Egypt. J. Agric. Res., 72 (4), 1994.

RESPONSES OF FENUGREEK PLANT TO PHOSPHORUS AND POTASSIUM FERTILIZATION

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(Manuscript received 26 October 1992)

Abstract

The present work was conducted during two seasons1990/1991 , 1991/1992 . At the farm of Medicinal and Aromatic Plant Section in Dokki and Sed Research Stations. The aim of this research was to study the effect of three levels of calcium supper phosphate (15.5% P_2O_5) (100,15 and 200kg/fd.) and two levels of potassium sulphate (48% K_2O_5), (150 and 100 kg/fd.) on the vegetative growth, yield and fixed oil of fenugreek plant. Generally data cleared that plant treated with 200 kg. calcium super phosphate and 100kg potassium sulphate gave the highest values of plant height, number of pods, fresh and dry weights of plant in both locations.

In Dokki location the treatment with 200 kg calcium super phosphate and 50kg potassium sulphate gave the highest results in branch number, seed yield, oil percentage and oil yield, but in Seds location the highest values were obtained by using 200 kg calcium super phosphate, 100kg potassium sulphate.

INTRODUCTION

The plant *Trigunella foenum graecum* is an annual herb native to the countries bordering on the eastern shores of the Mediterranean and largely cultivated in India, Egypt and Morocco. The seed has a faint characteristic odour when entire but strong when powdered and mucilagenous slightly better taste.

Fenugreek is used as a spice in carry powdered. The dry ground is employed in domestic medicine. When boiled with water, the decoction is used as a hot demulcent drink. Recently fixed oil of foenugreek is considered as a good locatagauge. It contains 28 percent of mucilage occurs in the endosperm, about 22 percent of protein, 16 percent of fixed oil, saponin and two alkaloids, tregonlline and choline.

In the literature rare was found dealing with the effect of P and K on foenugreek plant. However many investigators studied the effect of these elements on the other plants such as Ligum (1955), reported that the response of sunflower to P depended on the stage of growth, the time of application and on the P/N ratio. Increasing P at the early stage increased the contents of nucleo-proteins, phospholipids, phosphoric esters and favoured by the reduced content of nucleo protein and protein N. Nicolae *et al.* (1959) showed that superphosphate incorporated at the rate of 40Kg/ha, P_2O_5 to 20-22 cm. depth in calcareous cheirqnozem at the time of ploughing produced higher yield of sunflower seeds (10.75 Kg seed for each Kg of P_2O_5 applied than complete fertilizing with mineral NPK did. Proskura *et al* (1971) reported that application of 40Kg P_2O_5 and 40 Kg K_2O/ha increased seed yield of yellow fodder (*Lupinus lutus* L.) 12.1 and 17.2 % respectively. Shierski (1971) studied the effect of high rates of phosphate fertilizer on some varieties of yellow lupins and field peas. (He found that application of 102 Kg P_2O_5 /ha increased seed yield of lupin varieties (1.89 t/ha) was obtained with 51 kg P_2O_5 /ha. Increasing level to 102 Kg P_2O_5 /ha increased seed yield of lupin varieties. On bean (*Phaseolus Vulgaris* L.) Eira *et al.* (1974) found that this plant responded to P fertilizer, the highest seed yield (1.25 t/ha) was obtained with 1080 Kg P_2O_5/ha. cole (1975) reported that supply with P increased photosynthetic and seed protein content but had little effect on seed oil content of sunflower. Samul and Paprocki (1982) cleared that with yellow lupins increasing rates of applied P and K had little effect on plant height, number of pods and number of seeds / pod and per plant. On heliathus plant El-Embaby , (1982) found that the high level of phosphorus fertilization caused in-

creases in plant height and the dry weight of plant . High level of potassium also increased oil percent and oil yield.

Regarding the effect of macro elements (P and K) on the oil of plant, Golsteva and Varvarina (1974) on sunflower, noticed that the application of P and K increa sed the seed oil content. Karastina (1973) found that the application of 60 Kg P_2O_5 /ha gave the highest seed oil content of 54.7% compared with 48.5% (control). Aleksandrova and Rakitina (1975) reported that drilling 20 kg P_2O_5 /ha at sowing icnreased oil content of sunflower plant.

The aim of this work was to study the effect of phosphorus and potassium fertilizatin on the growth and oil content of foenugreek plant.

MATERIALS AND METHODS

This work was carried out during the two successive seasons 1990/1991 and 1991/1992 in two locations, the first location was at the Medicnal and Aromatic Plants Research Section at Dokki , Giza Governorate, and the second was at Horticultural Research Station at Seds, Beni-Suef Governorate.

The experiment in both locations was set in complete randomized blocks design with three replicates. Each experimental plot was 2x5 m.

The seeds of fenugreek were sown on October 22th in both seasons, seven treatments were carried out.

1	N	P_0	K_0
2	N	P_1	K_1
3	N	P_2	K_1
4	N	P_3	K_1
5	N	P_1	K_2
6	N	P_2	K_2
7	N	P_3	K_2

The following fertilizer treatments were conducted:

Where: N=100 Kg. Ammonium sulphate (20.6 % N) per feddan.

P_1, P_2, P_3 = 100, 150 and 200 Kg . Calcium super phosphate (105.5% P_2O_5)

For all the fertilization treatments, the specific fertilizer N, P and K added as three equal side dressings. The first application was after 6 weeks Dec. 8th from sowing . The second was dressed after three weeks Dec. 29th), followed by the third after 3 weeks (Jan 20th.). Firstly the P fertilization was added then after the N and K were added , all other agricultural practices were performed as usual.

Soil analysis : Samples of soil from each location were taken to determine the main macro elements, i.e. N, P and K. Table (1) indicates the analysis of these elements in both seasons and locations.

Table 1. The analysis of N,P and K in the two locations.

Locations	Dokki			Seds		
	Nitrate PPm	P PPm	K PPm	Nitrate PPm	P PPm	K mg/100g
Elements	32.6	11.9	385	31.8	12.0	39.5

The followeing data were recorded : plant height, number of branches and pods/ plant , the fresh and dry weights /plant , seed yield per plant and per plot, the percentage of fixed oil, seed content of fixed oil per plant and per plot in seeds.

The obtained data were statistically analised according to Snedecor (1966) . Oil seed was extracted by Soxhelt apparatus with hexane for six hrs. according to A.O.A.C. (1955).

RESULTS AND DISCUSSION

Effect of phosphorus and potassium levels on the vegetative growth and seed yield:

The results obtained for plant characters are shown in Tables (2 and 3) plant height, number of branches, fresh and dry weights of aerial parts, number of pods, pod length as well as seed yield per plant and per plot, showed significant differences as a result of levels of fertilizer comparing to the control.

Data revealed that plant height number of pods and fresh and dry weights of aerial parts of the plant were increased by increasing the levels of fertilization of (P and K) . Control plants were generally short, less in the number of pods and fresh and dry weight that may be due to the lack of the nutrients available in the soil. The differences between treatment , and control were statistically significant in both location in the two seasons.

In both locations the treatment P_3 K_2 (200 kg) calcium super phosphate (15.5%) P_2O and 100 Kg potassium sulphate 48% K_2O) gave the highest values of these parameters .

These results cleared the importance of increasing the levels of phosphorus and potassium fertilization on the growth of feunogreek under the surcumestances of this experiment.

Russel & Russel (1961) cleared the importance of phosphorus to the plant as it is one of the main constitutent of meristematic tissues. They added that , the increase of the plant height and number of tillers might be due to the increase in the number of cell of barly plant.

Regarding the effect of phosphorus and potassium fertilization on the number of branches and seed yield per plant and per plot. Data in Tables (2 and 3) showed that by increasing the levels of P and K fertilizations, number of branches and seed yield per plant and per plot were significantly increased than the control and other treatments in both locations, at the first and second seasons.

In Dokki location the treatment P_3K_1 caused the highest number of branches besides seeds yield per plant and per plot . The increasement due to this treatments increased) 66.7%) and (77.8%) in case of seed yield per plant, whereas they were (81.5%) and (80.6%) in seed yield per plot compared with the control (P_0K_0) in the two seasons respectively.

In seds location these increases were 60.6% and 60.6% in seed yield per plant, while they were 58.3% and 63.3% in seed yield per plot compared with the

Table 2. Effect of phosphorus and potassium fertilizations on growth, seed yield, oil percent and oil yield of Fenugreek plant in Dokki Location in 1991 and 1992 seasons.

Treatments / Seasons	Plant height / plant cm.		No. of branches / plant		Pod number/ plant		Pod length / plant cm.		Freshweight/ Plant gm		Dry weight/plant gm	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	95.10	67.10	1.60	1.50	11.90	11.10	11.30	8.03	20.90	18.20	2.60	1.70
N P_1 K_1	107.10	77.80	1.80	2.70	13.30	11.50	11.50	8.90	22.40	20.20	3.00	20
N P_2 K_1	110.90	88.30	3.60	3.10	17.20	14.60	12.43	9.97	28.10	24.10	3.30	4.10
N P_3 K_1	109.30	87.80	4.00	4.20	22.10	16.33	13.50	10.20	31.30	26.80	4.80	4.40
N P_1 K_2	108.20	83.80	2.90	3.70	13.30	12.70	11.47	9.80	26.90	21.50	3.30	3.70
N P_2 K_2	113.20	95.80	3.80	3.00	14.40	15.83	13.30	11.00	30.30	25.40	4.20	4.08
N P_3 K_2	121.30	100.00	2.90	2.88	23.10	16.90	11.93	10.73	34.80	31.00	4.97	5.30
L.S.D. 5%	12.57	9.72	0.83	1.07	2.19	2.94	1.34	1.30	3.09	2.85	0.54	1.03

Table 2. (cont.)

Treatments / Seasons	Seed yield / plant gm.		Seed yield/ plant Kg.		Oil percent		Oil yield / plant gm.		Oil yield / plant Kg.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	2.70	2.7	2.70	1.70	17.30	15.0	0.48	0.41	0.48	0.26
$N P_1 K_1$	3.50	3.10	3.42	2.20	19.00	15.50	0.67	0.48	0.65	0.34
$N P_2 K_1$	3.90	3.40	4.65	2.53	22.30	21.02	0.86	0.71	1.04	0.53
$N P_3 K_1$	4.50	4.80	4.90	3.07	215.30	23.7	1.14	1.13	1.24	0.73
$N P_1 K_2$	3.20	3.00	3.38	1.91	20.50	19.67	0.69	0.58	0.69	0.38
$N P_2 K_2$	2.70	3.00	3.32	2.02	25.06	23.67	0.68	0.68	0.83	0.48
$N P_3 K_2$	2.80	2.75	2.90	1.71	24.70	23.00	0.69	0.63	0.72	0.39
L.S.D. 5%	66.7	77.8	81.5	80.6	46.2	58.0	137.5	175.6	1858.3	180.7

Table 3. Effect of phosphorus and potassium fertilizations on growth, seed yield, oil percent and oil yield of Fenugreek plant in seds Location in 1991 and 1992 seasons.

Treatments / Seasons	Plant height / plant cm.		No. of branches / plant		Pods number/ plant		Pod length / plant cm.		Fresh weight/plant gm		Dry weight/plant gm	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	79.00	73.00	1.33	1.02	11.03	10.37	12.20	10.47	18.95	17.27	3.06	2.76
$N P_1 K_1$	79.66	73.66	1.37	1.07	13.53	11.43	12.35	10.87	20.53	19.67	3.62	3.42
$N P_2 K_1$	85.00	78.66	2.60	2.27	14.77	13.63	12.60	11.13	24.30	22.30	4.58	4.17
$N P_3 K_1$	85.00	82.33	3.80	3.57	16.90	15.87	13.20	12.23	29.63	25.47	5.43	5.04
$N P_1 K_2$	84.00	75.00	2.43	2.24	13.62	12.33	12.70	11.12	21.13	20.13	3.71	3.52
$N P_2 K_2$	85.00	79.33	2.67	3.33	15.07	14.27	12.93	12.10	26.30	23.60	4.79	4.39
$N P_3 K_2$	87.33	83.0	3.87	3.73	17.53	16.97	13.50	12.73	29.93	28.73	5.63	5.52
L.S.D. 5%	3.89	6.09	0.42	0.53	1.18	1.89	N.S.	N.S.	4.58	3.22	0.41	0.36

Table 3. (cont.)

Treatments / Seasons	Seed yield / plant gm.		Seed yield / plant Kg.		Oil percent		Oil yield / plant gm.		Oil yield/ plant Kg.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	1.80	1.27	1.94	1.83	17.50	15.40	0.31	0.19	0.34	0.26
$N P_1 K_1$	2.53	1.72	2.68	2.58	18.30	16.50	0.46	0.28	0.49	0.43
$N P_2 K_1$	2.62	1.84	2.88	2.69	19.20	17.30	0.50	0.32	0.56	0.47
$N P_3 K_1$	2.80	1.93	3.00	2.87	20.30	18.00	0.57	0.35	0.61	0.52
$N P_1 K_2$	2.59	1.79	2.77	2.66	18.90	16.80	0.49	0.30	0.52	0.45
$N P_2 K_2$	2.63	1.89	2.95	2.69	19.90	17.60	0.52	0.33	0.59	0.47
$N P_3 K_2$	2.89	2.04	3.07	2.93	20.70	18.90	0.60	0.39	0.64	0.56
L.S.D. 5%	0.16	0.14	0.40	0.73	1.50	0.88	0.06	0.03	0.97	0.35

untreated plants in the two seasons respectivelly.

Concerning pod length data in the same tables show a significant increase by increasing the levels of fertilizations (P and K) used in Dokki location, while this increase was insignificant at seeds location.

Pod length reached its maximum with the application of P and K at the rates of P_2K_2 in the two locations in the first and second seasons as shown in the table.

Effect of phosphorus and potassium fertilization levels on the oil percentage and oil yield /plant and plot:

Data in Tables (2 and 3) indicate that the used fertilization treatments significantly increased the oil percent and oil yield per plant and per plot compared with the untreated plant in both location in the two seasons.

In Dokki location by increasing the levels of fertilization the fixed oil percentage and oil yield were significantly increased . They reached their maximum by treating the plants with P_3k_1 these increments in the oil percentage were 46.2% and 58% but in case of oil yield, the increases per plant were 137.5% and 175.6%, as well as in the oil yield per plot they were 158.3% and 180.7% compared with the control in the two seasons.

The results cleared that adding 50kg. of potassium sulphate was sufficient to give the best results, it may be due to that this element was available for plant in the soil.

In Seds location the treatment P_3k_1 was the best treatment which gave the highest values of oil percent and oil yield. The increases in oil percentage were 18.3% and 22.7% whereas they were 93.6% and 105.3% in the case of oil yield per plant and they were 87.3 and 100.1% in the oil yield per plot compared with the untreated plant.

Generally these results are in agreement with those obtained by El-Embaby (1982) on sunflower, who reported that the highest level phosphorus and potassium fertilization significantly increased the oil percent and oil yield. He mentioned that the increases in the oil percent and oil yield might be attributed to that increasing the P at the early stage which is considered a main constituent of nucleus proteins,

phospholipids, phosphoric ester and other mineral phosphate compounds.

It can be concluded that little differences were found in the responce of foenugreek plant to phosphorus and potassium levels in the two locations under study , and this results may be attributed to the variation in soil and environmental conditions between the two locations.

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استجابة نبات الحلبة للتسميد الفوسفورى والبوتاسى

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معهد بحوث البساتين – مركز البحوث الزراعية .

أجرى هذا البحث بمزرعة قسم بحوث النباتات الطبية والعطرية بالدقى بالجيزة ، وأيضا فى مزرعة محطة بحوث سدس ببنى سويف . ويهدف هذا البحث الى دراسة تأثير ثلاث مستويات من سماد سوبر فوسفات الكالسيوم ٥ ، ١٥٪ (١٠٠ ، ١٥٠ ، ٢٠٠كجم/للفدان). ومستويين من سلفات البوتاسيوم ٤٨٪ (٥٠ ، ١٠٠كجم/للفدان) ، على النمو الخضرى ومحصول البذرة والزيت الثابت لنبات الحلبة فى كلا الموقعين . وقد أوضحت النتائج الآتية :

(١) أن المعاملة ٢٠٠كجم سوبر فوسفات كالسيوم (٥ ، ١٥٪) + ١٠٠كجم سلفات بوتاسيوم ٤٨٪ قد أعطت أعلى القيم من حيث طول النبات –عدد القرون– الوزن الطازج والجاف للأجزاء الهوائية من النبات فى كلا الموقعين .

(٢) فى منطقة الدقى أعطت المعاملة (٢٠٠كجم سوبر فوسفات كالسيوم ، ٥٠كجم سلفات بوتاسيوم) أعلى القيم من حيث عدد الفروع –محصول البذرة– نسبة الزيت الثابت وكذا محصول الزيت .

بينما فى منطقة سدس أعطت المعامله (٢٠٠ كجم سوبر فوسفات كالسيوم + ١٠٠ كجم سلفات بوتاسيوم أعل القيم فى المقاييس السابقه .

(٣) المعاملة ب ١٥٠كجم سوبر فوسفات كالسيوم +١٠٠كجم سلفات بوتاسيوم أعلى قيم فى طول القرن فى كلا الموقعين .

(٤) أوضحت النتائج أيضا أن استجابة نبات الحلبة للمستويات المختلفة من السماد الفسفورى أو البوتاسى تختلف حسب الموقع المنزرع فيه النبات حيث اختلاف العوامل الجوية وظروف التربة .