

# Evaluation of Some Lentil Genotypes at Different Locations in Turkey

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## ABSTRACT

Fourteen lentil (*Lens culinaris* Medik) genotypes were grown in two different locations in South-Eastern Anatolia of Turkey in 2001/2002. The observations were recorded on days to 50% flowering, days to maturity, biological yield per plant, seed yield per plant, plant height, first-pod bearing height, number of branches, pods per plant, seeds per plant, 1000 seed weight and grain yield. Analyses of variance revealed considerable variations for all the traits. Grain yield ranged from 158.4 to 235.7 kg/ha. Genotype x location interactions for biological yield per plant, seed yield per plant, number of pods plant and number of seeds per plant were significant, and for these characters heritability was found low due to high environmental effects. Days to 50% flowering, days to maturity and seed weight appeared to be useful traits because high heritability

**Key Words:** Lentil; Genotype; Yield; Turkey

## INTRODUCTION

Information on genetic variability and heritability is useful to formulate selection criteria for improvement of seed yield. Moderate heritability estimates for time to maturity and seed weight and low heritability for biological yield and seed yield per plant were reported by Rao and Yadav (1988). Chauhan and Singh (1998) reported low heritability estimate for plant height and high heritability estimate for 100 seed weight and this was followed by days to maturity, number of pods per plant, biological yield/plant and seed yield/plant. A phenotype is result of interplay between the genotype and its surrounding environment. A genotype does not exhibit the same phenotypic characteristics under all environments, and different genotypes respond differently to a specified environment (Ahmad & Pandey, 1983). Pandey and Srivastava (1982) reported that genotype x environment interaction was significant for grain yield. Stoilova and Pereira (1999) noted that wide variation was observed in terms of biological yield and number of pods plant. The aim of this work was to estimate variability and heritability of some economically important plant characters and determination of effects of different locations on seed yield and its components in lentil genotypes collected from South-Eastern Anatolia in Turkey, a famous region in lentil production.

## MATERIALS AND METHODS

Fourteen lentil genotypes were tested at two different localities, South-Eastern Anatolia at Turkey during 2001/2002 season. Three checks and 11 lines of lentil (*Lens culinaris* Medik) developed from previously collected

landraces in the Southeast Anatolia of Turkey, were used as experimental material. Within each location the experiment was replicated four times in a randomized completed block design. Each experimental plot was comprised 6 rows, 4m long, with inter-row and intra-row spacing of 20 cm and 2.5 cm respectively. Observations on biological yield per plant, seed yield per plant, plant height, first-pod bearing height, number of branches, pods per plant and seeds per plant recorded on ten plants selected randomly from four central rows of each plot. Days to maturity and days to flowering were recorded on per plot basis. Harvest area was 2.4 m<sup>2</sup> in each plot. Analyses of variance were conducted and means of genotypes over locations were determined for all characters. Variance components were estimated from expected mean squares and heritability of characters were estimated from ratio of genotypic variance to phenotypic variance (Comstock & Moll, 1963). Data were evaluated by MSTATC packet programme.

### Expected mean squares

$$\text{Genotypic variance} = \sigma^2_e + r \sigma^2_{gl} + rl \sigma^2_g$$

$$\text{Genotype x locality variance} = \sigma^2_e + 4 \sigma^2_{gl}$$

$$\text{Phenotypic variance} = \sigma^2_g + \sigma^2_{gl} + \sigma^2_e$$

$$\text{Error} = \sigma^2_e$$

$$\text{Heritability} = \sigma^2_g / \sigma^2_p$$

## RESULTS AND DISCUSSION

Significant differences were observed between genotypes for yield and its components (Table I). Heritability estimates were high for days to 50% flowering (0.83) and days to maturity (0.86). Similar finding was observed for days to maturity by Chauhan and Singh (1998). The genotype x location interaction was non

significant, indicating that these characters were non significantly affected by the environments. The mean days to 50% flowering and days to maturity was 106.7 to 140.8 days over the locations, respectively. The earliest line to flower was BM 76 (97.75 days) and latest line to flower was BM 201 (112.8 days). Days to maturity ranged from 134.3 to 144.8 days.

Biological yield per plant did not differ significantly between locations, but significant mean squares for genotype x locations interaction and genotypes suggested that the genotypes behaved differentially at the two locations with respect to the character (Table II). The highest biological yield per plant was observed in the line BM 760 (4.395 g/plant). Stoilova and Pereira (1999) reported that this character had wide variation. This character was exhibited the lowest heritability (0.08). Similar result was observed by Rao and Yadav (1988).

Differences for seed yield per plant were significant

between genotypes and genotypes x location interaction, indicating that they were responded differentially to environments. Seed yield per plant ranged from 1.05 to 1.92 g/plant. This character had low heritability (0.40). Hamdi *et al.* (2003) reported high variability and high heritability for seed yield per plant in lentil.

Plant height ranged from 34.2 to 40.6 cm, and this character showed low heritability (0.12). Low estimates of heritability for this character in lentil have been reported in previous studies (Dixit & Dubey, 1985; Chauhan & Singh, 1998). The genotype x location interaction was non significant, but genotypes was significant for this character. Genotype BM 760 had taller plants than other genotypes (Table III).

The highest lowest pod height was non significant for genotypes and genotypes x location interaction. The lowest heritability (0.04) was observed for the character.

Number of branches per plant was non affected by

**Table I. Analysis of variance and variance components estimated and heritabilities of some characters on 14 lentil lines at two different locations**

Variation Sources	D.F	DAF	DM	BY/P	SY/P	PH	HLP	B/P	P/P	S/P	SW	GY
Location	1	28.000	246.036**	0.712	0.769*	315.571**	31.080	0.241	589.723*	302.286	19.723*	778.906
Error	6	10.565	0.893	0.385	0.091	31.018	8.914	0.519	65.541	62.756	2.968	2559.233
Genotype	13	175.574**	140.566**	1.567**	0.324**	34.437*	9.704	1.947*	200.581**	216.337*	68.403**	3102.42**
Geno x Location	13	0.038	0.786	1.063*	0.207*	15.879	14.523	0.984	111.276**	188.040*	4.980	455.922
Error	78	3.508	2.258	0.541	0.113	16.435	10.914	0.918	46.926	101.588	5.055	585.139
Cv (%)		1.75	1.07	23.07	26.27	11.02	20.71	27.45	25.74	29.49	6.38	12.39
Variance Components Estimated From Expected Mean Squares Heritability												
Variance	DAF	DM	BY/P	SY/P	PH	HLP	B/P	P/P	S/P	SW	GY	
Genotype	21.074	17.033	0.063	0.091	2.319	0.602	0.121	11.163	3.537	7.909	298.51	
Genotype x year	0.867	0.368	0.13	0.0235	0.139	0.902	0.016	16.087	21.613	0.0187	32.30	
Phenotype	25.449	19.659	0.73	0.227	18.893	12.42	1.055	74.176	126.74	12.98	915.95	
Heritability	0.83	0.86	0.08	0.40	0.12	0.04	0.11	0.15	0.03	0.61	0.32	

DAF = Days to %50 Flowering, DM = Days to Maturity, BY/P = Biological Yield/Plant, SY/P = Seed Yield/Plant, PH = Plant Height, HLP = Highest Lowest Ppod Height, P/P = Pods/Plant, S/P = Seeds/Plant, SW = 100 Seed Weight, GY = Grain Yield

**Table II. Mean values for different characters in lentil lines at two different locations**

Lines/ Cultivars	Days to %50 Flowering			Days to Maturity			Biological yield per plant			Seed yield/Plant		
	Loc. 1	Loc. 2	Means	Loc. 1	Loc. 2	Means	Loc. 1	Loc. 2	Means	Loc. 1	Loc. 2	Means
Firat 87	106.0 d	107.0 d	106.5 de	143.5 ab	147.8 ab	143.5 a-c	3.101 bc	3.806 ab	3.453 b	1.19 bc	1.58 a-c	1.38 b
BM 76	97.25 g	98.25 g	97.75 i	134.5 f	136.5 g	134.5 f	2.788 bc	2.882 b-e	2.835 bc	1.08 bc	1.31 b-e	1.19 b
BM 498	111.3 ab	112.3 ab	111.8 ab	143.5 ab	146.8 a-c	143.5 a-c	3.581 ab	3.540 a-d	3.560 b	1.15 bc	1.25 b-e	1.20 b
Yerli Kırmızı	111.5 ab	112.5 a	112.0 ab	144.8 a	148.3 a	144.8 a	3.396 ab	3.646 a-c	3.521 b	1.13 bc	1.33 b-e	1.23 b
BM 711	109.0 bc	109.8 bc	109.4 c	142.5 b	145.5 c	142.5 c	2.518 bc	3.789 ab	3.154 bc	0.96 c	1.69 ab	1.33 b
BM 479	106.5 cd	107.8 cd	107.1 d	139.3 c	142.3 d	139.3 d	2.121 c	3.118 b-e	2.619 c	0.89 c	1.37 b-e	1.13 b
BM 500	100.0 f	101.0 f	100.5 h	134.3 f	137.3 g	134.3 f	2.688 bc	3.698 a-c	3.193 bc	1.03 c	1.47 a-d	1.25 b
BM 760	109.8 ab	111.0 ab	110.4 bc	144.0 ab	147.0 a-c	144.0 ab	4.419 a	4.371 a	4.395 a	1.89 a	1.95 a	1.92 a
BM 34	102.5 ef	103.5 ef	103.0 fg	134.8 ef	137.8 fg	134.8 f	2.739 bc	3.020 b-e	2.880 bc	1.11 bc	1.35 b-e	1.23 b
BM 152	105.8 d	106.8 d	106.3 de	137.3 cd	140.3 de	137.3 e	3.349 ab	2.728 c-e	3.039 bc	1.33 bc	1.18 c-e	1.25 b
F87 53L	104.3 de	105.3 de	104.8 ef	136.8 de	139.8 ef	136.8 e	2.829 bc	3.034 b-e	2.932 bc	1.20 bc	1.31 b-e	1.25 b
BM 601	110.0 ab	110.8 ab	110.4 bc	138.8 cd	140.3 de	138.8 d	3.433 ab	2.524 de	2.978 bc	1.12 bc	0.98 de	1.05 b
BM 499	101.3 f	102.3 f	101.8 gh	134.5 f	137.5 g	134.5 f	3.523 ab	2.247 e	2.885 bc	1.52 ab	0.92 e	1.22 b
BM 201	112.3 a	113.3 a	112.8 a	142.8 ab	145.8 bc	142.8 bc	3.042 bc	3.354 a-d	3.198 bc	1.11 bc	1.35 b-e	1.23 b
Means	106.23	107.23	106.71	139.36 b	142.32 a	140.84	3.11	3.27	3.19	1.19	1.36	1.28
LSD (5%)	G:2.69**	G:2.66**	G:1.86*	G:2.15**	G:2.24**	G:1.49**	G:1.07*	G:1.02**	G:0.73**	G:0.45**	G:0.50*	G:0.33
									LxG:1.04*			LxG:0.47*

**Table III. Mean values for different characters in lentil lines at two different locations**

Lines/ cultivars	Plant Height			Highest lowest Plant			Branches/Plant			Pods Per Plant		
	Loc. 1	Loc. 2	Means	Loc 1	Loc 2	Means	Loc1	Loc. 2	Means	Loc. 1	Loc. 2	Means
Firat 87	38.25	39.50	38.88 ab	17.00	17.00	17.00	3.85	3.40 a-e	3.62 a-e	28.13 bc	37.18ab	32.65 ab
BM 76	34.75	36.25	35.50 b-d	19.00	14.75	16.87	3.07	3.10 b-e	3.09 b-e	18.70 d-f	25.73cd	22.21 d-f
BM 498	34.50	36.25	35.38 b-d	14.25	16.75	15.50	3.62	4.32 ab	3.97 a-c	21.93 c-f	24.35cd	23.14 d-f
Yerli Kırmızı	38.50	36.75	37.63 a-d	15.25	16.00	15.62	4.05	3.97 a-c	4.01 ab	22.68 c-f	30.65ac	26.66 b-e
BM 711	34.50	34.00	34.25 d	16.25	15.75	16.00	3.87	4.57 a	4.22 a	16.58 ef	31.25ac	23.91 c-f
BM 479	31.75	37.25	34.50 cd	12.75	16.25	14.50	3.40	4.40 ab	3.90 a-c	14.82 f	27.55bd	21.19 ef
BM 500	32.00	36.25	34.13 d	14.25	14.75	14.50	2.65	3.52 a-e	3.09 b-e	22.98 c-f	37.97 a	30.48 bc
BM 760	40.00	41.25	40.63 a	14.00	19.00	16.50	3.72	3.87 a-d	3.80 a-d	39.88 a	36.65ab	38.26 a
BM 34	35.25	41.50	38.38 a-c	16.00	18.50	17.25	3.02	2.82 c-e	2.925 de	25.27 b-e	31.48ac	28.38 b-d
BM 152	32.50	40.50	36.50 b-d	14.50	18.25	16.37	3.95	2.82 c-e	3.388 a-e	33.05 ab	24.13cd	28.59 b-d
F87 53L	33.75	39.75	36.75 a-d	17.25	16.75	17.00	3.00	2.47 e	2.737 e	27.92 b-d	29.35ac	28.64 b-d
BM 601	37.25	41.00	39.13 ab	13.50	15.00	14.25	3.55	2.55 de	3.050 c-e	20.48 c-f	18.58 d	19.52 f
BM 499	32.50	37.75	35.13 b-d	16.50	13.00	14.75	3.37	2.77 c-e	3.075 b-e	27.15 b-d	21.75cd	24.45 c-f
BM 201	36.25	40.75	38.50 a-c	15.50	19.00	17.25	4.37	3.60 a-e	3.987 a-c	20.85 c-f	28.05ad	24.45 c-f
Means	35.12b	38.48a	36.80	15.43	16.48	15.96	3.54	3.44	3.49	24.31	28.90	26.61
LSD (5%)			G:4.03L*					G:1.37*	G:0.95*	G:9.39*	G:10.18	G:6.81** GxL:9.6** L:*

**Table IV. Mean values for different characters in lentil lines at two different locations**

Lines/ cultivars	Seeds Per plant			1000 Seed Weight			Grain yield		
	Loc. 1	Loc. 2	Means	Loc. 1	Loc. 2	Means	Loc. 1	Loc. 2	Means
Firat 87	33.35b-e	39.45	36.40 b	33.97 d-f	35.45 b-f	34.71 d-f	189.9 c-e	198.8 ab	189.9 e-g
BM 76	27.88 c-e	33.50	30.69 b	41.15 a	41.25 a	41.20 a	235.7 a	230.3 a	235.7 a
BM 498	39.55 a-c	33.50	36.53 b	36.30 cd	34.13 d-f	35.21 c-f	177.5 de	180.3 b	177.5 f-h
Yerli Kırmızı	25.45 de	38.57	32.01 b	33.30 d-f	32.88 fg	33.09 f	158.4 e	177.6 b	158.4 h
BM 711	25.80 de	44.87	35.34 b	34.90 c-f	36.58 b-e	35.74 c-e	176.9 de	173.4 b	176.9 f-h
BM 479	23.30 e	40.42	31.86 b	32.35 ef	34.97 c-f	33.66 ef	200.6 b-d	183.7 b	200.6 c-f
BM 500	26.63 de	36.65	31.64 b	39.35 ab	38.70 ab	39.03 ab	219.2 a-c	220.5 a	219.2 a-c
BM 760	52.10 a	47.95	50.03 a	35.22c-e	38.00 a-c	36.61 cd	188.5 c-e	180.8 b	188.5 e-g
BM 34	31.47 b-e	34.62	33.05 b	32.08 f	33.92 ef	33.00 f	226.2 ab	197.6 ab	226.2 ab
BM 152	41.00 ab	29.95	35.47 b	27.77 g	30.25 g	29.01 g	208.0 a-d	183.7 b	208.0 b-e
F87 53L	31.65 b-e	31.75	31.70 b	36.28 cd	35.17 c-f	35.72 c-e	217.7 a-c	205.5 ab	217.7 a-d
BM 601	28.65 b-e	26.07	27.36 b	35.20c-e	35.75 b-f	35.47 c-e	175.2 de	171.1 b	175.2 gh
BM 499	37.85 b-d	26.32	32.09 b	37.40 bc	37.47 b-d	37.44 bc	202.4 a-d	222.4 a	202.4 b-e
BM 201	30.82 b-e	37.85	34.34 b	32.30 ef	34.80 c-f	33.55 ef	194.7 b-d	171.6 b	194.7 d-g
Means	32.536	35.821		34.83	35.67		197.94	192.66	
LSD(5%)	G:12.73*		G:10.03*LxG: 14.2*	G:3.34*	G:3.388**	L:*G:2.238**	G:33.65**	G:35.50**	G:24.08**

environment significantly. Genotypes mean squares were significant for this character, and genotype BM 711 had maximum number of branches per plant at both locations followed by BM 760. Low heritability was observed for this character (0.11), but Chauhan and Singh (1998) noted that high heritability was observed for this character.

Number of pods per plant ranged from 19.52 to 38.26 (Table III). The genotype x location interaction was significant, and there were significant differences among genotypes. While genotype BM 760 produced more pods in location 1, genotype BM 500 produced more pods in location 2. The genotypes BM 760, Firat 87, BM 500, BM 34, BM 152 and F87-53L gave higher number of pods per plant than the population mean. At location 2 the genotypes produced more pods than location 1. Stoilova and Pereira (1999) noted that wide variation was observed in terms of number of pods plant. Number of pods per plant showed low heritability (0.15).

There were significant differences among genotypes and genotypes x location interaction for number of seeds per plant. The lowest heritability (0.03) for this character was observed.

1000 seed weight ranged from 29.01 to 41.2 g with mean of 35.25 g. The C.V. was 6.38% and LSD was 2.24 g (Table IV). BM 76 had the largest seeds (41 g/1000 seed) followed by BM 500 (39.00 g). Seed weight showed moderate heritability (0.61). Similar finding was observed by Chauhan and Singh (1998). Although seed weight had the highest heritability, this character was significantly affected by environments as genotype x location interaction was significant. Location 2 had more weight than location 1. Hamdi *et al.* (2002) reported that genotype x environment interaction was found for all characters including 100 seed weight in lentil.

For grain yield a wide range (158.4-235.7 kg/da) was observed (Table IV). The C.V. was 12.39% and LSD was

24.08 kg/da. There were significant differences among genotypes, but the genotype x location interaction was non significant, that is, effect of environment on this character seemed low of large variation from one location to another. Opposite our finding Pandey and Srivastava (1982) reported that genotype x environment interaction was significant for this character. Genotype BM 76 produced the highest grain yield at both locations. This character showed low heritability (0.32).

## CONCLUSIONS

In this study, days to 50% flowering, days to maturity and seed weight appear to have large heritabilities indicating low environmental effects for these characters. But seed yield per plant, lowest pod height, number of branches per plant, number of pods per plant, number of seeds per plant, biological yield per plant and grain yield have low heritability values indicating high environmental effects on those characters.

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