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Evaluation of Lentil (*Lens Culinaris* Medik.) Local Varieties in Southeastern Anatolia, Turkey

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Abstract

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Grain yield potential in relation to other important agronomic characters of 14 lentil (*Lens culinaris* Medik.) lines during four years was investigated to identify the high yielding promising lentil lines for further studies. Days to maturity ranged from 170 to 178 days. Plant height varied from 26.38 to 33.81cm. One thousand seed weight varied between 41.39 and 30.10 g with mean of 35.43 g. Number of pods plant⁻¹, biological yield plant⁻¹, seed yield plant⁻¹, and grain yield were found susceptible to environmental differences due to cultivar x year interaction. BM 76 among fourteen cultivars/lines was selected as a promising line in respect of seed weight, early maturing, and high yielded.

Key words: lentil, *Lens culinaris*, yields, yield components

Introduction

Lentil (*Lens culinaris* Medik) is a major grain legume crop in Turkey, and Turkey is one of the most important producers of lentil in the Mediterranean basin. The annual planted area is about 500 000 ha which constitutes 33.1 % of the total area under pulses. The annual lentil production is about 548 000 t, which is sufficient to meet local demand in the country and to export other countries.

The average seed yield of 10 960 kg/ha is considered higher than those of

the World are (FAO, 2003). Presently, this pulse is mainly cultivated in marginal areas of country.

Lentil had widely grown Southeastern Anatolia of Turkey from 1980 to 1990 due to Project of Decreased of non Cultivated Area. Planted areas of this crop have decreased in recent decades in the region due to irrigated areas. However, lentil still is important in dry areas. There are some problems such as lack of high and stable yielding cultivars. Particularly, lentil producers suffer from low seed yield during dry period in some years. Consequently,

we need to develop either new cultivars or to breeding old cultivars. Present study aimed to develop new cultivars from with high yielding old cultivars for this region. Although seed yield is the primary objective in most lentil breeding programs, knowledge on plant morphology for varieties of lentil is crucial in understanding the responses of the crop to growing conditions and in developing agronomic strategies to manage the crop. We were evaluated both yield and its components in this research. Pandey and Srivastava (1982) reported that genotype x environment interaction was significant for grain yield. Erskine (1985) revealed that, in 4500 lentil germplasm at Syria, days to flowering ranged from 118 to 162 days, and days to maturity varied from 154 to 197 days. He noted that grain yield varied from 10 to 3257 kg/ha. Mia et al. (1986) evaluated 200 lentils from different countries, and suggested that wide range variability existed among their lentil lines for seed yield plant⁻¹, 1000 seed weight, plant height, days to flowering and maturity. Zaman et al. (1989) stated that 1000 seed weight varied from 14.0 to 28 g. In addition, they noticed that seed yield plant⁻¹ ranged from 1.7 to 4.1 g at Bangladesh. Piergiovanni et al. (1998) who on analyzing a lentil collection from some European, Asian and African countries reported that the Mediterranean was the region with the highest variation for some agro/morphological traits. Stoilova Pereira (1999) were evaluated 120 lentil accessions were of different geographical origin reported that no of pods plant⁻¹ and no of seeds plant⁻¹ were showed remarkable variation. Sarker et al. (2000) reported that lentils, from Chili, took 132 days for flowering, and plant height had 31 cm. L'azaro et al. (2001) studied Spanish landraces of lentil in Spain, and

they were reported that means of days to flowering and days to maturity were 177.8 and 226.7 days, respect, and quantitative characters are susceptible to environmental differences. Hamdi et al. (2002) indicated that differences among genotype, location and genotype x location interaction were significant for grain yield and 1000 seed weight. In addition, Hamdi et al. (2003) reported that the environments (season and location) showed major effects the performance of genotypes.

Materials and Methods

The study was carried out at experimental area of Faculty of Agriculture, University of Dicle in Diyarbakir, Turkey, during 2001/2002, 2002/2003, 2003/2004 and 2004/2005 years. The soil of experimental area was clay loam, alkali, poor in organic matter. Meteorological data related to research area were given Table 1. According to Table 1, the weather from February to May over four years was rainy, and the rainfall, particularly in 2001 and 2003, was more than the long-term average. Moreover, the May 2001 and 2004 was rainier than the long-term average and other experiment years.

Two registered lentil cultivars (Firat 87 and Local Red) as control, one lentil line F8753L, originated ICARDA, and eleven lentil genotypes, from South-eastern Anatolia, were used in the study. While lentil lines from Southeastern Anatolia were formerly mixed population, it was developed it through selection of pure line.

Seeds were sown by seed drill 6 row plots of 4 m length, with 20 cm between the rows and 2.5 cm between plants. The experimental design was a randomized complete block (RCBD) with four replicates. Sowing was performed Nov.14,

Table 1
Rainfall (mm), temperature ($^{\circ}$ C) and humidity (%) distribution during crop seasons at Diyarbakir, Turkey

Months		Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
Long term average	Rainfall	30.8	54.6	71.4	74.6	68.4	66.2	73.5	40.8	7.2
	Temp.	17.1	9.8	4.1	1.6	3.6	8.3	13.9	19.3	25.9
	Humidity	48	68	77	77	73	66	63	56	36
2001-2002	Rainfall	67	52.3	131.7	31.2	46.1	73	65	34.9	1.3
	Temp.	16.3	7	5.1	0.7	5.6	9.4	12.2	17.9	26.3
	Humidity	50.7	61	82	77	58	64	69.4	48.8	29.7
2002-2003	Rainfall	15.7	36.6	74.1	68.4	151.8	80.7	80.6	5.4	26.9
	Temp.	18.6	10.2	11.3	4	2,5,0	6.5	13.4	20.4	26.4
	Humidity	41.9	55.3	71	78	75.8	64.5	66.1	45	24.5
2003-2004	Rainfall	33.3	62.5	87.9	85.1	93.4	9.3	54.9	97	16
	Temp.	19	8.8	8.7	3.3	2.7	9.6	12.8	18	26.4
	Humidity	40	67.7	76.1	81.9	79.6	5.4	49.6	54	23.3
2004-2005	Rainfall	1.3	123.1	4.7	58.7	46.8	58.4	36.8	26.5	33.1
	Temp.	18.2	8.2	1.4	2.3	3	8.4	14.1	19.6	25.8
	Humidity	41.2	69.4	59.9	66	61.7	53.3	51.9	44	11

Sources: State Meteorology Institute (Diyarbakir, Turkey)

2001, Jan.5, 2002, Nov.21, 2003, and Dec. 5, 2004. Days to 50% flowering and maturity from sowing onwards harvest were recorded. Plant height, number of pods plant⁻¹, number of seeds plant⁻¹, seed yield plant⁻¹, 1000 seed weight, biological yield plant⁻¹ were determined in ten plants randomly selected from each plot. Grain yield data is presented on per kg/da. Both years and combined analysis of variance over years were performed. MSTATC program was used to carry out statistical analysis. Means showing significance statistically were compared using Least Significance Difference (LSD) Test at 0.05 or 0.01-probability level related to significance level of means.

Results and Discussion

A combined analysis of variance for 14 lentil cultivars/lines over four years for days to flowering and maturity indicated that year, cultivar, and cultivar x year interaction were significant. Moreover, differences among the cultivars for each year were also significant for these characters. Analysis indicated that the BM 76 was found the earliest genotype with mean of 133 days, BM 201 with mean of 141 days was found the latest line among others (Table 2). Our findings agree with Erskine (1985) who found days to flowering ranged from 118 to 162 days. L'azaro et al. (2001) reported that this period was 177.8 days

Table 2
Mean values for days to flowering and maturity in lentil lines

Cultivars Lines	Days to 50% flowering (days)					Days to maturity (days)					Mean
	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005	
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	
Firat 87	106.0 wx*	159.5 b-d	149.0 f-h	143.8 lm	139.6 b	143.8 r	194.5 a-d	196.0 ab	180.0 lm	178.6 a	
BM 76	97.25 z	157.0 e	144.8 kl	134.0 s	133.3 f	134.0 u	182.0 kl	191.5 e-g	173.3 q	170.2 e	
BM 498	111.3 tu	159.5 b-d	148.5 g-?	141.3 no	140.1 ab	143.8 r	190.0 f-h	196.3 a	180.5 lm	177.6 a	
Local red	111.5 tu	161.8 a	150.5 f	134.0 s	139.4 b	145.0 r	194.8 a-d	196.8 a	175.8 o-q	178.1 a	
BM 711	109.0 v	160.0 a-c	150.3 fg	143.5 lm	140.7 a	142.8 r	183.5 jk	193.3 be	178.0 m-o	174.4 bc	
BM 479	106.5 w	157.0 e	146.8 ?j	141.5 no	137.9 c	138.0 s	185.3 ?j	195.3 a-d	176.8 n-p	173.8 c	
BM 500	100.0 z	157.0 e	144.8 kl	136.8 qr	134.6 e	134.0 u	183.8 jk	194.5 a-d	174.8 pq	171.8 d	
BM 760	109.8 uv	159.8 bc	149.0 f-h	142.5 mn	140.3 ab	144.0 r	192.5 d-f	195.5 a-c	179.0 mn	177.8 a	
BM 34	102.5 yz	157.8 de	144.5 kl	136.3 r	135.3 e	134.8 tu	185.8 ?j	192.8 c-f	173.0 q	171.6 de	
BM 152	105.8 wx	157.5 e	146.0 jk	138.5 pq	136.9 d	137.3 st	184.8 ?-k	189.5 gh	173.3 q	171.2 de	
F8753 L	104.3 xy	158.3 c-e	145.8 jk	140.3 op	137.1 cd	136.8 s-u	185.8 ?j	191.5 e-g	173.3 q	171.8 d	
BM 601	110.0 uv	159.5 b-d	149.3 f-h	144.5 kl	140.8 a	138.8 s	187.5 h?	195.3 a-d	179.8 lm	175.3 b	
BM 499	101.3 z	157.0 e	144.8 kl	136.0 r	134.8 e	134.5 tu	182.0 kl	193.3 be	175.5 o-q	171.3 de	
BM 201	112.3 t	160.3 ab	148.0 h?	143.5 lm	141.0 a	142.8 r	190.8 e-g	194.8 a-d	143.5 r	167.9 f	
Mean	106.2 d	158.7 a	147.3 b	139.7 c	137.98	139.3 d	187.3 b	194.0 a	174.0 c	173.66	
CV	1.77	0.81	0.57	0.68	0.95	1.11	1.8	0.84	0.43	1.19	
LSD5%	2.691**	1.836**	1.210**	1.368**	0.912**	2.202**	4.834**	2.329**	1.062**	1.440**	
	y: 0.752**	yc: 1.824**				y: 0.614**	yc: 2.879**				

*: Values followed by the same letter, for each measured variable within each column, do not differ significantly at the 0.05 level of probability (LSD), y: year, yc: year x cultivar interaction

Table 3
Mean values for plant height and number of pods plant⁻¹ in lentil lines

Cultivars Lines	Plant height (cm)					Number of pods plant ⁻¹				
	2001 2002	2002 2003	2003 2004	2004 2005	Mean	2001 2002	2002 2003	2003 2004	2004 2005	Mean
Firat 87	38.25	25.75 d *	31.25 a-d	32.75 a	32.00 ab	28.13 d-?	15.63 o-s	21.02 f-r	29.43 c-g	23.55 a-e
BM 76	34.75	25.25 d	27.50 ef	28.25 c	28.94 ce	18.70 j-s	13.50 p-s	21.65 f-q	29.05 c-g	20.73 d-f
BM 498	34.5	26.75 c	33.00 a	29.00 b	30.81 bc	21.93 f-p	19.75 h-r	28.20 d-?	22.33 f-p	23.05 a-e
Local Red	38.5	26.75 c	32.50 ab	28.25 c	31.50 b	22.68 f-o	20.55 g-r	19.17 ?-s	28.50 d-h	22.73 b-f
BM 711	34.5	29.50 a	28.75 c-e	28.25 c	30.25 b-d	16.58 l-s	14.50 o-s	16.98 l-s	28.85 c-g	19.23 ef
BM 479	31.75	23.75 de	27.50 ef	29.00 b	28.00 ef	14.82 o-s	12.30 rs	22.52 f-p	28.73 d-h	19.59 ef
BM 500	32	22.75 e	27.50 ef	25.25 c	26.88 f	22.98 f-o	17.45 k-s	28.45 d-h	33.22 b-e	25.52 a-c
BM 760	40	28.50 ab	32.25 a-c	34.50 a	33.81 a	39.83 b	15.85 n-s	17.75 k-s	26.38 d-k	24.95 a-d
BM 34	33.5	22.25 ef	23.50 g	27.50 c	26.69 f	25.27 e-m	10.15 s	25.63 d-l	48.97 a	27.51 a
BM 152	32.5	20.50 f	27.75 d-f	25.25 c	26.50 f	33.05 de	12.60 q-s	29.52 c-g	33.53 be	27.17 ab
F8753 L	33.75	24.25 de	28.50 de	28.75 b	28.81 de	27.92 d-?	15.73 o-s	20.50 g-r	34.63 b-d	24.69 a-d
BM 601	37.25	23.00 e	29.50 a-e	27.50 c	29.31 c-e	20.48 g-r	14.15 o-s	16.27 m-s	22.35 f-p	18.31 f
BM 499	32.5	22.25 ef	24.50 fg	26.25 c	26.38 f	27.15 d-j	15.38 o-s	24.88 e-n	37.85 bc	26.31 a-c
BM 201	36.25	23.75 de	29.00 b-e	27.00 c	29.00 c-e	20.85 f-r	14.73 o-s	21.88 f-p	29.67 c-f	21.78 c-f
Mean	35.00 a	24.64 c	28.786 b	28.39 b	29.205	24.31 b	15.16 c	22.46 b	30.96 a	23.223
CV%	11.04	6.22	8.59	8.29	9.21	27.03	20.48	27.44	28.7	28.05
LSD5%		2.191**	3.535**	3.366**	1.878**	9.398*	4.440**	8.816*	12.71*	4.550**
	y: 1.963**					y: 3.408**	yx:9.10**			

*: Values followed by the same letter, for each measured variable within each column, do not differ significantly at the 0.05 level of probability (LSD), y:year, yxc: year x cultivar interaction

Table 4
Mean values for number of seeds plant⁻¹ and biological yield plant⁻¹ in lentil lines

Cultivars Lines	Number of seeds plant ⁻¹					Mean	Biological yield plant ⁻¹ , g					Mean
	2001 2002	2002 2003	2003 2004	2004 2005	2005		2001 2002	2002 2003	2003 2004	2004 2005	2005	
Firat 87	33.35 d ⁻¹	21.25 m-t	30.92 e-o	37.10 c-j	30.66	3.093 c-h	1.726 l-r	2.487 g-l	3.098 c-h	2.601		
BM 76	27.88 g-s	17.27 st	27.85 g-s	36.88 c-k	27.47	2.788 c-k	1.534 o-r	2.423 h-o	3.406 c-f	2.538		
BM 498	39.55 b-g	25.20 k-s	34.85 c-l	29.97 e-q	32.39	3.581 bc	2.016 j-q	3.155 c-h	2.441 h-n	2.798		
Local Red	25.45 j-s	27.95 g-s	27.92 g-s	40.42 a-f	30.44	3.396 c-f	2.111 i-p	2.523 f-l	3.044 c-h	2.769		
BM 711	25.80 i-s	19.50 o-t	25.30 j-s	36.95 c-k	26.89	2.518 f-l	1.593 m-r	1.935 k-q	3.105 c-h	2.287		
BM 479	23.30 l-t	18.80 p-t	31.92 d-n	36.13 c-k	27.54	2.121 i-p	1.493 p-r	2.519 f-l	3.125 c-h	2.314		
BM 500	26.63 h-s	21.13 m-t	32.53 d-m	40.42 a-f	30.17	2.688 d-k	1.721 l-r	3.150 c-h	3.419 c-e	2.744		
BM 760	52.10 a	19.63 o-t	27.80 g-s	30.15 e-p	32.42	4.419 ab	2.094 i-p	2.354 h-p	2.833 c-j	2.925		
BM 34	31.47 e-n	11.52 t	30.10 e-q	50.02 ab	30.78	2.739 c-k	0.869 r	3.107 c-h	4.664 a	2.845		
BM 152	41.00 a-e	18.30 q-t	38.85 b-g	43.45 a-d	35.4	3.349 c-g	1.176 qr	2.713 c-k	2.791 c-k	2.507		
F8753 L	31.65 d-n	20.60 n-t	29.13 f-r	46.10 a-c	31.87	2.829 c-j	1.674 l-r	2.461 g-m	3.489 c-e	2.613		
BM 601	28.65 f-s	18.67 p-t	23.97 l-s	31.83 d-n	25.78	3.432 c-e	1.515 p-r	2.006 j-q	2.623 e-k	2.394		
BM 499	37.85 c-h	18.02 r-t	29.23 e-r	39.28 c-g	31.09	3.546 b-d	1.471 p-r	2.822 c-k	3.482 c-e	2.83		
BM 201	30.82 e-o	20.77 m-t	34.75 c-l	37.60 c-l	30.99	3.042 c-h	1.549 n-r	2.868 c-j	2.967 c-l	2.607		
Mean	32.54 b	19.90 c	30.37 b	38.31 a	30.278	3.110 a	1.610 c	2.609 b	3.178 a	2.627		
CV%	27.36	19.42	29.73	27.61	28	24.16	21.25	24.86	23.01	24.35		
LSD5%	12.73**	5.529**				1.074**	0.489**		1.046*			
	y: 4.073**	yc:11.84**				y:0.2943**	yc:0.8933**					

Table 5
Mean values for seed yield plant⁻¹ and grain yield in lentil lines

Cultivars Lines	Seed yield plant ⁻¹ , g						Grain yield, kg/ha					
	2001	2002	2003	2004	2005	Mean	2001	2002	2003	2004	2005	Mean
	2002	2003	2004	2005	2005	Mean	2002	2003	2004	2005	2005	Mean
Firat 87	1.196 c-l*	0.843 j-q	1.035 f-p	1.331 c-h	1.101 a-d	1.101 a-d	1899 c-k	979.7 s-u	2154 a-e	1762 f-m	1699 b-e	1699 b-e
BM 76	1.079 f-p	0.763 m-r	1.150 c-n	1.559 bc	1.138 a-c	1.138 a-c	2357 a	1147 p-t	2264 ab	1846 d-k	1903 a	1903 a
BM 498	1.153 c-n	0.931 h-q	1.254 e-j	0.844 j-q	1.046 a-d	1.046 a-d	1775 f-m	912.3 s-u	1998 b-g	1425 m-q	1528 e	1528 e
Local Red	1.128 d-o	0.929 h-q	0.891 i-q	1.362 c-g	1.078 a-d	1.078 a-d	1584 j-o	1076 q-u	1745 f-m	1712 g-m	1529 e	1529 e
BM 711	0.961 g-q	0.738 n-r	0.816 k-q	1.207 c-l	0.930 cd	0.930 cd	1769 f-m	1027 r-u	1854 d-k	1602 i-o	1563 de	1563 de
BM 479	0.899 i-q	0.712 o-r	1.112 e-o	1.219 c-k	0.985 b-d	0.985 b-d	2006 a-g	1257 o-s	1865 d-k	1822 e-l	1737 a-d	1737 a-d
BM 500	1.032 f-p	0.807 k-q	1.397 e-f	1.540 b-d	1.194 ab	1.194 ab	2192 a-d	1151 p-t	2276 ab	1359 n-r	1745 a-c	1745 a-c
BM 760	1.899 ab	0.837 j-q	0.961 g-q	1.129 d-o	1.206 a	1.206 a	1900 c-k	992.1 s-u	1952 b-l	1687 g-n	1633 b-e	1633 b-e
BM 34	1.110 e-o	0.384 r	1.235 c-j	2.011 a	1.185 ab	1.185 ab	2262 ab	965.1 s-u	1486 l-p	1744 f-m	1614 b-e	1614 b-e
BM 152	1.326 c-h	0.570 qr	1.276 c-l	1.209 c-l	1.095 a-d	1.095 a-d	2080 a-f	901.3 tu	2170 a-e	1639 h-n	1698 b-e	1698 b-e
F8753 L	1.200 c-l	0.791 l-r	1.168 c-m	1.830 ab	1.247 a	1.247 a	2177 a-d	1016 r-u	2185 a-d	1752 f-m	1783 ab	1783 ab
BM 601	1.121 d-o	0.689 p-r	0.803 k-r	1.064 f-p	0.919 d	0.919 d	1752 f-m	766.4 u	2228 a-c	1562 k-o	1577 c-e	1577 c-e
BM 499	1.517 b-e	0.685 p-r	1.200 c-l	1.503 b-e	1.226 a	1.226 a	2024 a-g	974.4 s-u	1930 b-j	1695 g-n	1656 b-e	1656 b-e
BM 201	1.112 e-o	0.720 o-r	1.222 c-k	1.163 c-m	1.054 a-d	1.054 a-d	1947 b-l	850.8 tu	1967 b-h	1631 h-n	1599 c-e	1599 c-e
Mean	1.195 b	0.743 c	1.109 b	1.355 a	1.1	1.1	1980 a	1001 c	2005 a	1660 b	1662	1662
CV%	26.62	23.08	26.91	27.67	27.27	27.27	26.62	19.46	14.6	16.56	15.17	15.17
LSD5%	0.454**	0.244**		0.5371**			335.4**	418.7**				
	y: 0.147**	yc:0.419**			0.2095*		y: 13.93**	yc:35.21**				17.61**

*: Values followed by the same letter, for each measured variable within each column, do not differ significantly at the 0.05 level of probability (LSD), y: year, yc: year x cultivar interaction

Table 6
Mean values for 1000 seed weight in lentil lines

Cultivars Lines	1000 seed weight				
	2001 2002	2002 2003	2003 2004	2004 2005	Mean
Firat 87	34.00 m-q*	37.19 gh	33.65 m-s	34.16 m-q	34.75 d
BM 76	41.17 a-c	40.78 a-d	41.94 a	41.66 ab	41.39 a
BM 498	32.58 p-t	34.34 l-p	32.84 o-t	32.07 rst	32.96 e
Local Red	33.32 n-t	33.72 m-s	32.44 q-t	32.70 p-t	33.04 e
BM 711	34.90 j-n	32.73 p-t	31.77 t	31.78 t	32.80 e
BM 479	32.38 q-t	34.35 l-p	33.19 n-t	31.58 t	32.87 e
BM 500	39.38 c-e	37.67 e-g	41.44 ab	36.99 g-l	38.87 b
BM 760	35.24 i-m	40.06 b-d	36.13 g-l	37.22 gh	37.16 c
BM 34	34.59 k-o	37.05 g-l	39.97 d	36.49 g-j	37.03 c
BM 152	27.78 u	31.57 t	31.99 r-t	29.05 u	30.10 f
F8753 L	36.30 g-k	40.64 a-d	40.91 b-d	35.46 h-m	38.33 b
BM 601	35.22 i-m	39.53 cd	31.94 st	33.82 m-r	35.13 d
BM 499	37.44 fg	39.27 d-f	41.60 a-d	36.12 g-l	38.61 b
BM 201	32.32 q-t	32.52 p-t	34.11 m-q	33.30 n-t	33.06 e
Mean	34.76 b	36.53 a	35.99 a	34.46 b	35.435
CV%	3.76	4.33	2.91	3.76	3.73
LDS 5%	1.867**	2.262**	1.499**	1.851**	0.9225**
	y:0.6043**	yx:1.845**			

*: Values followed by the same letter, for each measured variable within each column, do not differ significantly at the 0.05 level of probability (LSD), y: year, yxc: year x cultivar interaction

in Spain. The maximum time taken to seed maturity was by Local red and Firat 87 (178 days), whereas the genotype BM 76 to seed maturity took 170 days. Opposite our findings, Sarker et al. (2000), and L'azaro et al., (2001) reported that this period was taken 132 and 226.7 days, respect, for in their lentil lines. This variation may also be due to the genetic and climatic factors. According to combined analyze over four years, difference between the earliest and the latest maturing

genotypes was about one week. This result is of a great importance for drought stress that caused severely losses of yield in some years in dry areas as Southeastern Anatolia region, Turkey. In 2000 growing season, these characters were showed lower values than other years, since experiment could be performed on 15 January due to extremely rainfall. Cultivars which grown widely in the region, were matured later than some lentil lines.

The wide variation for plant height ob-

served among cultivars. Plant height was varied from 26.38 to 33.81 cm. It was determined that BM 34 and BM 499 were the shortest, and BM 760 was the tallest among lentil lines (Table 3). Plant height was highly affected by differences among years, and tallest height among years was obtained from 2001/2002 growing season. Plant height is of a characteristic, which affected by environmental conditions due to its moderate/low heritability. (Chauhan and Singh, 1998; Bicer and Sakar, 2004). Piergiovanni (2000) reported that plant height varied from 28 to 41 cm in their material. Sarker et al. (2000) stated that plant height was record in 31 cm.

Number of pods plant⁻¹ ranged from 18.31 to 27.51. The genotypes BM 34, BM 152, and BM 499 had higher number of pods plant⁻¹ than the population mean (Table 3). Cultivars were responded differentially to years, and in particularly, genotypes, in 2004/2005 experimental season, produced more pods than those of other growing seasons. This character may be susceptible environmental conditions due to low heritability as Stoilova & Pereira (1999) noted.

Differences among genotypes were not significant for number of seeds plant⁻¹, but significant mean squares for cultivar x year interaction suggested that the cultivars behaved differentially with respect to the character over four experiment years (Table 4). Stoilova Pereira (1999) reported that no of seeds plant⁻¹ was showed remarkable variation in their lentil lines.

Biological yield plant⁻¹ ranged between 2.956 and 2.01 g. Cultivar x year interaction were significant. Differences among years was significant, and the analysis showed that the cultivars/lines in the 2001 and 2004/2005 growing seasons were pro-

duce more biological yield (Table 4).

Differences for seed yield plant⁻¹ among both cultivars and years were significant (Table 5). The maximum seed yield plant⁻¹ was record in F 8753L 1.25 g followed by BM 499 and BM 760 (1.20), which were statistically at par with one another. Considerable variation was observed this character as reported Mia et al. (1986) and Piergiovanni et al. (1998). The cultivar x year interaction was significant. These findings indicated that this character might be affected by different environmental conditions. Zaman et al. (1989) reported that seed yield plant⁻¹ ranged from 1.7 to 4.1 g. This result pointed out that seed yield potential in lentil may be varied from cultivar to cultivar.

Grain yield range from 1903 to 1528 kg/ha, and BM 76 had maximum grain yield (Table 5). Erskine (1985) reported that grain yield had a wide variation (from 10 to 3257 kg/ha) in his materials. Cultivars showed highly different responses to years. Cultivar x year interaction was significant. L'azaro et al. (2001) reported that quantitative characters such as grain yield are susceptible to environmental differences Pandey and Srivastava (1982) and Hamdi et al. (2002) reported that genotype x environment interaction for yield was significant.

Seed weight of genotypes varied between 41.39 and 30.10 g with mean of 35.43 g (Table 6). While BM 152 had the lowest seed weight, the highest seed weight among genotypes was for genotype BM 76. Seed weight of lentil lines used in research had higher than that of control groups. Our findings opposite, Zaman et al. (1989) reported that seed weight their materials ranged from 14 to 28 g. This revealed that seed weight varied from cultivar to cultivar. Cultivar x year

interaction was significant. Our finding agrees with Hamdi et al. (2002).

Conclusions

This study revealed that lines were collected from Southeastern Anatolia had wide variability for all characters, especially grain yield and 1000 seed weight. Line of BM 76 is able to choose for grain yield and 1000 seed weight in this region.

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