THE EFFECTS OF SPRING AND WINTER SOWINGS ON YIELD AND YIELD COMPONENTS OF SOME FENUGREEK *(Trigonella foenum-graecum* L.) LINES

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ABSTRACT: This study was carried out at the experimental fields of the Department of Field Crops, Faculty of Agriculture and University of Ankara during 1997-1998. Seven fenugreek lines and a Standard variety were used as a study material. These lines were improved in our department by using single plant selection method.

According to the results of this research, following traits ranged as indicated: Plant height 68.57-91.33 cm, seed yield 86.70-137.00 kg/da, biological yield 305.9-430.4 kg/da, branch number per plant 1.67-2.27, pod number per plant 11.07-14.27, seed number per pod 11.47-13.53 and one thousand seed weight 16.86-21.44 g in winter sowing. The results in spring sowing changed between 60.70-76.90 cm, 40.13-73.23 kg/da, 212.4-308.0 kg/da, 1.67-2.60, 9.90-12.53, 11.63-14.10 and 13.77-16.68 g, respectively.

Key Words: Fenugreek, *Trigonella foenum-graecum*, seed yield, pod number per plant, seed number per pod.

BAZI ÇEMEN *(Trigonella foenum-graecum* L.) HATLARINDA YAZLIK VE KIŞLIK EKİMİN VERİM VE VERİM ÖZELLİKLERİ ÜZERİNE ETKİLERİ

ÖZET: *Bu araştırma Ankara Üniversitesi, Ziraat Fakültesi, Tarla Bitkileri Bölümü deneme tarlasında 1997 ve 1998 yıllarında yürütülmüştür. Çalışmada 7 çemen hattı ve bir standart çeşit materyal olarak kullanılmıştır. Bu hatlar tek bitki seleksiyonu yöntemi ile bölümümüzde geliştirilmiştir.*

Araştırma sonuçlarına göre kışlık ekimde bitki boyu 68.57-91.33 cm, tohum verimi 86.70-137.00 kg/da, biyolojik verim 305.9-430.4 kg/da, bitkide dal sayısı 1.67-2.27 adet, bitkide meyve sayısı 11.07-14.27 adet, meyvede tohum sayısı 11.47-13.53 adet ve bin tohum ağırlığı 16.86-21.44 g arasında değişim göstermiştir. Yazlık ekimden elde edilen sonuçlar sırasıyla 60. 70-76.90 cm. 40.13-73.23 kg/da. 212.4-308.0 kg/da, 1.67-2.60 adet, 9.90-12.53 adet, 11.63-14.10 adet ve 13.77-16.68 g arasında değişmiştir.

Anahtar Sözcükler: *Çemen, Trigonella foenum-graecum, tohum verimi, bitkide mevve sayısı. meyvede tohum sayısı.*

INTRODUCTION

Fenugreek *(Trigonella foenum-graecum* L.) is an annual, herbaceous and aromatic plant belonging to *Fabaceae* family. Genus *Trigonella* contains about 100 species and 50 of them grow naturally in Turkey. However, the *T.foenum-graecum* species is only cultured agriculturally (Seçmen et al. 1995).

Fenugreek is cultured in Turkey for domestic consumption and export with plaktın area of about 900 ha and seed production of about 850 tons (Ayanoğlıı and Mert, 1999). In the world, important producer countries of fenugreek are India, Egypt, Ethiopia, Morocco, Algeria, Lebanon, Spain and Italy (Akgül, 1993)

The origin of fenugreek is in the Mediterranean Region and Asia. It is among the oldest of medicinal and aromatic plants. Its seed was a popular cure-all in ancient Egypt and India and later on among the Greeks and Romans. Their special nutritive characteristics and flavour. The seeds of fenugreek are used as spices and as the coating of pastrami. Fenugreek tea was prescribed for bronchitis, sore throat, tuberculosis, flagging sexual desire and as a

general tonic. Also if its tea is taken internally, it is effective for relieving gas pains. In addition to these, some experimental data suggest that extracts of the seeds do lower blood sugar level (Ferguson, 1997). Fenugreek seeds include saponin, which produces diosgenin as a result of hydrolization constant oil, mucilage, trigonellin, protein, kolin, nicotinamide and small amount of essential oil (Akgül, 1993).

Fenugreek is sown in autumn in worm regions and it is sown in spring time from at the beginning of March to the end of April in cold regions. In practice, there is no registered cultivar of fenugreek in Turkey so far. In recent years, some studies have been done in order to obtain inbred lines, finally to register new cultivars. We have been working for last ten years on productivity and yield of the fenugreek, on the other hand to improve new cultivar that has resistance against cold conditions. So far 7 fenugreek lines that have good performance regarding seed yield and cold resistance have been obtained in our department

The aim of this study was to determine yield and yield components of inbred fenugreek lines in spring and winter sowing times comparative with a standard variety. in coming years, some of these lines wil1 be registered, especially for winter resistance.

MATERIALS AND METHODS

This research was carried out at the University of Ankara, Faculty of Agriculture, experimental fields of the Department of Field Crops during 1997-1998. in this study, seven fenugreek-inbred lines and a standard variety were used as a material. These lines were improved by single plant selection method. Standard variety was obtained from the fenugreek production area

Winter sowing was performed at the end of September in 1997, and spring sowing w as done at the middle of March in 1998. In these experiments, randomised block design was used with three replications. Sowing rate was 4 kg/da and rows were spaced 30 cm apart in both experiments. The experiments were not watered and no fertilizer was given. Climate data related to the research location are shown in Table 1.

Table l. Climate data of the research location in Ankara /Turkey

Months	Rainfall (mm)	Temperature (°C)	Relative humidity (%)
September 1997	0.20	15.8	56.0
October	60.0	12.9	67.0
November	36.9	7.4	73.0
December	65.5	3.6	76.0
January 1998	10.9	2.1	73.0
February	52.8	3.2	69.0
March	45.8	3.9	68.0
April	71.1	13.6	67.0
May	t>4.3	16.0	70.0
June	47.6	20.2	65.0
July	18.0	24.7	53.0

Characters investigated were as follows: plant height, seed yield, biological yield, branch number per plant, pod number per plant, seed number per pod and one thousand seed weight. Plant height, branch number, pod number per plant and seed number per pod values were recorded on 10 plants individually in each plot. Results were subjected to analysis of variance and Duncan's Multiple Range Test in order to find differences among the lines at the 0.05 level.

RESULTS AND DISCUSSION

Plant Height: Plant height among the lines ranged between 60.70-76.90 cm in spring sowing and 68.57-91.33 cm in winter sowing (Table 2). Statistically differences were occurred among the lines in spring sowing. Plant height of all inbred lines was higher than the standard in both sowing times. Winter sowing affected plant height in all fenugreek lines and Standard variety between ratios of 6.89-28.58 %.

Table 2. Changing of plant heights (cm) in winter sowing according to spring sowing

Lines	Spring sowing	Winter sowing	Changing ratio (%)
Line - 1	68.73 bc*	82.63	20.22
Line - 2	76.90 a	82.20	6.89
Line - 3	71.03 b	91.33	28.58
Line - 4	70.73 b	76.83	8.62
Line - 5	68.63 bc	77.20	12.49
Line - 6	69.23 bc	78.17	12.91
Line - 7	65.43 c	80.07	22.38
Standard	60.70 d	68.57	12.97
Average	68.92	79.63	15.54

*Mean values followed by the different letters are significant at the 0.05 level

Banafar and Nair (1992) reported that maximum plant height in fenugreek was 117 cm. in another study performed in Turkey, plant height was found between 46.07 - 50.94 cm (Sade et al. 1994). Mean values obtained in our study were in between the results of previous researches.

Seed Yield: Seed yield values changed from 40.13 kg/da to 73.23 kg/da in spring sowing and ranged between 86.70 - 137.00 kg/da in winter sowing (Table 3). Differences among lines were found statistically significant in both sowing times. In winter sowing, all lines are in the same statistically group except Line - 2. Lines formed four different groups in spring sowing. Inbred fenugreek lines had higher seed yield than the standard variety. Seed yield is very important character in fenugreek. Because, seed is the most important part of the fenugreek for different usage purposes.

Table 3. Changing of seed yields (kg/da) in winter sowing according to spring sowing

Lines	Spring sowing	Winter sovvmg	Changing ratio (%)
Line - 1	54.03 be*	128.07 ab	137.03
Line - 2	60.67 b	124.30 b	104.88
Line - 3	50.70 c	131.37 ab	159.11
Line - 4	56.57 be	130.37 ab	130.46
Line - 5	50.20 c	125.93 ab	150.86
Line - 6	73.23 a	130.77 ab	78.57
Line - 7	62.90 b	137.00 a	117.80
Standard	40.13 d	86.70 c	116.05
Average	56.05	124.31	121.78

*Mean values followed by the different letters are significant at the 0.05 level

Winter sowing caused high amount of seed increasing in all lines. Seed yield increasing ratios changed between 78.57 - 159.10 %. Average seed yield was 124.31 kg/da in winter sowing while it was 56.05 kg/da in spring sowing. This means that average increasing ratio was 121.78%.

Date related to seed yield in fenugreek were obtained as follows: 60.4 - 66.4 kg/da (Rao et al. 1983), 122.6- 171.7 kg/da (Sharma and Bhatı, 1987), 89.1 - 102.3 kg/da (Maliwal and Gupta, 1989), 155.0 - 173.0 kg/da (Detroja et al. 1996) and 132.0 - 220.1 kg/da (Ayanoğlu and Mert, 1999). Spring sowing values in our study were lower than the previous researches data except that of Rao et al (1983). But there was a similarity between previously published data and seed yield values in winter sowing.

Biological Yield: Biological yield values of lines changed between 212.4 - 308.0 kg/da in spring sowing and 305.9 - 434.0 kg/da in winter sowing (Table 4). There were statistically significant differences among the lines in both sowing times. The lines and standard were formed 4 different groups in spring sowing and 3 groups in winter sowing. Inbred lines had good performance more than standard variety regarding biological yield.

Table 4. Changing of biological yields (kg/da) in winter sowing according to spring sowing

Lines	Spring sowing	Winter sowing	Changing ratıo (%)
Line - 1	289.7 ab*	430.4 a	48.56
Line - 2	280.9 b	421.3 a	49.98
Line - 3	286.8 b	434.0 a	51.33
Line - 4	222.1 d	383.9 b	72.85
Line - 5	248.7 c	384.0 b	54.40
Line - 6	308.0 a	382.5 b	24.18
Line - 7	281.6b	431.9 a	53.37
Standard	212.4d	305.9 c	44.02
Average	266.3	396.8	40.00

*Mean values folowed by the different letters are significant at the 0.05 level

If sowing times compared, winter sowing resulted in an increase in biological yield. Increasing ratio changed between 24.18 - 72.85 %. According to average biological yield, there was a 130.5 kg/da difference between sowing times.

In other studies, biological yield was recorded as 447.7 kg/da by Bhati et al (1988) and 218.5 - 343.4 kg/da by Arslan et al (1989). Winter sowing results showed agreement with Bhafi et al's record, while spring values had similarity with Arslan et al's data. Biological yield is affected by means of many factors such as irrigation, fertilization, amount of precipitation, temperature and so on. Because of this, yield values may change by researches.

Branch Number: Branch number values was between 1.67 - 2.60 m spring sowing and 1.67 - 2.27 in winter sowing. There was no significant difference among the lines in both sowing times. The average number of branches per plant was 2.08 and 1.99, respectively (Table 5).

Table 5. Changing of branch numbers in winter sowing according to spring sowing

Lines	Spring sowing	Winter sowing	Changing ratıo (%)
Line - 1	2.10	1.67	-20.48
Line - 2	1.67	2.27	35,93
Line - 3	2.10	2.22	5,71
Line - 4	1.87	2.07	10.69
Line - 5	2.20	1.77	-19.55
Line - 6	2.60	2.27	-12.69
Lıne - 7	2.23	1.90	-14.80
Standard	1.87	1.77	-5.35
Average	2.08	1.99	-4.33

Increasing ratio in branch number ranged between -20.48 % and 35.93 %. Average increasing ratio was -4.33 % that means number of branch decrease slightly m winter sowing. The number of branches decreased in lines and Standard except for Line - 2 and Line - 4.

The number of branch values were recorded in previous studies as 3.58 - 5.66 (Ayanoğlu and Mert, 1999), 5.22 - 5.66 (Mert and Kırıcı, 1998) and 2.32 - 3.13 (Özdemir and Gürbüz, 1998). The results of this research were lower than the previous data. in our experiments, sowing rates were 4 kg/da that caused high amount of plant density. This may be caused decreasing the number of branches in both sowing times compared with the results of other researches.

Pod Number Per Plant: The pod number per plant of fenugreek lines varied between 9.90 - 12.53 in spring sowing and 11.20 - 14.27 in winter sowing. Differences among the lines were not significant in both sowing times. The average pod number per plant was 11.26 m spring sowing and 12.41 in winter sowing (Table 6).

Table 6. Changing of pod number per plant in winter sowing according to spring sowing

Lines	Spring sowing	Winter sowing	Changing ratio (%)
Line - 1	9.90	11.20	13.13
Line - 2	11.60	14.27	23.02
Line - 3	11.87	11.95	0.68
Line - 4	11.23	11.73	4.45
Line - 5	12.10	13.07	8.02
Line - 6	12.53	14.03	11.97
Line - 7	10!27	11.27	9.74
Standard	10.57	11.77	11.35
Average	11.26	12.41	10.21

Pod number per plant increased in all lines and Standard variety in winter sowing. Increasing ratio changed between 0.68 % and 23.02 %. Average increasing ratio was 10.21 %. The number of pod per plant is one of the most important traits that affects seed yield in fenugreek (Mali and Swalka, 1987). Because of this, winter sowing has more advantage than spring sowing in order to obtain more seed yield.

The results of our research showed similarities with the data of Özdemir and Gürbüz (1998) having pod number of 11.20 - 15.00. However, pod number would have been higher if the sowing rate had been lower than 4 kg/da. Because, plant density affects branch number and pod number per plant.

Seed Number Per Pod: The seed number per pod values were determined between 11.63 - 14.10 in spring sowing and 11.47 - 13.53 in winter sowing. There was no significant difference among the lines in both sowing times (Table 7). Standard variety showed similar results with those of the inbred lines in this trait. Average seed number per pod value was 12.97 in spring sowing and 12.44 in winter sowing and difference between them was not significant.

Table 7. Changing of seed numbers per pod in winter sowing according to spring sowing

Lines	Spring sowing	Winter sowing	Changing ratio (%)
Line - I	13.53	11.50	-15.00
Line - 2	14.10	12.63	-10.42
Line - 3	11.63	13.03	12.04
Line - 4	13.13	13.53	3.05
Line - 5	13.13	13.10	-0.23
Line - 6	12.20	11.47	-5.98
Line - 7	12.83	11.87	-7.48
Standard	13.12	12.40	-5.48
Average	12.97	12.44	-4.09

Increasing ratios of seed number per pod changed between -15.00 % and 12.04 %. The average increasing ratio was -4.09 % that means seed number per pod decreased no significantly in winter sowing. The important increasing of one thousand seed weight in winter sowing may be caused decreasing of seed number per pod.

The results of this research showed similarities with the results of Ayanoğlu and Mert, 1999(11.61 - 15.23) and Mert and Kırıcı, 1998(14.30- 15.22).

One Thousand Seed Weight: Statistically, there were significant differences among the lines in winter sowing but no significant differences in spring sowing ($P < 0.05$). One thousand seed weight values ranged between 13.77 - 16.68 g in spring sowing and 16.86 - 21.44 g m winter sowing. One thousand seed weight of Standard variety was lower than the all inbred lines in both sowing times. The average values were 15.10 g in spring sowing and 19.18 g in winter sowing (Table 8).

Table 8. Changing of one thousand seed weights (g) in winter sowing according to spring Sowing

Lines	Spring sowing	Winter sowing	Changing ratio (%)
Line - 1	14.49	18.75 de*	29.39
Line - 2	15.49	19.36 cd	24.98
Line - 3	15.87	20.36 b	28.29
Line - 4	14.64	18.31 e	25.07
Line - 5	14.76	18.62 de	26.15
Line - 6	15.14	19.75 bc	30.44
Line - 7	16.68	21.44 a	28.54
Standard	13.77	16.86 f	22.44
Average	15.10	19.18	27.02

*Mean values fo lowed by the different letters are significant at the 0.05 level

Increasing ratios of one thousand seed weight in fenugreek lines varied between 22.44 % and 30.44 %. The average ratio was 27.02 % that means one thousand seed weight was affected positively by winter sowing. Also increasing of this trait affected seed yield positively in winter sowing.

The results of this research were higher than the values of 11.70 - 13.39 g reported by Sharma and Bhati, (1984). However, they showed similarities with the results of Ayanoğlu and Mert, 1999 (12.23 - 18.58 g) and Özdemir and Gürbüz, 1998 (14.80 - 19.60 g).

As a result, especially seed yield and one thousand seed weight were affected positively by winter sowing. The increasing ratio of seed yield was 121.78 % in winter sowing; because of this, winter sowing should be preferred in suitable conditions in fenugreek production. in Turkey, fenugreek is sown generally in early spring. Especially line - 7 in our inbred fenugreek lines showed good performance in winter sowing regarding seed yield and one thousand seed weight without irrigation and fertilization. In the future we will emphasise for registration of Line-7 as variety.

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