

## The effect of stages of pinching of apical bud and spraying with nutritious solution (premium) on seeds and oil yield of Fenugreek (*Trigonella foenum-graecum* L.)

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### ABSTRACT

A field experiment was conducted in a silt clay loam during the winter season of 2016-2017 in Diyala province using a factorial experiment according to Randomized Complete Block Design (RCBD) to study the effect of stage of pinching of apical bud at (without pinching, 35, 50 days) after germination and spraying with three levels of nutrition solution (PREMIUM) (0, 0.4, 0.8 g.L<sup>-1</sup>) on seeds and oil yield of fenugreek plants. There was a significant effect and a probability level of 0.05 for the interaction treatment (pinching after 50 days of germination and spraying with nutritious solution 0.8 g.L<sup>-1</sup>) in the seed yield, biological yield and oil yield was 2080 kg.h<sup>-1</sup>, 16.61 g.plant<sup>-1</sup> and 158.49 kg.h<sup>-1</sup>, respectively. while the interaction treatment of (pinching after 50 days of germination and spraying with the nutritious solution 0.4 g.L<sup>-1</sup>) gave a significant increase in oil percentage of (7.75%).

**Keywords:** Foliar nutrition , Fenugreek , Pinching.

### تأثير مراحل قرط القمة النامية والرش بالمحلول المغذي (PREMIUM) في حاصل البذور والزيت للحلبة (*Trigonella foenum-graecum* L.)

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### المستخلص

نفذت تجربة حقلية في تربة طينية غرينية اثناء الموسم الشتوي 2016-2017 في محافظة ديالى باستعمال تجربة عاملية وفق تصميم القطاعات العشوائية الكاملة (RCBD) لدراسة تأثير ثلاث مواعيد من قرط القمة النامية (بدون قرط ، 35 ، 50) يوما بعد الانبات والرش بثلاث مستويات من المحلول المغذي PREMIUM (0 ، 0.4 ، 0.8) غم.لتر<sup>-1</sup> في حاصل البذور والزيت لنبات الحلبة وظهرت النتائج : وجود تأثير معنوي وعلى مستوى احتمال 0.05 لمعاملة التداخل (القرط بعد 50 يوم من الانبات والرش بالمحلول المغذي 0.8 غم.لتر<sup>-1</sup>) في حاصل البذور والحاصل البيولوجي وحاصل الزيت وكانت 2080 كغم.هـ<sup>-1</sup> و 16.61 غم. نبات<sup>-1</sup> و 158.49 كغم.هـ<sup>-1</sup> على التتابع ، في حين اعطت معاملة التداخل (القرط بعد 50 يوم من الانبات والرش بالمحلول المغذي 0.4 غم. لتر<sup>-1</sup>) زيادة معنوية في نسبة الزيت وكانت ( 7.75 % ) .  
الكلمات المفتاحية : التغذية الورقية ، الحلبة ، القرط .

### 1. INTRODUCTION

Medical plants are a major source of many drugs used for various therapeutic purposes because they contain effective compounds that are used in the preparation of many medicines and in various bodies [3]. *Trigonella foenum-graecum* L. One of the Leguminosae plants rich in nutrients such as proteins, sugars and fats and containing effective biochemical compounds, including alkaloids, As seed oil is an essential component of the medicinal effect of the plant, The main oil content in seeds reaches to 6-8%, it is rich by the unsaturated fatty acids (linolenic, linoleic and olie),

which is estimated at 70%, Which has proved its vital efficacy as antibacterial and fungal compounds [27]. In addition, the fenugreek seeds are an important source for drugs used in the treatment of many diseases, including lowering cholesterol in the blood and diabetes and protect against cancer [9]. The containment of Iraqi soil on high percentages of carbonate minerals or the tendency of soil interaction towards alkalinity with the lack of organic matter are basic factors that reduce availability of nutrients and uptake in the soil, and the excessive and unbalanced use of fertilizer is detrimental to the physiological

processes of the plant. The use of foliar fertilizers as spraying, with balanced rates is one of the solutions to these problems, as foliar nutrients are highly efficient in the processing of the plant in a balanced combination of the major and minor elements, which increase the contract of flowers and fill the various plant needs for growth and production under various environmental and climatic conditions surrounding it. The simultaneous spraying of plants, especially in the pre-flowering and seed formation stages, is very important for changing the direction of physiological processes towards the sink and accelerating the transfer of sugars and nutrients from leaves to seeds [10]. Khalid [15, 17] found that the of trace elements positively affected the growth and manufacture of essential oils in the seeds of a number of medicinal plants under the arid zones conditions, with what found [19] that spraying with foliar fertilizers on the soybean plant increased the seed yield. In fact, foliar nutrients are contributed and help to stimulate enzymes and vital processes (oxidative reactions) as well as other vital and physiological processes of respiration and photosynthesis in plants [20]. The spraying of a group of foliar fertilizers on the fenugreek plant influenced in the increase and activity of its biochemical activities [12]. pinching technique is the removal of the lateral buds of the main stem under specific conditions and growth stages of the plant to change its hormonal balance by reducing the proportion of Strigolacton in the side buds and increasing the auxins after the pinching. This certainly stimulates the growth of the side buds and vegetation in the plant, which in turn changes the type of relationship between the source and the sink (seeds), increase in the appearing of flowering buds and the vital activity of photosynthesis and metabolic accumulation and thus good production of the crop and its components [11, 26]. This is confirmed by [4] that the process of pinching has a significant impact in increasing the growth and yield traits of the fenugreek plant. The aim of the research is to identify and evaluate the feasibility of the pinching of apical bud

process in production rather than the use of chemical growth regulators and to assess their effect with levels of foliar nutrient (PRIMIUM) and interaction between them in the seeds production and oil for the fenugreek plant under the environmental conditions of the central region of Iraq.

## 2. MATERIALS AND METHODS

A field experiment was conducted during the winter season (2016-2017) in Diyala province, in silt clay loam soil as shown in Table (1) to study the effect of stage of pinching of apical bud and spraying with the PREMIUM solution (Chinese origin of LOXOWO) in the production of the seeds and oil yield for the fenugreek plant (cultivar =Indian). The experiment land was talliged, smoothing and divided into plots with dimensions of 1.5 mx 1.5 m, leaving sections between the experimental units of 0.5 m. A factorial experiment was used according to Randomized Complete Block Design (RCBD) and with three replicates, the NPK fertilizer was added at once with tillage and at 100 kg.h<sup>-1</sup>. Then the cultivating was done on 20/10/2016 by 7 lines within each plot and the distance between the line and the last 20 cm and between pit and another 15 cm. After the seeds were soaked for 12 hours [24], with three seeds in one pit and then removed to be one plant for each pit after a week from germination stage. The factors included: The first factor: Pinching process of apical bud for the plant was conducted, with three dates for the pinchings of (without pinching, 35, 50 days of germination). The second factor was sprayed with foliar nutrient solution (PRIMIUM) and three concentrations (0, 0.4, 0.8 g.L<sup>-1</sup>) by two spraying, the first one on 15/1/2017 and The second after ten days after dividing each concentration into two parts. Spray each of the above concentrations until the total wetness for the vegetative system of the plant and in the early morning to facilitate absorption with the addition of (R-COOK) to the nutritious solution by 1 ml.L<sup>-1</sup> to increase the spread of the solution on the surface of the leaf, crop and irrigation service operations were conducted according to needs.

**Table 1:** Chemical and physical properties for experiment soil before cultivating

Texture	Availability of N mg.kg <sup>-1</sup>	Availability of P mg.kg <sup>-1</sup>	Availability of K mg.kg <sup>-1</sup>	pH	EC ds.m <sup>-1</sup>	Organic substance g.kg <sup>-1</sup>
Silt clay loam	39	17.25	161	7.8	2.91	3.1

**Table 2:** Chemical components of foliar solution (PREMIUM)

NPK	Nitrogen in the urea form %	Nitrogen in the ammonia form %	Potassium in the form of fifth phosphorus oxide %	Chelated Magnesium %	Chelated Iron %
20:20:20	2.1	17.9	20	0.1	0.1
Chelated Zinc %	Chelated Copper %	Boron in the sodium borate form %	Molybdenum in the sodium molybdate form %	Vitamin B	
0.05	0.05	0.05	0.0005		

**Experiment indicators:**

Seed yield (kg.h<sup>-1</sup>), Biologist yield (g.plant<sup>-1</sup>) and the percentage of oil (%): The oil content of the seeds was estimated using the Soxhlet device and the solvent petroleum solvent according to method in [1] and oil yield (kg.h<sup>-1</sup>). The statistically significant data was analyzed using the statistical analysis program [22] and the mean values were measured using L.S.D at a probability level of 0.05 [23].

**3. RESULTS AND DISCUSSION****Seed yield (kg.h<sup>-1</sup>)**

The results of the statistical analysis in Table (3) showed that there was a significant effect for the pinching, spraying with the nutritious solution and interaction between them in the seed yield of the fenugreek plant. The pinching treatment after 50 days of germination excelled the pinching treatments without pinching and pinching after 35 days of cultivating with an increase of 11.4% and 6.5% %, respectively. This may be due to the fact that the pinching process after 50 days led to increased vegetative branches, which was reflected in the efficiency of photosynthesis and transfer of processed materials to the sink (seeds) and increase the weight of seeds in the plant. This was confirmed by [18, 25] that the

pinching of the fenugreek plant led to increase the seed yield. As shown in the table above, the spray treatment of (0.8 g.L<sup>-1</sup>) is significantly excelled in seed yield which is not different from the treatment of (0.4 g.L<sup>-1</sup>) and an increase of 8.8% and 8.1% compared to the treatment of non-spraying nutritious, respectively. This may be attributed to the vital role of the nutritious solution (PREMIUM) of the availability nutrients and sufficient to meet the requirements of vital processes in the leaves and increase the efficiency of the photosynthesis process as well as its role in the rate of production and transport of sugars and carbohydrates necessary to represent food in storage places in the fruit and thus increase the seed yield of the plant and hectare. These results are similar to [19] that found the spraying with foliar nutrients significantly increased the yield of soybean seeds. On the other hand, the interaction treatment of (pinching after 50 days of germination and spraying was 0.8 g.L<sup>-1</sup>) was excelled by giving the highest rate of this trait was 2080 kg.h<sup>-1</sup>, with an increase of 22.1% compared with the lowest rate of 1703 kg.h<sup>-1</sup> for interaction treatment (without pinching and without spray of nutrients).

**Table 3:** Effect of pinching and spraying with PREMIUM in Seed yield(kg.h<sup>-1</sup>)

Treatments	Pinching treatments a day after germination			
Levels of Nutrient Solution (g.L <sup>-1</sup> )	without pinching	35	50	Average Effect of Nutrient Solution
0	1703	1786	1913	1800
0.4	1883	1916	2043	1947
0.8	1834	1964	2080	1959
<b>Average effect of pinching</b>	1806	1888	2012	
<b>LSD (0.05)</b>				
<b>Pinching 22.40, Spraying 22.42, Interaction 38.89</b>				

**Biological yield (g.plant<sup>-1</sup>)**

Table (4) shows that there was a significant effect of the seeds in the biological yield of the plant. The pinching treatment after 50 days of germination was given the highest average for this trait of (16.17 g.Plants<sup>-1</sup>) with an increase of (9.4%, 7.2%) and the pinching after 35 days of germination which gave them both (14.78,15.08 g.Plant<sup>-1</sup>), respectively. This may explain the vital role of the pinching process at this stage of plant growth in altering the hormonal balance towards the formation and increase of vegetative branches [13] Increasing the leaf area, here is a role in increasing the rate of photosynthesis, accelerating the transfer and distribution of its biomass products and increasing plant weight. This is agreed with [25] that found the pinching process of the fenugreek plant led to an increase in biological yield. The results in the same table showed that the spray treatment with the nutritious solution of (0.8 g.L<sup>-1</sup>) was excelled by giving the highest average of (15.71 g.plant<sup>-1</sup>) Although it is not significantly different from spray treatment

(0.4 g.L<sup>-1</sup>) And by an increase of each (6.91% and 6.01%) respectively, compared to the lowest average non-spraying treatment which gave of (14.69 g.plant<sup>-1</sup>). This may be because PREMIUM contains ratio of a balanced of nutrients and is availability for photosynthesis, cell expansion and division. As well as containing the nitrogen element and its important role in the construction of protein and chlorophyll and the creation of the hormone elongation of cells IAA [14]. These results are similar to [5,16] that they found the spraying of the *Nigella sativa* and the Rapeseed yield by foliar fertilizers resulted in an increase in the biological yield. There was a significant interaction between the treatments, the combination that consist of (pinching after 50 days of germination and spraying was 0.8 g.L<sup>-1</sup>) recorded the highest rate of the biological yield was (16.61 g.plant<sup>-1</sup>), with an increase of 17.46% compared with the lowest rate of (14.14 g.plant<sup>-1</sup>). at interaction treatment of (without pinching and without spray of nutrients).

**Table 4:** Effect of pinching and spraying with PREMIUM in the biological yield (g.plant<sup>-1</sup>)

Treatments	Pinching treatments a day after germination			
Levels of Nutrient Solution (g.L <sup>-1</sup> )	without pinching	35	50	Average Effect of Nutrient Solution
0	14.14	14.44	15.50	14.69
0.4	15.29	15.22	16.24	15.58
0.8	14.92	15.60	16.61	15.71
<b>Average effect of pinching</b>	14.78	15.08	16.17	
<b>LSD (0.05)</b>				
<b>Pinching 0.187, Spraying 0.189, Interaction 0.325</b>				

### The percentage of oil (%)

Table (5) indicates a significant effect for the treatments of pinching and spraying by nutritious solution and interaction between them in the percentage of oil (%). The pinching treatment after 50 days of germination was excelled by giving the highest average of 7.58% compared to treatment without pinching and pinching after 35 days of germination, which gave the lowest average (7.15%) (7.39%) respectively, this may be due to the role of the pinching in increasing the size of total vegetative and its impact on growth and expand roots in education and increase the absorption of water and elements nutrients, which prolong the period of fullness of seeds and high oil content. Seed quality improves in the period between physiological maturation and its completeness [6]. As well as the important role of the process of pinching in the activation of some vital processes, including photosynthesis in the manufacture of carbohydrate compounds and their accumulation in the seeds in the form of

fat [7, 26]. This result is agreed with [2] that found the pinching of the Arugula plant increased the proportion of oil in the seeds. Table (5) shows the spraying treatment with ( $0.4 \text{ g.L}^{-1}$ ) excelled by giving the highest average of oil percentage of 7.50%, Although it did not differ significantly from the spray treatment of  $0.8 \text{ g.L}^{-1}$ , compared with the lowest percentage of oil found when not sprayed with a nutritious solution (7.17%). This may be due to the role of foliar nutrient spraying as an effect on the increase of enzymes' vital activity and activate the bio-path to create a fats in the plants [8, 17]. This is similar to [15]. The results showed that there was a significant interaction between the above factors and the superiority of the interaction treatment (pinching after 50 days of germination and spraying  $0.4 \text{ g.L}^{-1}$ ) with the highest percentage of oil in the seed of 7.75% and an increase of 11.3% compared to the lowest rate of 6.96% without pinching and without spraying nutrients).

**Table 5:** Effect of pinching and spraying with PREMIUM in the percentage of oil (%)

Treatments	Pinching treatments a day after germination			Average Effect of Nutrient Solution
Levels of Nutrient Solution ( $\text{g.L}^{-1}$ )	without pinching	35	50	
0	6.96	7.19	7.37	7.17
0.4	7.19	7.56	7.75	7.50
0.8	7.32	7.42	7.62	7.45
<b>Average effect of pinching</b>	7.15	7.39	7.58	
<b>LSD (0.05)</b>				
<b>Pinching 0.179, Spraying 0.181, Interaction 0.310</b>				

### Oil yield ( $\text{kg.h}^{-1}$ )

Table (6) show that there was a significant effect of the pinching. The pinching treatment excelled after 50 days of germination in the oil yield by giving the highest average of ( $152.73 \text{ kg.h}^{-1}$ ) and an increase rate of 18.0% and 9.3% compared to treatment without pinching and pinching after 35 days of the germination were ( $129.39$  and  $139.66 \text{ kg.h}^{-1}$ ) respectively. This was attributed to the effect of pinching after 50 days of germination to increase the proportion of oil and seed yield as shown in Tables (5, 3) respectively. This result is similar to [21] that

the pinching of the *Polygonum aviculare* plant led to increase oil yield in the unit area. The results in the above table indicate that there is a significant effect of spraying with the nutritious solution in this trait. The spray treatment has exceeded of ( $0.4 \text{ g.L}^{-1}$ ) by giving the highest average of  $146.19 \text{ kg.h}^{-1}$  which is not significantly different from the treatment of  $0.8 \text{ g.L}^{-1}$ , increase its amount (12.9%) compared to the non-spray treatment, which gave the lowest mean  $129.39 \text{ kg.h}^{-1}$ , This may be due to the effect of spray by foliar nutrient in increasing the seed yield and the percentage

of oil as shown in tables (3, 5) respectively. Table (6) shows a significant interaction between the pinching and spray treatments in the oil yield. The interaction (pinching after 50 days of germination and spraying with 0.8 g.L<sup>-1</sup>

<sup>1</sup>) achieved the highest rate was 158.49 kg.h<sup>-1</sup>. While the lowest rate of oil content was 118.54 kg.h<sup>-1</sup> was at the interaction treatment of (without pinching and non-spraying).

**Table 5:** Effect of pinching and spraying with PREMIUM in the oil yield (kg.h<sup>-1</sup>)

Treatments	Pinching treatments a day after germination			Average Effect of Nutrient Solution
	without pinching	35	50	
Levels of Nutrient Solution (g.L <sup>-1</sup> )				
0	118.54	128.41	141.37	129.39
0.4	135.40	144.84	158.33	146.19
0.8	134.24	145.72	158.49	146.15
Average effect of pinching	129.39	139.66	152.73	
LSD (0.05)				
Pinching 1.166, Spraying 1.169, Interaction 2.019				

It is concluded from the experiment that the pinching of apical bud and spraying with nutritious solution (PREMIUM) of the fenugreek has a significant effect on seed and oil yield. We recommend that other studies be carried out on other plants to determine the critical concentration of this nutrient, selecting different periods for plant cloning and determining the best suitable period for the pinching.

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