



# RESPONSE OF FENUGREEK *TRIGONELLA FOENUM-GRAECUM* L. TO PINCHING, FERTILIZATION WITH NITROGEN AND COBALT CHLORIDE

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## Abstract

The research was carried out in Horticulture field, College of Agriculture and Forestry, Mosul University, during the period from 2<sup>nd</sup> Nov. 2017 till 29<sup>th</sup> June 2018 on *Trigonella foenum-graecum* L. local variety, to study plants response to pinching, nitrogen fertilizer as urea at two levels: 0 and 60 Kg.h<sup>-1</sup>, and spraying with cobalt chloride at: 0 and 10mg.l<sup>-1</sup>. The amazing experience performed using split division within randomized full block design with 3 plot(1\*2 m<sup>2</sup>) and (25) plants in plot. The results showed that pinching caused an important growth in shoots and number of leaves, number of seeds in a pod and total seed yield. On other hand nitrogen fertilization gave an important growth in plant height and leaves number. Finally, pinched plants which fertilized with urea at 60 kg.h<sup>-1</sup> and sprayed with 10 mg.l<sup>-1</sup> of cobalt chloride gave the largest value of total seed yield 1677.23 kg.h<sup>-1</sup> compared with lowest significantly value 1447.73 kg.h<sup>-1</sup> for control.

**Key words :** *Trigonella foenum-graecum*, Fertilization, Fenugreek.

## Introduction

Fenugreek *Trigonella foenum-graecum* L. locally recognized as Helba belonging to Fabaceae family (Acharya *et al.*, 2008), the plant native in western Asia and South-Eastern Europe( Martin *et al.*, 2008). Fenugreek is annual herbal pulses which grows to 50 cm height, it has cultivated for a long time in Mediterranean countries (Martin *et al.*, 2011), mainly used as spicy food, fodder and medicine as green leaves, pods and seeds in various preparations (Manjula *et al.*, 2015). The seeds and leaves are well-known as a medicine for diabetes, dyspepsia and reduce blood cholesterol, as colic flatulence in dysentery, diarrhea, chronic cough (Meharfarin *et al.*, 2010; Gad and Abdel-Moez, 2015).

Pinching is a practice influenced on growth and yield characters of fenugreek (Singh *et al.*, 2017), which caused an increase in branches number, leaves, vegetative dry weight, and flowers bearing branches then seed yield and crop quality (Vasudevan *et al.*, 2008). In field experiment conducted on fenugreek Lakshmi *et al.*, (2015) found that un-pinched plants record a significantly higher value of plant height 59.69 cm, while plants pinched

in 30 days after sowing gave maximum number of pods 45.02 pods.plant<sup>-1</sup> and seed yield 2230 kg.h<sup>-1</sup>. Jaywalker *et al.*, (2018) emphases that pinching *Trigonella corniculata* at 40 days after sowing gave significantly best results of plant height, the maximum branches number and leaves number compared with pinching in 30 or 50 days after sowing.

Nitrogen is a mutual plant nutrition which encourage botanical growth in plant (Omid-beigi, 2007). Many studies used Nitrogen fertilizer on fenugreek showed an increase in vegetative growth (Shoots and leaves number), delayed maturation, and the amount of the seeds (Mondal *et al.*, 2017). On other hand, Datta *et al.*, (2017) notice that fertilizing *Trigonella foenum-graecum* cv. Hissar sonali plants with 80 Kg.ha<sup>-1</sup> of nitrogen gave a significantly best results of plant height at 75 days after sowing 64.24 cm, number of secondary branches of plant 13.38 and days to 50 % flowering 62.51 days, but adding 60 kg.ha<sup>-1</sup> of nitrogen gave best result of seed yield per plot and projected yield.

Cobalt is a useful ingredient for higher plants regardless of absence of evidence of their part in metabolism particularly in nitrogen fixation (Yadav and

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Khonna, 1988). In the study of Gad and Abdel Moez (2015) on *Trigonella foenum-graecum* that cobalt treatment caused to record higher values of plant height, pods yield and root dry weight compared with control.

The aim of this research was studying influence of pinching, nitrogen fertilization and spraying with cobalt chloride on the growth and productivity of local fenugreek plants.

## Materials and Methods

This experiment was accomplished in field of College of Agriculture and Forestry, University of Mosul, during period from 2<sup>nd</sup> Nov. 2017 until 29<sup>th</sup> June 2018 on *Trigonella foenum-graecum* L. Local variety, to study influence of some factors on growth and seed yield. The factors studied include: Pinching the tip of main stem when 10-12 cm length and (after 3-4 pear of leaves emerge on plant) and without pinch. The second factor was nitrogen fertilizer as Urea CO(NH<sub>2</sub>)<sub>2</sub> (46% N) at two levels: 0 and 60 kg.h<sup>-1</sup>, adding to the soil twice, first when plants 10-15cm length, and the second after one month. The third factor is cobalt chloride at 0 and 10 mg.l<sup>-1</sup> spraying on vegetative growth after one week of fertilization with nitrogen. The study included 8 treatments replicated 3 times in plot 1×2 m<sup>2</sup>, plants in the plot was 50cm between plants and 75cm between rows. Topical experience carried out by using plot split division within randomized full block design.

All agricultural practices were done as needed include irrigation, weed control etc.. Harvesting was done at 29<sup>th</sup> June 2018 manually. The data recorded include: plant length (cm) by using 5 plants in plot randomly. Number of branches (branch.plant<sup>-1</sup>) on main stem. Stem diameter (mm) at height 5 cm from soil surface. Total number of leaves (leaf.plant<sup>-1</sup>). The number of pods (pod.plant<sup>-1</sup>). Diameter of pod (mm), by using venire caliper, the average of 25 pods for each plot. Number of seeds in pod (pot of seeds<sup>-1</sup>), by using 25 pods for each plot. Total yield (kg.h<sup>-1</sup>) by utilizing following equation.

$$\text{Total yield (Kg.h}^{-1}\text{)} = \frac{\text{Experimental yield (Kg.h}^{-1}\text{)}}{\text{Experimental volume} \times 8000(\text{m}^2)}$$

The data obtained from the trials were subjected to statistical analyses by using (SAS, 2001) and treatment compared statistically through utilizing Duncan various experiment at 5%.

## Results and Discussion

### Plant height (cm)

Information present in table 1 illustrated which pinching caused significantly decreased plant height.

Nitrogen fertilizer caused a significantly decrease of plant height compared with control. In general plant pinched fertilized with 60 kg.h<sup>-1</sup> Urea and non-sprayed with cobalt chloride cause the record lowest value of plant height 62.53 cm.

### Number of branches (branch.plant<sup>-1</sup>)

Pinching plant gave the highest value of branch number 11.50 branch.plant<sup>-1</sup> (Table 2). On other hand, the height number of branch per plant 13.26 was record when plants pinched and fertilized with nitrogen and sprayed with cobalt chloride at 10 mg.l<sup>-1</sup> compared with control 5.71 branch.plant<sup>-1</sup>.

### Stem diameter (mm)

The data present in table 3, showed that all interactions didn't differ significantly between them, and the higher value record 6.60 mm when plant pinched, fertilized with 60 kg.h<sup>-1</sup> Urea and non-sprayed with cobalt chloride compared with control 4.44 mm which decreased significantly leaves number (leaf.plant<sup>-1</sup>).

### Leaves number

The data present in table 4 showed that the pinched plants gave a higher value of leaves number 114.74 leaf.plant<sup>-1</sup>, also the nitrogen fertilizer caused to record a significant value 112.20 leaf.plant<sup>-1</sup> compared with 89.27 leaf.plant<sup>-1</sup> for control. The interaction between pinching and nitrogen fertilizer at 60 kg.h<sup>-1</sup> combined with spraying with 10 mg.l<sup>-1</sup> of cobalt chloride gave the significantly higher value 144.49 leaf.plant<sup>-1</sup>.

### Pod number (pod.plant<sup>-1</sup>)

The interaction treatment between plant pinching and nitrogen fertilization at 0 and 60 kg.h<sup>-1</sup> distinction by increasing pod number significantly and gave 49.06 and 53.97 pod.plant<sup>-1</sup> respectively (Table 5). On other hand, pinching plant fertilized with nitrogen fertilizer at 0 and 60 kg.h<sup>-1</sup> and sprayed with cobalt chloride at 10 mg.l<sup>-1</sup> gave a significantly higher values of pod number per plant 54.43 and 58.23 pod.plant<sup>-1</sup> respectively compared with control 38.91 pod.plant<sup>-1</sup>.

### Pod diameter (mm)

Information in table 6 illustrated which pinched plant, sprayed with 10 mg.l<sup>-1</sup> cobalt chloride and not fertilized with nitrogen fertilizer gave significantly larger value of pod diameter 4.98mm.

### Number of seed in pod (pot of seeds<sup>-1</sup>)

Information in table 7 showed which pinching caused a significantly increase of seed number in pod 16.26 compared with 14.22 seed.pod<sup>-1</sup> for control. Nitrogen fertilizer at 60 kg.h<sup>-1</sup> gave significantly least result 16.24

**Table 1:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on plant height (cm) of fenugreek plant *Trigonella foenum-graecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	70.63a-c	72.26 ab	71.44 a	71.08 a
	60	74.86 a	66.56 b	70.71 a	
Pinching	0	65.66 bc	64.33 bc	64.99 b	64.60 b
	60	62.53 c	65.86 bc	64.20 b	
Pinching x cobalt chloride	Non-Pinching	72.75 a	69.41 ab	Effect of nitrogen	
	Pinching	64.10 b	65.10 b		
Nitrogen x cobalt chloride	0	68.11 a	68.30 a	68.22 a	
	60	68.70 a	66.21 b	67.45 b	
Effect of cobalt chloride		68.42a	67.25a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

**Table 2:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on branches number (branch.plant<sup>-1</sup>) of fenugreek plant *Trigonella foenum-graecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	5.71 d	7.36 d	6.54 c	7.28 b
	60	8.34 b-d	7.70 cd	8.02 bc	
Pinching	0	7.94 cd	12.68ab	10.31 ab	11.50 a
	60	12.10 ab	13.26 a	12.68 a	
Pinchingx cobalt chloride	Non-Pinching	7.03 b	7.53 b	Effect of nitrogen	
	Pinching	10.02 ab	12.97 a		
Nitrogen x cobalt chloride	0	6.82 b	10.02 b	8.42 a	
	60	10.22 ab	10.48 a	10.35 a	
Effect cobalt chloride		10.52a	10.25 a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

**Table 3:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on stem diameter (mm) of fenugreek plant *Trigonella foenum-graecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	4.44 b	5.55 ab	5.00 b	5.05 a
	60	5.09 ab	5.13 ab	5.11 b	
Pinching	0	5.50 ab	6.54 a	6.02 a	6.25 a
	60	6.60 a	6.37 a	6.48 a	
Pinching x cobalt chloride	Non-Pinching	4.77 b	5.34 ab	Effect of nitrogen	
	Pinching	6.05 a	6.45 a		
Nitrogen x cobalt chloride	0	4.97 b	6.05 a	5.51 a	
	60	5.85 a	5.75 a	5.80 a	
Effect cobalt chloride		5.41a	5.90 a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

seed.pod<sup>-1</sup> compared with 14.35 seed.pod<sup>-1</sup> for control. In general, there were no differences between many interactions but lowest values of seed in pod was 11.96.

### Total yield (kg.h<sup>-1</sup>)

Information in table 8 explained that the plants which pinched gave largest value of yield 1621.85 kg.h<sup>-1</sup> compared with 1513.94 kg.h<sup>-1</sup> for control. While, there

were no significant differences between most inter action of pinching, nitrogen fertilizer and spraying with cobalt chloride but the highest yield record 1677.23 kg.h<sup>-1</sup> when plants pinched interacted with 60 kg.h<sup>-1</sup> of nitrogen fertilizer and spraying with 10 mg.L<sup>-1</sup> of cobalt chloride compared with the lowest value of yield 1447.73 kg.h<sup>-1</sup> for control.

The results in table 2 indicate that pinching caused an important growth in number of branches of plant. This result is consistent with Kauser et al (2016). Pinching plants also led to a growth in number of leaves per plant (Table 4). This increase may be attributed to growth in number of branches on plant. This result may be interpreted according to the change in the concentrations of auxin and cytokinin in plant. The internal concentration of cytokinin in plant increased after pinching, according to Cline (1994). Cline (1991 and 1994) observed that removing the shoot tip of *Verbascum thapsus* caused a significant increase in branching and this indicates that apical dominance lasts through the effect of developing shoot apex which induced by attracting nutrients to the developing apex or hormones or the overlap between nutrient attraction and hormones. Beveridge *et al.*, (2003), indicated that the growth of buds is genetically controlled in

branches, stem, roots, or both. There is evidence to show that growth of side shoots is not only controlled by the developing apex only. Fay and Throop (2005) showed that plant branches is a character which shows equipoise between growth from apical and side structural cells, that equipoise is controlled through many morphological, physiological and environmental factors containing

**Table 4:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on leaves number (leaf.plant<sup>-1</sup>) of fenugreek plant *Trigonella foenum-gracecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	78.31 de	34.11 c-e	81.20 b	86.73 b
	60	108.68 b-d	75.83 e	92.25 b	
Pinching	0	79.98 de	114.69 a-c	97.33 b	114.74 a
	60	119.82 ab	144.49 a	132.15 a	
Pinching x cobalt chloride	Non-Pinching	93.50 a	79.97 a	Effect of nitrogen	
	Pinching	99.90 a	129.59 a		
Nitrogen x cobalt chloride	0	79.14 b	99.40 ab	89.27 b	
	60	114.25 a	110.15 a	112.20 a	
Effect cobalt chloride		96.70 a	104.78 a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

**Table 5:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on pod number (pod.plant<sup>-1</sup>) of fenugreek plant *Trigonella foenum-gracecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	38.91 c	41.60 bc	40.25 b	40.30 a
	60	43.60 bc	37.10 c	40.35 b	
Pinching	0	43.69 bc	54.34 a	49.06 a	51.52 a
	60	49.72 a-c	58.23 a	53.97 a	
Pinching x cobalt chloride	Non-Pinching	41.25 ab	39.35 b	Effect of nitrogen	
	Pinching	64.71 ab	56.33 a		
Nitrogen x cobalt chloride	0	41.30 b	48.02 a	44.66 a	
	60	46.66 ab	47.66 a	47.16 a	
Effect cobalt chloride		43.98 a	47.84 a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

**Table 6:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on pod diameter (mm) of fenugreek plant *Trigonella foenum-gracecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	3.16 cd	3.09 d	3.12 b	3.57 a
	60	4.37 ab	3.88 b-d	4.03 ab	
Pinching	0	4.07 b	4.98 a	4.53 a	4.38 a
	60	3.98 bc	4.50 ab	4.24 a	
Pinching x cobalt chloride	Non-Pinching	3.77 a	3.38 a	Effect of nitrogen	
	Pinching	4.03 a	4.74 a		
Nitrogen x cobalt chloride	0	4.62 a	3.03 a	3.83 a	
	60	4.17 a	4.09 a	4.13 b	
Effect cobalt chloride		3.90a	4.06 a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

number, arrangement and integration of effective structural cells and hormones including metabolism and movement. The data in table 7 indicate an important increase in number of seeds in a pod when plants pinched. The above results may explain by the improvement of vegetative growth characteristics, especially the increase in the number of branches and leaves, which led to increase in plant nutrient content which subsequently

supported the increase of total yield (Table 8).

From the review of the data in table 3, an important growth in the number of leaves of plant at nitrogen fertilization at a concentration of 60 kg.h<sup>-1</sup> was observed. This result may be explained because nitrogen fertilizers is significant one of macro parts that plant wants them extremely, found in a large number of significant organic parts in necessary process of plant, found in DNA and RNA and in proteins and chlorophyll and numerous of enzyme cofactors, forming ATP, NADP and NADPH<sub>2</sub>, and in cellular velum and mitochondria and chloroplasts (Campbell and Campbell 1998).). The effect of nitrogen fertilizers may be because of high rate of root growth and cause to accumulate high rate of desiccated materials that make ingest a large quantity of water that grows plant liveliness while nitrogen found to make photosynthesis that makes rise in total plant growth, Asgarpanah (2012) aforesaid which nitrogen is regarded one of main nutrients that supports plants to grow while it binds mightily with growth found in number of plant leaves. data in table 8 indicate that the number of seeds in pod increased significantly when fertilized at 60 kg.h<sup>-1</sup> of nitrogen. This increase may be due to the accumulation of nutrients in the plant because of increase in number of leaves.

(Vasudevan *et al.*, 2008). Cobalt is an important part for specific microorganisms specially these determines nitrogen in the atmosphere, its lack lower capacity of install nitrogen (Yado *et al.*, 1988, Balai *et al.*, 2005). Addition of cobalt to high purity nutrients solution basically growing host-plant and tempered symptoms of nitrogen lack. Cobalt requirements for nitrogen fixation are greater

**Table 7:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on number of seed in pod (seed.pod<sup>-1</sup>) of fenugreek plant *Trigonella foenum-graecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	11.96 c	13.03 bc	12.50 b	14.22 b
	60	15.80 ab	16.10 a	15.95 a	
Pinching	0	16.37 a	16.06 a	16.21 a	16.26 a
	60	15.85 ab	16.66 a	16.21 a	
Pinching x cobalt chloride	Non-Pinching	13.88 b	14.56 ab	Effect of nitrogen	
	Pinching	16.11 a	16.36 a		
Nitrogen x cobalt chloride	0	14.16 a	14.55 a	14.35 b	
	60	15.82 a	16.38 a	16.24 a	
Effect cobalt chloride		14.99 a	15.46 a		

\* Instruments in every column which have same list did not different considerably at p= 0.05.

**Table 8:** Effect of Pinching, nitrogen fertilizer and spraying with cobalt chloride on total yield (kg.ha<sup>-1</sup>) of fenugreek plant *Trigonella foenum-graecum*.

Pinching	Nitrogen (kg.h <sup>-1</sup> )	cobalt chloride (mg.l <sup>-1</sup> )		Pinching x nitrogen	Effect of pinching
		0	10		
Non-Pinching	0	1447.73 b	1529.80 ab	1488.77 c	1513.94 b
	60	1597.60 ab	1480.63 ab	1539.12 bc	
Pinching	0	1652.00 ab	1618.63 ab	1635.32 a	1621.85 a
	60	1539.53 ab	1677.23 a	1608.38 ab	
Pinching x cobalt chloride	Non-Pinching	1522.67 a	1505.22 a	Effect of nitrogen	
	Pinching	1595.77 a	1647.93 a		
Nitrogen x cobalt chloride	0	1549.87 a	1574.22 a	1562.04 a	
	60	1568.57 a	1578.93 a	1573.75 a	
Effect cobalt chloride		1559.22 a	1576.58 a		

\* Modality in every column which have same list did not different considerably at p= 0.05.

than those for host-plant growth (Watsn *et al.*, 2001), Banerjee *et al.*, (2005) Cobalt was immediately proportionate to vitamin B<sub>12</sub> that have a significant part in nitrogen fixation in the atmosphere. Cobalt is important for growth rhizobia, particular bacteria participated in suppression of legumes and nitrogen fixation, (Abdul Jaleel *et al.*, 2009 and Rangnekar *et al.*, 2013) where cobalt registered extreme leaf area indicator, accumulation of dry matter in atmospheric elements of plants, dry weight of roots, plant height also yield pod in both cowpea and peanuts compared with controls.

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