AcademicPres

Available online at www.notulaebotanicae.ro

Print ISSN 0255-965X; Electronic ISSN 1842-4309

Not. Bot. Hort. Agrobot. Cluj 36 (1) 2008, 20-24

Notulae Botanicae Horti Agrobotanici Cluj-Napoca

Studies on Variability of Lentil Genotypes in Southeastern Anatolia of Turkey

BICER B. Tuba[1)], Dogan SAKAR[2)]

[1)]*Department of Field Crops, Faculty of Agriculture, University of Dicle, Diyarbakir, Turkey, e-mail: tbicer@dicle.edu.tr*

Abstract

Sixty-four lentil genotypes from ICARDA were evaluated at Diyarbakir, Turkey in 2003/2004 season. Eleven characters were studied. Days to maturity ranged from 188 to 196 days, and some genotypes were earlier than the local check, or same. Total 42 genotypes, suitable for mechanical harvest, were taller than 25 cm plant height. Seed yield per plant varied from 0.5 g to 2.366 g. The genotypes for cold tolerance were determined, and the genotypes of 1-3 scale were selected future lentil-breeding programme. Grain yield ranged from 776.8 kg/ha for FLIP 96-47L to 3242.3 kg/ha for FLIP 2004-49L. Grain yield was positively correlated with days to maturity, biological yield per plant, and plant height, number of seeds and pods per plant and seed yield per plant, negatively correlated with days to flowering and number of branches per plant.

Keywords: lentil, *Lens culinaris* Medik., yield, variation, correlation, Turkey

Introduction

Lentil (*Lens culinaris* Medik) is Turkey's most important pulse crop, and Turkey is a net exporter of its. Domestic production is largely focus on red lentils. South-Eastern Anatolia grows the bulk of Turkish red lentils. It was grown on an area of 382394 ha with yield a production of 272593 tons in South-Eastern Anatolia during 2005-2006, as against area of 5000000 ha with a production of 580 000 tons on Turkey basis (PMSIS 2005-2006). The South Eastern Anatolia Project, the largest integrated regional development project in Turkey, is aim to irrigate approximately 1.7 million hectares of land for farming. The project has significant changed the regional cropping pattern, and cotton has become the predominant crop in these areas. However, it is important to note that lentil production areas in particular may not greatly affected by the project. Because, in dry area, lentil continue to be major crop in the region. Turkish lentil production during 1999 and 2005 years was severely curtailed due to severe drought conditions, unstable varieties and changed cropping pattern (Arslan, 2007). Especially, lentil producers were significantly affected by lentil varieties, low yielding and drought sensible. Therefore, lentil varieties with higher yield potential derive from several sources such as other countries, landraces, germplasm are needed. Identification of better genotypes with desirable traits and their subsequent use in breeding programme and establishment of suitable selection criterion can be helpful for successful varietals improvement programme. Systematic research on lentil started recently, compared to other early-domesticated crops. During the last two and a half decades, research progress has been made in various aspects of the crop. Large numbers of germplasm have been collected, evaluated and preserved at national and international levels, with the International Center for Agricultural Research in the Dry Areas (ICARDA) holding the largest collection of cultivated and wild germplasm accessions. A major effort has been made to study the genetic variation in the world germplasm collection, in order to understand local adaptation and to develop specific research programmes. Genotypes with resistance to various biotic and abiotic stresses, and directly exploited or used in breeding programmes. New genotypes have been bred with good standing ability, suitable for mechanical harvest for West Asia and North Africa (Sarker & Erksine, 2005). Earlier researchers (Stoilova & Pereira, 1999) were evaluated 120 lentil accessions from different geographical origin and identified remarkable variation at the level of number of branches plant^{-1}, number of pods plant^{-1} and number of seeds plant^{-1}. other researchers (L´azaro et al., 2001) studied one hundred and one Spanish landraces of lentil maintained in the Plant Genetic Resources Centre and coming from different micro-climatic areas in Spain, and 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. Piergiovanni (2000) reported that days to flowering ranged from 104 to 106 days, plant height from 28-41 cm and first pod height from 11 to 26 cm in Italian lentil populations. This study aimed to determine the some traits of ICARDA lentil genotypes in Southeastern Anatolia of Turkey.

Materials and methods

Sixty-three lentil genotypes, obtained from ICARDA (one genotype Turkey origin, other one Jordan origin, rest

Table 1 Range, mean, standard deviation, and coefficient of variation (%) for different characters in 64 lentil genotypes

Genotypes	Days to 50 % flowering	Days to maturity	Biological yield per plant	Plant height	First pod height	Number of branches per plant	Number of pods per plant	Number of seeds per plant	Seed yield per plant	Grain yield	Cold tolerance
PI 339319	145	190	1.378	19	12	1.8	10.2	13.4	0.500	723.9	6
81S 15	145	191	3.942	27	15	2.1	37.9	44.9	1.649	1500.7	3
FLIP 90-25L	145	189	3.155	24	16	1.9	29.8	38.6	1.594	1507.4	7
FLIP 96-47L	144	190	1.970	23	12	1.8	23.2	30.7	0.874	776.8	4
FLIP 97-28L	145	188	3.145	24	15	2.2	24.2	41.2	1.480	1619.4	1
FLIP 99-1L	144	193	3.764	29	14	2.2	35.9	40.6	1.518	1867.1	2
FLIP 2002-7L	144	193	2.440	26	12	2.0	20.7	26.9	0.870	2122.5	2
FLIP 2002-8L	146	192	3.466	27	14	2.1	32.4	38.9	1.573	1858.8	3
FLIP 2002-9L	142	192	3.221	27	15	2.0	26.0	30.2	1.433	2033.8	1
FLIP 2002-10L	143	191	2.023	23	13	2.3	19.8	24.7	0.931	1815.9	4
FLIP 2002-11L	143	190	4.106	28	14	2.4	36.1	39.4	1.970	1948.8	3
FLIP 2002-15L	143	190	2.198	21	12	2.6	23.8	36.8	0.997	981.9	2
FLIP 2002-16L	143	193	2.514	21	10	2.0	21.2	29.9	1.173	1928.2	4
FLIP 2002-17L	146	192	1.651	22	9	2.5	14.7	23.0	0.693	1417.0	7
FLIP 2002-24L	143	192	2.677	27	14	1.9	18.2	24.8	1.009	2165.0	5
FLIP 2002-28L	144	192	2.485	26	14	2.1	24.1	39.6	1.125	2146.0	5
FLIP 2002-29L	144	193	3.409	25	14	2.5	29.8	31.7	1.579	1669.1	4
FLIP 2002-30L	145	193	3.131	28	13	2.2	29.3	45.9	1.510	1626.4	3
FLIP 2002-31L	145	192	2.170	24	13	1.8	20.1	25.9	0.998	1851.9	2
FLIP 2002-32L	143	193	2.380	24	13	1.9	22.0	30.2	1.045	2019.6	1
FLIP 2002-34L	143	194	4.386	29	16	2.3	36.4	39.6	1.108	2212.6	2
FLIP 2002-37L	144	194	2.796	28	15	2.1	22.7	26.5	1.034	2193.0	1
FLIP 2003-8L	144	193	3.441	27	14	2.4	26.7	32.5	1.456	1833.4	4
FLIP 2003-9L	143	193	2.775	27	13	1.8	26.9	32.4	1.344	2043.5	4
FLIP 2003-10L	144	194	2.919	25	15	1.9	24.9	29.2	1.212	1438.1	5
FLIP 2003-11L	143	194	3.290	29	15	2.8	31.2	36.7	1.436	1845.7	4
FLIP 2003-12L	144	192	3.359	27	13	2.5	36.2	41.6	1.234	1914.0	3
FLIP 2003-13L	149	191	2.578	27	15	2.2	23.2	31.2	1.126	2330.5	2
FLIP 2003-14L	143	194	2.000	28	15	1.8	14.9	18.2	0.803	2133.4	3
FLIP 2003-15L	143	194	2.855	23	14	1.5	20.3	24.8	1.096	2769.4	3
FLIP 2003-16L	141	194	3.850	27	14	2.3	30.0	42.7	1.670	2138.2	3
FLIP 2003-18L	143	190	3.114	25	12	2.1	31.5	35.7	1.396	1869.5	3
FLIP 2003-19L	143	194	1.853	19	10	2.0	18.4	23.3	0.747	1577.1	3
FLIP 2003-22L	143	190	2.903	23	12	2.3	23.8	28.2	1.063	1612.2	3
FLIP 2003-23L	143	194	2.314	26	13	1.6	15.3	21.6	0.953	1935.6	6
FLIP 2003-24L	143	193	2.710	28	18	2.5	21.2	23.3	1.053	1563.5	4
FLIP 2003-25L	143	194	2.982	25	16	2.0	26.2	35.8	1.975	1110.3	6
FLIP 2003-26L	143	194	3.610	29	17	2.4	28.9	35.6	1.107	2572.1	6
FLIP 2003-27L	144	194	3.319	25	11	1.8	28.9	34.5	1.563	2989.8	5
FLIP 2003-28L	143	194	3.804	24	13	1.4	23.7	36.4	1.586	1684.3	1
FLIP 2004-2L	143	194	2.611	22	11	2.0	18.4	22.4	1.062	1944.4	1
FLIP 2004-4L	144	190	3.707	27	11	1.9	32.1	43.4	1.710	1558.9	3
FLIP 2004-5L	144	194	3.553	23	10	2.1	35.9	43.7	1.867	1613.2	3
FLIP 2004-6L	144	194	2.178	25	13	1.8	17.0	20.3	0.925	1606.1	5
FLIP 2004-7L	144	194	3.197	24	14	2.2	20.3	23.5	1.046	1853.1	3
FLIP 2004-10L	143	194	3.093	24	10	2.1	26.0	30.9	1.526	2328.2	6
FLIP 2004-13L	143	194	3.252	26	12	2.1	27.5	35.4	1.291	1841.9	3
FLIP 2004-14L	143	194	3.442	28	12	1.7	34.2	40.2	1.470	1674.7	6
FLIP 2004-15L	143	194	2.386	27	14	2.3	21.2	26.3	1.144	1876.4	5

22

Table 1 Range, mean, standard deviation, and coefficient of variation (%) for different characters in 64 lentil genotypes (Continuation)

Genotypes	Days to 50 % flowering	Days to maturity	Biological yield per plant	Plant height	First pod height	Number of branches per plant	Number of pods per plant	Number of seeds per plant	Seed yield per plant	Grain yield	Cold
FLIP 2004-17L	145	191	2.628	23	9	1.9	21.6	31.4	1.208	1702.5	2
FLIP 2004-20L	144	193	3.092	26	14	2.1	30.2	43.0	1.596	1706.6	1
FLIP 2004-21L	144	193	2.606	24	13	2.2	22.4	28.0	1.091	1395.8	6
FLIP 2004-22L	144	192	2.207	28	18	2.0	20.9	39.5	0.950	1243.8	3
FLIP 2004-28L	144	196	2.065	24	14	2.1	25.2	28.0	1.474	2440.4	6
FLIP 2004-29L	144	192	3.825	30	19	2.2	29.7	35.6	1.657	1413.1	1
FLIP 2004-30L	144	192	3.514	29	12	2.1	31.9	36.0	1.690	1524.2	3
FLIP 2004-34L	143	195	2.585	26	15	1.9	24.2	28.0	1.091	2120.1	7
FLIP 2004-35L	143	193	2.640	26	14	2.2	26.1	30.7	1.229	2614.9	8
FLIP 2004-46L	143	193	3.763	25	15	2.4	30.8	36.9	1.977	2059.7	2
FLIP 2004-47L	143	195	3.008	27	15	1.9	31.0	36.5	1.507	2338.9	3
FLIP 2004-48L	142	191	2.666	27	15	2.2	18.3	28.1	1.063	1807.1	4
FLIP 2004-49L	142	195	4.103	27	12	2.2	32.9	50.2	2.366	3247.3	6
FLIP 2004-50L	142	191	3.019	23	12	2.2	30.8	38.4	1.421	1583.0	3
L. check(Sakar)	143	191	2.882	24	13	2.3	24.9	28.1	1.573	2102.7	3
Range	141-149	188-196	1.378-4.386	19-30	9-19	1.4-2.8	10.2-37.9	13.4-50.2	0.5-2.4	723.9-3242.3	
Mean±std error of mean	143.6 ±0.145	192.6 ±0.208	2.939 ±0.081	25.484 ±0.305	13.469 ±0.258	2.095 ±0.033	25.691 ±0.772	32.681 ±0.947	1.303 ±0.044	1858.41 ±5.708	
Standard dev.	1.162	1.667	0.651	2.443	2.062	0.263	6.179	7.576	0.354	456.64	
CV (%)			22.15	9.586	15.3	12.6	24.0	23.2	27.2	24.6	

ICARDA crosses, along with one check (Sakar, Turkey) were tested at University of Dicle, Faculty of Agriculture Diyarbakir, Turkey, during growing season of 2003/2004. Each of the genotypes was planted in six row plots with 4 m long with inter-row spacing of 20 cm. Ten randomly selected competitive plants from each of plot were tagged for recording observations on ten economic traits. Observation of cold tolerance was record on a scale of 1 to 9 (1: no visible symptom of damage, 9: 100% plant killing). Cold tolerance was record on three times; first and second record was in early spring, February and March, and the last record was within two days after 04-05 April 2004 when it was seen extraordinary cold days, which continued in two days -6^{0}C tempearture (State Meteorology Institute, Diyarbakır, Turkey, 2004). The data were statistically analyzed by using 'MSTATC' (Michigan State University, East Lansing, MI) computer package. Pearson's correlation coefficients were calculated to determine the relationships between yield and yield components.

Results and discussion

Table 1 presented the mean, standard deviation and range of each morphological character for 64 lentil genotypes analyzed. The 50% flowering days varied from 141 (FLIP 2003-16L) to 149 days (FLIP 2003-13L). L´azaro et al. (2001) reported 117.8 days for 50% flowering in Spain, whereas Piergiovanni (2000) reported this period ranging from 104 to 106 days in the Italians' lentil populations. These results were different from each other and may be explain by the differences between climatic factors and genotype.

The days to maturity varied from 188 to 196 days, and it was revealed that some genotypes many (e.g. ICARDA cross) were earlier than the local check, or same. Local variety (Sakar) is only one of the earliest varieties in the region where the experiment were conducted. L´azaro et al. (2001) reported a period of 226 days as maturity time in Spain. Biçer and Şakar (2007) reported that ICARDA genotypes for flowering and maturity were earlier than in their local and commercial varieties. According to Kusmenoglu and Muehlbauer (from Tullu et al., 2001) high seed yield has been obtained through development of cultivars with shorter vegetative and generative growth periods.

Maximum biological yield plant^{-1} was produced by FLIP 2002-34L (4.386 g/plant^{-1}) followed by FLIP 2002-11L, FLIP 2004-49L that gave 4.00 g each. PI 339319 (from Turkey), and FLIP 96-47L exhibited minimum biological yield (1.378, 1.970 g/plant, respectively).

The maximum plant height was observed for the FLIP 2004-29L (30 cm) followed by FLIP 99-1L, FLIP 2003-11L, FLIP 2003-26L and FLIP 2004-30L, and the genotype PI 339319 had the minimum height (19 cm). Most

Table 2 Correlations among characters in lentil

Traits	Days to 50 % flowering	Days to maturity	Biological yield per plant	Plant height	First pod height	Number of branches per plant	Number of pods per plant	Number of seeds per plant	Seed yield per plant
Days to maturity	-0.312*								
Biological yield per plant	-0.179	0.077							
Plant height	-0.052	0.197	0.551**						
First pod height	-0.025	0.047	0.235	0.606**					
Number of branches per plant	-0.011	-0.149	0.215	0.196	0.171				
Number of pods per plant	-0.067	0.002	0.840**	0.485**	0.133	0.303*			
Number of seeds per plant	-0.017	-0.109	0.732**	0.405**	0.101	0.233	0.854**		
Seed yield per plant	-0.149	0.071	0.782**	0.342**	0.093	0.155	0.766**	0.747**	
Grain yield	-0.212	0.477**	0.276*	0.290*	0.025	-0.040	0.165	0.086	0.235

of genotypes from ICARDA had taller than local check. Lentil sown in large area in the region, so selection of tall genotypes is very important for mechanic harvest. Genotypes that exceed 25-30 cm of plant height in the material can be evaluated for this purpose. Piergiovanni (2000) reported a plant height from 28-41 cm in her material. The difference could be attributed to climatic factors and genetic make up of genotypes, because plant height is moderate/low heritability, and environmental conditions play a major role on this character (Chauhan and Singh, 1998, Biçer and Şakar, 2004). First pod height varied from 9 to 19 cm with a mean of 13.47 cm. Karadavut et al. (1999) evaluated ICARDA lentil acccessions reported that these lines showed smaller plant height and first pod height than local varieties.

Maximum number of pods plant^{-1} was produced by the genotype 81S 15, from Jordan, (37.9) followed by FLIP 2002-11L (36.1), FLIP 2002-34L (36.4) and FLIP 2003-12L (36.2), however, genotype PI 339319 produced minimum pods (10.2). The range of number seeds of plant^{-1} was 13.4-50.2, with the following fluctuations: 50.2 (FLIP 2004-49L), 44.9 (81S 15), 45.9 (FLIP 2002-30L), 43.7 (FLIP 2004-5L) and 43.0 FLIP 2004-20L (FLIP 2004-20L) among genotypes had produced maximum number of seeds plant^{-1}. Considerable variation was observed for number of pods plant^{-1} and number of seeds plant^{-1}. These results agree with Stoilova and Pereira (1999) reported.

Seed yield per plant varied from 0.5 g (PI 339319) to 2.366 g (FLIP 2004-49L), and the mean of this character was of 1.303 g. This finding does is not in agreement with Stoilova and Pereira results (1999) who found that the weight of seed/plant (g) ranging from 0.2 to 4.78. This result correlate with the number of seeds per plant of genotypes, and there was a significant positive correlation between seed yield per plant and number of seeds per plant (Hamdi et al., 2003). This character was showed remarkable variation (27.2%).

The range of grain yield was 723.9-3242.3 kg/ha, and the genotype FLIP 2004-49L gave the highest yield (3242.3 kg/ha). The greatest number of genotypes yielded 1500-1800 kg/ha. The results indicated that the mean of grain yield in material which were used was exceed the mean of Turkey lentil yield (1090.0 kg/ha).

Lentil genotypes, in the experiment, were affected by cold that occurred on 04-05 - April 2004. Observation of cold tolerance revealed that response to cold among genotypes varied from genotype to genotype. While genotypes FLIP 97-28L, FLIP 2002-9L, FLIP 2002-32L, FLIP 2002-37L, FLIP 2003-28L, FLIP 2004-2L, FLIP 2004-20L and FLIP 2004-29L did not record symptom of damage, while the genotypes FLIP 90-25L, FLIP 2002-17L and FLIP 2004-34L proved to be susceptible genotypes. Because of evaluation for cold tolerance, lead to selection some genotypes with regard to cold tolerant.

Correlations

Correlations among characters in lentil are presented given Table 2. Grain yield was positively correlated with days to maturity, biological yield per plant, and plant height, number of seeds and pods per plant and seed yield per plant. Also, this trait was negatively correlated with days to flowering and number of branches per plant. Hamdi et al (2003) showed that seed yield was positively and significantly correlated with pod numbers, plant height and negatively with flowering duration. Also, Singh (1977) reported that grain yield showed positive correlation with pod number and plant height. Seed yield per plant was positively and significantly correlated with biological yield per plant, plant height, number of pods and seeds per plant. Plant height had a significant positive correlation with first pod height, number of pods and seeds per plant.

The results of this study revealed the presence of genetic variation in terms of yield and its components among the studied lentil genotypes. It was possible to identify the most promising genotypes for inclusion in the lentil-breeding programme. It was selected 24 lentil genotypes within 64 genotypes, in respect of plant height, number

of pods per plant and cold tolerant for the South-eastern Anatolia of Turkey, where lentil crops widely grown.

References

Arslan, M, 2007, www.gidasanayii.com/modules.php?name=News&file=article&sid=12898-24k.

Bicer, B. T., D. Şakar, 2004, Evaluation of some lentil genotypes at different locations in Turkey. Int. J. of Agr. and Biology 6(2), 317-320.

Bicer, B. T., D. Şakar, 2007, Comparision of exotic lentil lines to native cultivars for agronomic and morphologic traits. J. of Agri., Sci., Ank. Uni, Fac. of. Agriculture 13(3):279-284.

Chauhan, M. P. , I. S. Singh, 1998, Genetic variability, heritability and expected genetic advance for seed yield and other quantitative characters over two years in lentil, Lens Newsletter 25 (1 and 2), 3-6.

Hamdi, A. A., A. El-Ghareib, S. A. Shafey, M. A. M. Ibrahim, 2003, Direct and indirect relationships among lentil characters. J.of Agr. Research 81(1).

Karadavut, U., C. Erdoğan, S. Özdemir, H. H. Geçit, 1999, A research on the winter growing of some small lentil lines in Amik plain. Third Turkey Field Crops Cong., 15-18 Nov., Adana, Turkey, 407-412.

L´azaro, A. M. R., Luc´ıa de la Rosa, I. Mart´ın, 2001, Relationships between agro/morphological characters and climatic parameters in Spanish landraces of lentil (*Lens culinaris* Medik.). Genetic Resources and Crop Evolution 48, 239–249.

Piergiovanni, R. Angela, 2000, The evolution of lentil (*Lens culinaris* Medik.) cultivation in Italy and its effects on the survival of autochthonous populations. Gen. Res. and Crop Evolution 47, 305–314.

PMSIS, 2005-2006, Republic of Turkey, Prime Ministry State Institute of Statistics.

Sarker, A., W. Erksine, 2005, Recent progress in the ancient lentil , http://journals.cambridge.org.

Singh, T. P., 1977, Harvest index in lentil (*Lens culinaris* Medik.). Euphytica 26(3), 833-839.

Stoilova, T. , M. G. Pereira, 1999, Morphological characterization of 120 lentil (Lens culinaris Medik) accession. Lens Newsletter 26(1 and 2), 7-10.

Tullu, A., I. Kusmenoglu, K. E. McPhee, F. J. Muehlbauer, 2001, Characterization of core collection of lentil germplasm for phenology, morphology, seed and straw yields. Genetic Resources and Crop Evolution 48, 143-152.