is considered one of the essential elements for plants because it is involved in many physiological processes such as photosynthesis and increasing its products, and it has a great role in the formation of chlorophyll and it enters in enzymatic reactions, which affects the growth and development of plants. The role of iron in the activity of many enzymes is due to its ability to lose and acquire electrons in the process of oxidation and reduction in plant tissues, including respiratory enzymes, as it contributes to the synthesis of cytochromes important in the process of photosynthesis and also enters in the synthesis of plant proteins (Al-Hasnawi et al 2018). The present study was conducted on effect of spraying with extract of fenugreek seed and chelated iron on vegetative and flowering growth of petunia.

## MATERIAL AND METHODS

This study was conducted in the lath house at University of Basra during the growing season 2020. Petunia seedlings were selected at the age of one month and were similar in size from one of the nurseries of Al-Hartha district in Basra province. After it was brought, it was recycled into two pots with a diameter of 20 cm. The chemical and physical traits of the peat moss produced by Klass man (Table 1). The agronomic operations were included fertilization, irrigation and weeding whenever the need arises. The seedlings were sprayed three times a season with a period of 15 days between spraying. Foliar spray treatments were conducted

fenugreek seed extract 0, 4, and 8 g L<sup>-1</sup> and chelated iron 0, 35, 70 mg L<sup>-1</sup>. The seedlings were sprayed with fenugreek seed extract and chelated iron in the early morning until complete wetness and three drops/liter of dispersal (Tween-20) were added to smooth the distribution of the solution on the leaves. The experiment was conducted according to a randomized complete block design with a factorial experiment consisting of two factors. The number of treatments was with three replications. The results were analyzed using analysis of variance by testing the lowest significant difference LSD and the averages were compared at a probability level of 0.05. The studies traits included vegetative growth indicators plant height (cm), total number of leaves plant<sup>-1</sup>, number of side branches plant<sup>-1</sup>, leaf area (cm<sup>2</sup>), and fresh weight of the vegetative growth (g), dry weight of the vegetative growth (g). Indicators of flower growth include flower diameter (cm), length of flower stalk (cm), diameter of flower stalk (mm), fresh weight of flowers (g), dry weight of flowers (g), length of flowering period (day) and number of flowers<sup>-1</sup>. Root growth indicators were number of roots plant<sup>-1</sup>, root length (cm) and fresh weight of the root growth (g).

**NPK in leaf:** Nitrogen content in leaves (g. Kg<sup>-1</sup>) was

**Table 1.** Physical and chemical traits of peat moss produced by Klass man

Traits	Values
PH	3.5-4.5
Organic matter	95-97
Ash content%	3-5
Total nitrate%	1
Humidity %	50
Density	70-90

**Table 2.** Nutritional components and mineral elements of fenugreek seeds on the basis of dry weight

Components	%	Elements	Mg g <sup>-1</sup>
Humidity	9.82	Potassium	240.19
Total ash	5.58	Sodium	68.02
Ash, dissolved in water	2.51	Magnesium	3.19
Ash dissolved in acid	2.10	Manganese	2.76
The extract dissolved in water	34.96	Iron	1.07
Protein	22.80	Zinc	1.58
Reducing sugars	7.76	Copper	0.17
Fixed oils	6.25		
Volatile oils	1.04		
Fiber	5.19		
Re-gels	26.20		

estimated using steam distillation device (Keldal). Phosphorous content in leaves (g Kg<sup>-1</sup>) were estimated using a Spectrophotometer at wavelength of 700nm. Potassium content in leaves (g Kg<sup>-1</sup>) was determined using a flam photo meter and iron content in leaves (mg Kg<sup>-1</sup>) was measured at a wavelength of 510 nm.

## RESULTS AND DISCUSSION

**Vegetative growth:** Fenugreek seed extract contributed to the improvement of the vegetative traits of the plant (Table 3). It was at high concentration at 8 g L<sup>-1</sup> and was significantly different from the two concentrations except for the plant height traits, which was significantly different from the control treatment. The spraying of plants with chelated iron had a significant effect in obtaining a significant increase in the studied traits, which were plant height and total number of leaves. The concentrations 35 and 70 mg. L<sup>-1</sup> led to a significant increase in these traits, and that the higher concentration had the largest effect compared to the control plants, except for the dry weight of vegetative growth, which differed significantly from the concentration of 70 mg L<sup>-1</sup> with the control plants.

**Flowering growth:** The spraying petunia plants with fenugreek seed extract had a significant effect on the traits of flower diameter, flower stalk length and diameter, flowering duration and the number of flowers at 4 and 8 g 1 liter of fenugreek seed extract compared to control plants except for concentration 8 gm liter<sup>-1</sup> of this extract was significantly superior in increasing the fresh weight of vegetative grow compared to the control plants. The iron chelate has a role in improving the flowering traits of the treated plants, where the treatment with the concentration 75 mg L<sup>-1</sup> resulted in a significant increase in the diameter of the flower, the height and diameter of the flower stalk, the fresh dry weight of the flower, duration of flowering and the number of flowers compared to the control plants (Table 4). The effect of the bi-interaction between the two study factors had a significant effect, where spraying with fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> and chelated iron at a concentration of 70 mg L<sup>-1</sup> resulted in a significant increase in the flowering traits represented (flower diameter, length of the flower stalk, diameter of the flower stalk, fresh and dry weight of flowers, length of flowering, number of flowers) as compared to the control plants.

**Root growth:** The spraying plants with fenugreek seed extract had a significant effect on the root growth traits, where the treatment by spraying with a concentration of 8 g L<sup>-1</sup> in fenugreek seed extract resulted in a significant increase in all root growth traits, including the number of roots, root length and weight. The fresh and dry roots of the root system

**Table 3.** Effect of spraying with fenugreek seed extract and iron on the vegetative growth indicators of the petunia hybrid plant

Treatments		Dry weight of the vegetative growth (g)	Fresh weight of the vegetative growth (g)	Leaf area (cm <sup>2</sup> )	Number of side branches Plant <sup>-1</sup>	Total number of leave plant <sup>-1</sup>	Plant height(cm)	
Fenugreek seed extract concentrate (g L <sup>-1</sup> )	0	2.1	8.83	4.50	8.89	18.00	12.00	
	4	2.56	9.67	5.53	9.56	26.67	14.56	
	8	2.68	12.22	6.56	12.56	29.56	14.67	
LSD (p= 0.05)		0.47	0.80	0.28	1.09	2.31	1.32	
Concentration of chelated iron (mg L <sup>-1</sup> )	0	1.93	8.67	4.80	9.00	17.89	11.89	
	35	2.20	9.22	5.90	10.43	27.33	13.56	
	70	3.33	12.83	6.97	12.44	29.56	17.56	
LSD (p= 0.05)		0.47	0.80	0.28	1.09	2.31	1.32	
Interaction between fenugreek seed extract and chelated iron	0	0	1.00	4.17	3.53	4.67	10.00	8.00
		35	1.50	7.83	4.33	8.00	18.33	13.60
		70	2.00	11.00	5.36	14.00	27.33	15.33
	4	0	1.53	9.50	5.10	6.00	20.00	11.00
		35	2.10	10.30	5.57	9.33	26.33	13.67
		70	2.01	11.03	5.98	11.00	33.67	16.67
	8	0	1.89	2.67	4.11	7.61	15.33	9.33
		35	2.99	13.00	5.85	12.30	29.00	19.00
		70	3.50	14.50	6.24	14.00	44.33	20.33
LSD (p= 0.05)		0.82	1.39	0.49	1.89	4.01	2.29	

**Table 4.** Effect of spraying with fenugreek seed extract and iron and on the flowering growth indicators of the petunia hybrid

Treatments		Flowering period (day)	Dry weight of flowers (g)	Fresh weight of flowers (g)	Diameter of flower stalk (mm)	Length of flower stalk(cm)	Flower diameter (cm)	
Fenugreek seed extract concentrate (g L <sup>-1</sup> )	0	25.33	0.46	1.60	1.41	3.00	2.90	
	4	27.22	0.58	1.78	1.68	3.80	3.60	
	8	38.33	0.60	2.05	2.20	4.57	4.57	
LSD (p= 0.05)		1.75	0.13	0.20	0.22	0.35	0.35	
Concentration of chelated iron (mg L <sup>-1</sup> )	0	26.78	0.47	1.50	1.62	3.00	2.99	
	35	30.11	0.56	1.59	1.68	3.55	3.81	
	70	38.78	0.62	2.11	2.32	4.79	4.54	
LSD (p= 0.05)		1.75	0.13	0.20	0.22	0.35	0.35	
Interaction between fenugreek seed extract and chelated iron	0	0	17.33	0.27	1.30	1.07	2.33	2.61
		35	26.18	0.30	1.31	1.54	3.16	3.17
		70	35.24	0.63	2.00	2.50	4.83	4.00
	4	0	19.67	0.40	1.46	1.32	2.67	2.88
		35	32.00	0.35	1.90	1.53	3.23	3.76
		70	32.00	0.60	2.20	2.60	4.00	4.00
	8	0	23.00	0.34	1.43	1.37	3.20	3.90
		35	40.33	0.40	1.90	2.11	4.97	4.00
		70	42.67	0.87	2.68	2.62	6.20	5.00
LSD (p= 0.05)		3.04	0.22	0.35	0.38	0.62	0.61	

reached (15.83 roots. plant<sup>-1</sup>, 15.89 cm, 8.85 g, 3.03 g), respectively, compared to the control plants. The interaction between spraying with fenugreek seed extract at a concentration of 4 g L<sup>-1</sup> and chelated iron at a concentration of 35 mg L<sup>-1</sup> resulted in a significant increase in the number of roots of the plant, reaching 21.00 roots Plant<sup>-1</sup> compared to the lowest number of roots, which reached 11.00 roots. Plants<sup>-1</sup> was for control plants. The interaction between spraying with fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> and iron at a concentration of 70 mg L<sup>-1</sup> resulted in a significant increase in the fresh and dry weight of the root total, reaching 10.04 g and 3.74 g, respectively, compared to the lowest dry weight, which reached 4.76 g, 2.01 g, respectively, was for the control plants.

**NPK content in leaf:** Nitrogen (N%): The nitrogen content of the leaves was significantly affected by spraying with the fenugreek seed extract, so the plants that were sprayed with the fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> were recorded significantly higher nitrogen content in leaf compared to the plants that were sprayed with fenugreek seed. The bi-interaction between the fenugreek seed extract and the chelating iron, indicate that the plants sprayed with the fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> with chelated iron at a concentration of 70 mg L<sup>-1</sup> was superior in their nitrogen content, was 2.53% compared to the lowest

content in the leaves of plants that were not sprayed (0.83%).

**Phosphorous (P%):** Plants sprayed with fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> were superior in phosphorous content in leaf as compared to the leaves of plants that were sprayed with fenugreek seed extract at a concentration of 4 g L<sup>-1</sup>. The bi-interaction indicate that the plants that were sprayed with fenugreek seed extract at a concentration of 8 mg L<sup>-1</sup> with chelated iron at a concentration of 70 mg L<sup>-1</sup> were significantly superior in phosphorus in leaf reaching 0.31% compared to the lowest content of 0.12% in leaves of the plants that had not been sprayed.

**Potassium (K%):** There were significant differences in the potassium content of the leaves, where the plants that were sprayed with the fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> as compared to the leaves of the plants that were sprayed with the same extract at a concentration of 4g L<sup>-1</sup> and on the plants not sprayed. The bi-interaction between spraying with fenugreek seed extract and chelated iron had a significant effect. Plants that were sprayed with fenugreek seed extract at a concentration of 8 g L<sup>-1</sup> with chelated iron at a concentration of 70 mg L<sup>-1</sup> gave the highest iron content in leaf ( 97.00 mg Kg<sup>-1</sup> ) as compared to the lowest content of 60.22 mg Kg<sup>-1</sup> in plants not been sprayed. The significant increase in the nutrient content of the leaves as a result of spraying with the fenugreek seed extract may be due to the

**Table 5.** Effect of spraying with fenugreek seed extract and iron and their interactions on the root growth indicators of the petunia hybrid

Treatments		Root length (cm)	Number of roots plant <sup>-1</sup>	Dry weight of the root growth (g)	Fresh weight of the root growth (g)	
Fenugreek seed extract concentrate(g L <sup>-1</sup> )	0	14.17	14.22	2.50	7.17	
	4	15.00	15.41	2.98	8.19	
	8	15.89	15.83	3.03	8.85	
LSD (p= 0.05)		0.82	0.77	0.16	0.30	
Concentration of chelated iron(mg L <sup>-1</sup> )	0	12.72	12.80	2.35	6.66	
	35	14.56	16.00	2.98	8.60	
	70	17.78	16.67	3.19	8.96	
LSD (p= 0.05)		0.82	0.77	0.16	0.30	
Interaction between fenugreek seed extract and chelated iron	0	0	11.67	11.00	2.01	4.76
		35	12.67	14.00	2.39	7.60
		70	20.67	17.67	3.10	9.16
	4	0	12.17	13.17	2.49	7.83
		35	17.33	21.00	3.72	9.07
		70	13.00	13.33	2.72	7.68
	8	0	14.33	14.23	2.55	7.39
		35	13.67	15.00	2.83	9.12
		70	19.67	17.00	3.74	10.04
LSD (p= 0.05)		1.42	1.34	0.28	0.53	

**Table 6.** Effect of spraying with fenugreek seed extract and iron on the NPK in leaf of the petunia hybrid

Treatments		Iron concentration (mg Kg <sup>-1</sup> )	K (%)	P (%)	N (%)	
Fenugreek seed extract concentrate(g L <sup>-1</sup> )	0	68.44	1.79	0.15	1.35	
	4	82.33	2.80	0.22	1.90	
	8	89.70	2.94	0.26	2.21	
LSD (p= 0.05)		1.41	0.10	0.01	0.08	
Concentration of chelated iron( mg L <sup>-1</sup> )	0	73.41	2.20	0.18	1.54	
	35	80.07	2.72	0.21	1.84	
	70	87.00	2.96	0.25	2.08	
LSD (p= 0.05)		1.41	0.10	0.01	0.08	
Interaction between fenugreek seed extract and chelated iron	0	0	60.22	1.31	0.12	0.83
		35	70.11	1.75	0.15	1.50
		70	75.00	2.30	0.17	1.72
	4	0	78.00	2.50	0.17	1.80
		35	80.00	2.11	0.20	1.91
		70	89.00	2.20	0.28	2.00
	8	0	82.00	2.80	0.18	2.00
		35	90.10	2.86	0.29	2.11
		70	97.00	2.90	0.31	2.53
LSD (p= 0.05)		3.11	0.14	0.03	0.11	

containment of this extract with many nutrients (El-Adai 2013).

The reason for the increase in the percentage of nitrogen in the leaves when spraying plants with the iron element is due to the role of the iron element in increasing the vegetative growth activity caused by this element, which requires the withdrawal of the largest possible amount of nitrogen from the soil to meet the plant's need by influencing the activation of chlorophyll and proteins. It results in an increase in the need for this element to perform many physiological processes of the plant, the increase in the percentage of phosphorous in the leaves when spraying plants with the iron component is due to the encouragement of vegetative growth, represented by increasing the number of leaves (Table 6) and leaf area. The NPK content affects the physiological chemical and biological processes, and this in turn leads to an increase in carbohydrate compounds and the containment of the seeds of the fenugreek on the cytokinin growth regulator leads to an increase in the division of meristematic cells and increases the number and size of cells and this is positively reflected in the leaf area for the plant (Hilal 2011), which increases the height of the plant, as for the significant increase in the traits of the root system when treated with the extract of fenugreek seeds, it may be due to the increase in vegetative growth, (Table 3) and the increase in the efficiency of the photosynthesis process and the manufacture of nutrients and their transfer to

the root, thus increasing the growth of the cells of the root due to its increase in number, elongation and large size (Minkle and Kirby 2000). The NPK content of the leaf when treating the petunia plant with chelated iron may be due to the increase in the efficiency of absorption in the plant and thus the accumulation of the element in the leaves, which is included in the composition of the chlorophyll molecule, and this raises the efficiency of the process of photosynthesis and the increase of its products, such as carbohydrates, which reflected positively on the increase in the number of flowers. The iron has known physiological roles such as increasing the production of auxins and gibberellins and this reflected positively on the increase in vegetative growth represented by plant height, number of side branches, number of leaves, leaf area, fresh and dry weight) and this result agrees with Abass et al (2013) on *tasania* and Alastor and Shueli (2015) on *Jasminum*.

## CONCLUSION

The treatment with fenugreek seed extract and chelating iron led to improvement of the flowering, vegetative and root growth traits and the content of the leaves of the elements of the petunia plant.

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