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Study on Red Lentil Genotypes For Drought And Cold Tolerance And Yield Components

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Abstract: This study was conducted at rainfall conditions in Southeastern Anatolia of Turkey, Diyarbakır, during 2011-2012 growing season. This work reviewed the three different lentil nurseries obtained from ICARDA; 1.Lentil International Elite Nursery-Drought Tolerance-2012, 2.Nursery-Early-2012 and 3.Nursery-Red-2012. The experiment was designed a simple lattice (7x7) and (6x6). Total one thousand twenty-two genotypes were evaluated for cold, drought tolerance and other agronomical and botanic traits. Wide variation observed for all traits among genotypes. Hopeful genotypes for earlier, more pods, average yield, drought and cold resistance were selected in first trial. The most genotypes affected by cold in all trials, also, some genotypes in plots killed by low temperature. Total thirteen genotypes (ILL10827, ILL10831, ILL10833, ILL10906, ILL10913, ILL10917, ILL10960, ILL10966, ILL10969, ILL10971, ILL6002 and ILL7979) were selected for drought trials in the region.

Key words: Red lentil, (*Lens culinaris* Medik), drought, cold

Kırmızı Mercimeklerde Kurağa ve Soğuğa Tolerans ve Verim Unsurları Üzerine Bir Araştırma

Özet: Bu çalışma 2011-2012 yılı yetişme mevsiminde Diyarbakır'da yürütülmüştür. Bu çalışmada ICARDA'dan temin edilen üç farklı mercimek denemesi (1. Kurağa tolerans, 2. Erkencilik, 3.Kırmızı mercimek verim denemesi) özetlenmiştir. Deneme basit latis (7x7) ve (6x6) deneme deseninde düzenlenmiştir. İncelenen özellikler yönünden genotipler arasında geniş varyasyon belirlenmiştir. Toplam 122 genotip soğuk, kurak ve diğer tarımsal ve botanik özellikler yönünden incelenmiştir. İlk denemede erkenci, yüksek bakla üreten, orta verimli, kurak ve soğuğa toleranslı ümitvar genotipler seçilmiştir. Birçok genotip soğuk zararı görmüş parseldeki bazı bitkiler tamamen ölmüştür. Toplam 13 genotip (ILL10827, ILL10831, ILL10833, ILL10906, ILL10913, ILL10917, ILL10960, ILL10966, ILL10969, ILL10971, ILL6002 ve ILL7979) bölgedeki kurağa dayanıklılık ile ilgili denemelerde kullanılmak üzere seçilmiştir.

Anahtar Kelimeler: Kırmızı mercimek, (*Lens culinaris* Medik), kurak, soğuk

1. INTRODUCTION

The total area and production of lentil is importantly decreasing in Turkey. During the last two decades (1991 to 2010), the area decreased from 537 thousand hectares to 192 thousand hectares, and production decreased from 440 thousand tons to 380 thousand tons (TUİK, 2011). Most of the production (89%) in Turkey comes from Southeastern Anatolia region. Especially in 2007/2008, the total seasonal rainfall was importantly decreased at 40 percent rate, compared to normal years, and lentil sown area severely affected by drought stress. As a result, lentil production decreased by 79% compared to previous years. Blum, (1986) reported that plants are exposed to numerous stress factors during their lives, which is of a significant effect on the growth of plants. Drought stress has the highest percentage (26%) when the usable areas on the earth are classified in view of stress factors. There is a lot of literature reporting the effects of temperature and rainfall on crop yield. Cooper et al. (2008) noted that not only the seasonal rainfall totals and their season-to-season variability were important, but also the "within season" variability had a major effect on crop yield. Erskine and El Ashkar quantified the effect of rainfall on lentil seed yield and found that rainfall accounted for 79.8% of the variance of seed yield. Mishra et al. (2007) and Silim et

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al. (1993) reported that lentil is traditionally grown as a rain-fed crop under various cropping systems that often suffer from intermittent and terminal drought. Silim et al. (1993) invested the twenty-five diverse lentil lines under both irrigated and rainfed conditions. In first year, the total seasonal rainfall was 403 mm and average rainfed biomass and seed yields were 5.0 and 1.8 t ha^{-1}, respectively. In contrast, in second year, the total season rainfall was 180 mm and average biomass and seed yields were only 0.67 and 0.12 t ha^{-1}, respectively. Early maturity was correlated with seed yield. In the dry season, 49% of the variation in seed yield among lines was accounted for by variation in flowering time. For severely drought-prone areas, selection for early flowering is therefore required. Agsakalli et al (2001) reported that relationships between rainfall and plant height were positive and significant, but temperature and plant height character had a negative association. Although seed yield is the primary objective in most lentil breeding programs, plant morphology of varieties is important in understanding the responses of the crop to growing conditions. There is a lot researches ended on the plant and agronomic traits in lentil collections different in the countries and climatic conditions (Pandey and Srivastava (1982); Mia et al. (1986); Zaman et al. (1989); Piergiovanni et al. (1998); Erskine (1993); Stoilova Pereira (1999); Sarker et al. (2000); L'azaro et al. (2001); Bicer and Sakar (2008), and some research still continuing in worldwide. We aimed to select the lentil genotypes to be adapted Southeastern Anatolia region from a few ICARDA lentil collections. Lentil genotypes evaluated for especially earlier, drought resistance, cold tolerance and high yielding in our region.

2. MATERIALS AND METHOD

Trials were conducted at rainfall conditions in Southeastern Anatolia of Turkey, Diyarbakır, during 2011-2012 growing season.

Soil of experimental area is sandy, slightly stony, low clay and low organic matter. Soil quickly dried after rainfall, due to high infiltration. Climatic conditions were given Table 1. Low temperature affected plants from November to March. Total precipitation during cropping season from February to July was 272.5 mm, but most precipitation was recorded from January to March. Growing season especially regeneration term exposure the water deficient.

Table 1. Meteorological data in 2011-2012, Diyarbakır, Turkey.

	Years	**Temperature (^{o}C)**			**Precipitation (mm)**	**Humidity (%)**
Months		Mean	Max.	Min.		
Nov.	2011	6.4	18.4	-7.1	73	58.5
Dec.		2.3	11.9	-8.1	40.2	73.9
Jan.	2012	2.4	11	-8.6	78.3	85
Feb.		1.9	14.8	-8.4	74.4	68
March		5.1	18.1	-5.8	44	59
April		15.2	27.8	2	26.2	58
May		19.6	33	8.6	41	58
June		27.7	41.7	9.4	7	27.8

This study summarized three different lentil nurseries: 1.Lentil International Elite Nursery-Drought Tolerance-2012, 2.Lentil International Elite Nursery-Early-2012 and 3.Lentil International Elite Nursery-Red-2012.

1. Drought Tolerance-2012 consist of forty-nine lentil genotypes including two improved checks (ILL6002 and ILL7979) from International Center for Agricultural Research in the Dry Areas (ICARDA) and one local check (Özbek).

2. Early-2012 included thirty-three lentil genotypes, two improved checks (ILL6994 and ILL8006) from ICARDA and one local check (Kafkas).

3. Red -2012 consisted of thirty-three lentil genotypes, two improved checks (ILL5883 and ILL10847) from ICARDA and one local check (Kişlik Kirmizi 51). Each of the genotypes

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was planted in 3 rows with 3 m length with inter-row spacing of 25 cm. The experiment was conducted a simple lattice (7x7) and (6x6) with two replicates. Number of seeds per plot was 400 seeds. Genotypes were sown in the first week of December. Weed was controlled by hand. Plants were harvested in 5th June by hand. Harvested area was 2.25 m^2. Drought tolerance was evaluated visually at maturity (according to percentage pod setting) on drought tolerance score on a 1-9 scale (1: free, 3: tolerant, 5: intermediate, 7: susceptible, 9: highly susceptible). Observation for cold tolerance (1-9) (1: free, 3: tolerant, 5: intermediate, 7: susceptible, 9: highly susceptible) was recorded two times, one in March the other in April. Observation on cold were recorded the number of plants germinated before onset of winter and after the winter is over. Stand (1-5; 1:very good, 5: very poor) and Vigor (1-5; 1:very good, 5: very poor) recorded two times during flowering and podding over all plot. Total ten plants were selected in harvest time for other traits. The data were statistically analyzed by using 'MSTATC' (Michigan State University, East Lansing, MI) package programme.

3. RESULTS

1. Lentil International Elite Nursery-Drought Tolerance -2012

Differences among genotypes were significant for all traits (Table 2). Genotypes ILL10917 and ILL10975 by 136 days were the first flowered genotypes. All genotypes were earlier flowering than local check (145 days), also, ILL6002 and ILL7979, improved checks, were late flowering. Days to maturing ranged from 180 days to 187 days. Six genotypes (ILL10749, 10827, 10836, 10963, 10968 and 10970) matured in 180 days. ILL10795, ILL10835, ILL10922 and ILL10972 late matured. Plant height ranged from 19.0 cm to 28.0 cm. ILL 10893, ILL10753, ILL10906, ILL10922, ILL6002 and Ozbek were determined as tall genotypes. ILL10749, ILL10826, ILL10960 and ILL10965 were shorter than other genotypes. Number of pods plant^{-1} ranged from 9.0 to 40.3. The maximum number of pods per plant determined from ILL10922, ILL10965 and ILL6002. 1000 seed weight ranged from 34.5 g in ILL10826 to 58.0 g in ILL10795. Generally genotypes had large seeded. Maximum seed yield plant^{-1} observed from ILL6002 (2.49 g). Grain yield varied from 22.5 g to 117.5 g. Maximum grain yield observed from Ozbek, ILL10827, ILL10906, ILL10907 and ILL10963. Genotypes ILL10795, ILL10796 and ILL10975 had minimum grain yield. Genotypes ILL10827, ILL10831, ILL10833, ILL10906, ILL10913, ILL10917, ILL10960, ILL10966, ILL10969, ILL10971, ILL6002 and ILL7979 were selected for drought. These genotypes founded hopeful for drought trials in the region.

2. Lentil International Elite Nursery-Early -2012

The analysis of variance indicated significant differences among genotypes for days to maturity, seed yield plant^{-1}, plant height, number of pods plant^{-1}, 1000 seed weight and grain yield (Table 3). Flowering ranged 137 days to 142 days, and all genotypes were almost flowered at the same time. However, six genotypes were early flowered by137 days. Kafkas, local check, was late flowered by 142 days. Number of days between first and last maturing genotypes was ten days. ILL 10970 was the earliest matured genotypes by 175 days. The latest genotypes were ILL 10897 and ILL 10912 by 185 days. ILL 10912 was one of the latest flowered (141 days) and matured (185 days) with in genotypes. Maximum plant height (25 cm) was observed from genotypes ILL 10807, ILL 10897 and ILL 10912. Generally plant height values were very low. This case may be based on climatic conditions during growing season (Table 1). Number of pods plant^{-1} ranged from 9.9 to 43.8. Genotypes produced a lot of pods. ILL 10820 had maximum pods per plant (48.3). Generally individual lentil plants produce less, but in this experiment season, winter lasted longer, and some plant rows was kill by cold, so individual plants could be produce more pods. Genotypes generally had large seeded, and ILL10897 had maximum 1000 seed weight (72.7 g), which seed color was green. Seed yield plant-1 ranged from 0.45 g in ILL10971 to 2.69 g in ILL10820. Since most genotypes affected by cold, grain yield values was low. Local check, Kafkas, had maximum unit area grain yield by 102.5 g. Minimum grain yield obtained from ILL10947 by 13.0 g. The genotypes were affected by cold damage. Total nineteen genotypes almost killed from cold damage by scale 7.

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3. Lentil International Elite Nursery-Red -2012

Differences among lentil genotypes were significant for days to flowering, plant height, first pod height, number of pods plant^{-1}, 1000 seed weight, grain yield and cold tolerance (Table 4). Days to flowering ranged from 139 days to 151days. Four genotypes (ILL 10847 (improved check), 10917, 10794 and 10769) were earlier flowered than other genotypes and local check. ILL10793 and ILL10895 were the latest flowered genotypes. Plant height ranged from 17.5 cm in ILL10794 to 26.0 cm in ILL10800, ILL10900 and ILL10906. Plant height of Kişlik Kirmizi 51, local check, was 25.5 cm. Generally plant height at lentil in this region is taller than 25 cm. However, in this research season, plants were very short. Winter season lasted longer than previous years, vegetative growth period was short, and the plants flowered before tall. The first pod height was in 7.0 cm to 13.5 cm. Number of branches plant^{-1} ranged from 1.9 to 3.8, although there was variation for this character; differences among genotypes were not significant. Number of pods plant^{-1} was 15.4 in ILL10780 to 54.5 in ILL10823. Plants in the some rows killed by cold, inter-plant competition decreased due to low plant population density. A great number of genotypes could be produce more than 20 pods per plant.1000 seed weight ranged from 38.7 in ILL10766 to 57.7 g in ILL10749. 1000 seed weight of Kişlik Kirmizi 51, local check, was 43.7 g. Plants harvested over all plot, and maximum grain yield observed from Kişlik Kirmizi 51 (99.5 g) followed ILL10900 (89.5 g). All genotypes almost damaged by cold, and cold scale ranged from 3 to 8. Total ten genotypes (ILL 10753, 10770, 10783, 10792, 10793, 10823, 10895, 10897, 10899 and 10847) recorded as cold susceptible by scale 7. Four genotypes (ILL 10756, 10790, 10800 and 10847) was free damage, and seven genotypes (ILL10791, 10894, 10900, 10917, 10921, 10922 and Kişlik Kirmizi 51) were tolerant. Genotypes seriously were affected by *Galium aparine* as weed.

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Table 2. Elite Nursery-Drought Tolerance -2012

Accession No (ILL)	DAF	DAM	PH (cm)	NBP	NPP	100 SW (g)	SYP (g)	GY (g)	COLT (1-9)	DR
10749	139	180	19.5	2.3	12.7	53.5	1.46	48.9	7	
10753	143	183	26.0	2.9	19.4	49.0	1.39	44.75	7	
10756	138	182	20.5	2.6	21.0	50.5	1.16	32.5	5	
10794	139	181	21.0	2.5	12.0	43.0	0.75	29.0	5	
10795	138	187	25.5	2.5	21.4	58.0	1.94	36.5	5	
10796	143	184	22.0	1.6	10.5	47.5	1.40	28.2	7	
10821	139	183	22.5	1.0	9.0	45.0	1.25	32.0	8	
10823	138	182	23.0	2.2	17.9	35.5	1.15	31.2	8	
10824	141	182	23.5	2.0	16.65	43.0	0.99	48.5	7	
10825	137	181	20.5	2.5	10.15	46.0	0.58	40.0	3	
10826	143	183	19.5	2.8	21.5	34.5	1.34	50.0	7	
10827	138	180	20.5	2.9	20.4	51.5	1.19	100.0	3	+
10830	138	183	20.0	2.5	26.6	41.5	1.66	47.0	3	
10831	138	184	23.0	2.8	24.7	39.5	1.35	73.5	7	+
10833	141	181	22.5	2.6	25.1	47.5	1.45	66.0	3	+
10834	139	182	22.0	2.1	24.5	49.5	1.58	45.5	7	
10835	140	187	22.0	2.4	21.6	42.5	1.17	74.5	5	
10836	140	180	22.0	2.7	29.0	35.5	1.46	42.5	7	
10893	139	183	28.0	1.5	24.9	46.5	2.15	57.5	5	
10894	138	181	24.5	2.2	24.4	49.0	1.50	54.5	5	
10897	140	182	22.5	2.2	23.8	43.5	1.70	33.5	5	
10898	139	184	23.0	2.1	15.5	43.5	1.65	32.5	5	
10899	139	181	22.5	3.1	25.6	40.5	1.05	71.0	3	
10900	142	182	24.0	2.9	25.3	53.5	1.39	57.5	5	
10906	141	183	26.5	2.3	31.4	47.0	1.75	88.0	5	+
10913	144	186	23.5	2.6	35.5	46.5	2.05	53.5	7	+
10915	138	185	23.5	2.2	20.5	45.5	1.13	51.0	5	
10917	136	181	22.5	2.2	23.8	46.5	1.08	85.5	3	+
10921	138	186	23.0	2.4	22.2	45.5	1.39	76.0	4	
10922	140	187	25.5	2.3	40.3	48.5	2.31	71.5	5	
10947	137	182	20.0	2.6	12.3	37.5	0.55	37.0	5	
10960	138	182	19.5	2.2	17.0	40.5	0.69	44.5	5	+
10961	140	181	22.0	2.7	20.8	44.0	1.16	40.5	5	
10963	142	180	22.0	2.8	20.5	37.5	1.13	90.0	3	
10964	139	185	20.0	2.6	27.9	49.5	1.12	72.0	3	
10965	138	182	19.0	3.3	37.8	51.5	1.16	80.5	5	
10966	137	181	22.0	2.5	10.3	45.5	0.50	56.5	5	+
10967	139	182	20.5	2.5	20.1	50.0	0.86	70.0	5	
10968	139	180	21.5	3.0	17.3	45.0	0.98	70.5	3	
10969	138	181	22.0	2.5	22.0	39.5	1.05	40.5	5	+
10970	137	180	20.0	2.8	24.1	43.0	1.18	55.5	7	
10971	138	181	21.0	3.0	20.6	41.0	1.16	74.0	3	+
10972	140	187	20.5	2.8	21.8	43.0	1.07	33.0	5	
10973	137	183	20.0	2.1	15.6	45.5	0.94	36.5	8	
10974	139	183	24.5	2.3	14.1	55.5	1.28	61.0	5	
10975	136	181	20.0	1.9	26.7	39.0	1.27	22.5	8	
6002	140	183	25.5	2.5	38.5	54.5	2.49	75.5	3	+
7979	141	182	22.5	2.4	16.8	40.0	0.74	71.5	5	+
Özbek	145	185	26.0	4.0	18.0	39.0	0.98	117.5	1	
Mean	139	182	22.3	2.4	21.47	45.32	1.2	56.15		
LSD	3.68**	3.52**	3.72**	1.14**	9.37**	8.59**		20.58**	**	

DAF: Days to Flowering, DAM: Days to Maturity, PH: Plant Height, FPH: First Pod Height, NBP: Number of Branches Plant $^{-1}$, NPP: Number of Pods Plant^{-1}, SYP: Seed yield plant^{-1}, 100 SW: 100 Seed Weight, GY: Grain Yield, COLT: Cold Tolerance, DR: Drought Tolerance

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Table 3. Elite Nursery-Early -2012

Accession No (ILL)	DAF	DAM	PH (cm)	FPH (cm)	NBP	NPP	1000 SW (g)	SYP (g)	GY (g)	COLT (1-9)	ST (1-5)	V (1-5)	S
10802	140	181	22	8.0	3.05	18.9	38.7	1.49	51.5	5	4	4	+
10803	138	184	20	8.0	2.95	18.2	45.0	1.08	19.5	7	5	5	
10804	137	183	20	8.0	2.55	18.5	38.0	0.92	27.5	5	5	5	
10805	141	182	17	8.5	2.50	21.0	36.7	1.03	44.0	5	5	5	
10806	139	180	22	7.5	2.60	17.5	40.5	1.08	41.0	7	5	4	
10807	142	180	25	10.0	2.75	28.6	32.5	1.27	54.0	5	5	5	
10808	140	183	17	7.5	2.70	25.5	47.2	1.03	31.5	3	5	5	-
10809	140	181	21	8.5	3.70	32.9	47.2	1.90	38.5	7	5	4	+
10810	142	183	19	10.0	2.25	16.0	44.5	0.91	54.5	7	4	4	
10811	141	181	21	9.5	2.60	19.1	41.0	1.36	70.5	7	3	3	+
10812	141	180	22	9.5	3.10	27.9	49.0	1.47	56.0	5	4	4	
10817	138	180	18	9.0	2.45	16.5	27.9	0.78	29.5	7	5	5	
10818	139	183	22	10.0	2.70	23.5	53.0	1.41	56.5	7	4	4	
10819	140	182	18	7.0	2.20	19.5	42.1	0.99	50.0	5	5	5	
10820	139	181	20	7.5	2.75	43.8	44.0	2.69	48.0	7	5	5	
10830	137	181	20	8.0	2.65	30.3	41.5	1.74	78.0	5	4	4	+
10893	137	178	22	9.5	2.50	20.6	52.4	1.19	55.5	4	4	3	
10897	140	185	25	10.0	2.30	22.0	42.8	1.62	37.5	5	3	3	
10899	141	184	19	8.5	2.55	20.2	47.2	1.43	32.0	7	4	4	
10900	138	180	19	7.0	2.45	22.9	55.0	1.27	37.0	7	4	4	-
10912	141	185	25	10.5	3.45	30.1	46.6	1.71	30.5	7	4	4	
10921	140	182	23	10.5	3.15	27.0	54.0	1.76	66.0	3	3	3	+
10922	140	183	23	9.5	2.15	16.4	42.0	0.91	28.5	7	4	5	
10947	140	180	23	10.5	2.50	34.4	43.1	2.28	13.0	7	4	4	-
10948	137	181	21	9.5	2.65	24.0	40.5	1.40	22.5	7	5	5	--
10949	140	180	22	8.5	2.75	42.2	44.7	2.04	68.5	5	4	3	+
10951	137	181	20	8.5	2.15	11.8	36.7	0.59	19.0	7	5	5	-
10953	142	181	25	9.5	2.95	22.8	52.9	1.71	32.5	7	3	3	
10961	138	180	20	9.0	1.25	20.2	41.0	1.03	81.5	7	5	2	-
10964	141	182	20	9.0	3.0	19.6	46.2	1.15	30.0	5	5	5	
10965	143	182	19	8.0	2.40	23.8	48.5	1.13	48.5	5	5	4	-
10970	139	175	20	7.0	2.30	19.5	39.5	0.91	41.0	7	5	4	-
10971	140	180	19	8.0	2.35	10.0	42.5	0.45	42.5	5	5	5	-
6994	139	180	23	10.0	2.90	9.9	42.7	0.51	48.0	5	3	3	
8006	137	178	20	7.5	2.25	23.2	33.2	0.91	41.0	7	4	4	-
Kafkas	142	178	24	11.5	3.80	34.5	37.7	1.77	102.5	3	2	2	
Mean	140	181	21	9.0	2.65	25.1	44.28	1.30	45.22				
LSD	4.03*	4.00*	4.78*	ns	-	9.88**	16.1**	0.88*	14.8**	ns	ns	ns	

DAF: Days to Flowering, DAM: Days to Maturity, PH: Plant Height, FPH: First Pod Height, NBP: Number of Branches Plant -1, NPP: Number of Pods Plant^{-1}, SYP: Seed yield plant^{-1}, 1000 SW: 1000 Seed Weight, GY: Grain Yield, COLT: Cold Tolerance, ST: Stand, V: Plant Yield Vigor, S:selection

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Table 4. Elite Nursery-Red -2012

Accession No (ILL)	DAF	DAM	SYP (g)	PH (cm)	FPH (cm)	NBP	NPP	1000 SW (g)	GY (g)	COLT (1-9)	Stand (1-5)	V (1-5)	S
10749	140	182	1.52	21.0	8.5	2.3	25.3	57.7	34.7	4	4	4	+-
10753	141	185	1.27	24.0	10.5	1.9	23.4	50.2	67.0	7	4	4	
10756	142	182	1.29	20.5	10.0	2.9	34.2	51.5	56.5	5	4	2	+
10766	146	185	1.74	23.5	9.50	3.0	34.2	38.7	36.5	5	5	4	
10767	146	185	1.36	22.5	10.0	2.4	28.0	49.0	28.5	5	4	3	
10769	139	185	1.61	19.0	7.0	2.4	22.2	51.5	23.2	4	5	5	
10770	140	182	1.26	18.0	7.0	2.4	23.0	39.6	26.0	7	5	5	
10773	145	185	1.53	22.5	9.0	2.3	30.6	44.7	60.0	4	4	4	+
10778	141	185	1.33	21.0	9.5	2.8	21.3	48.2	20.9	4	5	4	-
10780	147	185	0.93	25.0	8.5	2.6	15.4	53.5	22.5	5	5	5	
10783	150	185	1.17	20.5	8.0	3.7	21.5	45.4	25.7	7	5	5	+-
10790	143	185	1.81	25.5	10.5	3.0	32.8	48.0	82.5	2	3	3	+
10791	145	185	1.18	25.0	9.5	3.3	22.8	50.2	44.0	3	4	4	
10792	141	185	1.45	21.5	8.0	2.1	26.4	44.2	41.0	7	4	4	
10793	151	182	2.54	25.5	11.0	3.1	47.0	43.2	26.0	7	4	4	
10794	139	184	0.90	17.5	8.5	2.1	16.7	40.7	28.7	5	5	5	-
10795	141	185	2.17	24.5	8.5	2.8	35.0	54.2	84.3	4	4	5	+
10796	146	185	1.12	22.0	9.5	2.4	23.3	44.2	56.2	4	3	2	
10800	143	185	2.98	26.0	13.0	3.3	47.3	50.7	65.2	1	3	2	
10823	142	185	2.57	22.5	8.0	2.5	54.5	47.8	19.5	7	4	5	-
10893	140	185	1.40	23.0	11.0	2.4	23.7	54.3	41.5	5	4	3	
10894	142	185	1.91	25.0	11.0	2.6	35.0	44.2	48.8	3	4	4	
10895	151	182	1.74	23.0	10.5	4.2	33.7	50.7	36.2	7	4	4	
10897	140	185	1.53	21.0	8.0	2.5	25.3	47.7	53.2	7	5	4	
10898	142	185	1.68	23.5	10.0	2.9	30.3	52.0	48.7	4	4	4	
10899	142	185	1.49	25.0	9.0	2.9	25.2	46.0	49.2	7	4	4	
10900	145	185	1.51	26.0	13.5	3.8	48.9	49.5	89.5	4	3	2	
10906	144	185	1.95	26.0	12.5	3.3	30.6	42.5	81.7	4	4	4	
10913	147	185	1.68	23.0	9.0	2.4	30.5	49.5	38.2	4	4	4	
10915	140	185	1.44	23.0	10.0	3.0	26.2	41.2	20.5	4	5	5	
10917	139	182	2.08	21.0	7.5	2.9	38.6	50.0	60.0	3	4	3	
10921	141	185	1.48	19.0	8.0	2.7	22.7	51.5	48.0	3	5	5	
10922	143	185	2.46	22.5	8.0	2.5	34.2	43.5	30.0	4	5	5	-
5883	143	185	2.21	24.0	8.0	2.7	40.7	41.0	69.5	3	3	3	
10847	139	185	1.42	21.1	7.5	2.3	31.0	45.2	16.7	7	5	4	-
Kişlik Kirmizi 51	147	185	1.59	25.5	11.5	2.8	29.3	43.7	99.5	3	2	2	
Mean	143	184	1.69	22.7	9.4	2.7	30.3	46.1	46.8				
Duncan	2.2**	ns	ns	1.**	1.1*	ns	7.8*	2.3**	13.3**	*	*	*	

DAF: Days to Flowering, DAM: Days to Maturity, PH: Plant Height, FPH: First Pod Height, NBP: Number of Branches Plant -1, NPP: Number of Pods Plant^{-1}, SYP: Seed yield plant^{-1}, 100 SW: 100 Seed Weight, GY: Grain Yield,COLT: Cold Tolerance, PV: Plant Vigor, Stand: STD, S: selection

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4. DISCUSSION

1. Drought Tolerance-2012: total fifty genotypes were evaluated for drought and other traits. Differences among genotypes were significant. Genotypes ILL10827, ILL10833, ILL10906, ILL10913, ILL10917, ILL10922 and ILL10971 were selected for earlier, more pods, average yield, drought and cold resistance. Genotypes ILL10960, ILL6002 and ILL7979 were selected for next trails. Most genotypes shorter than 25 cm and short stem make too difficult the harvest. Total precipitation in reproductive growth period from March to June was 107 mm (Table 1), and the plant height was affected by low precipitation. Agsakalli et al (2001) reported that relationships between rainfall and plant height were positive and significant, but temperature and plant height character had a negative association. In experiment, ICARDA genotypes had taller plant height than local checks. Bicer and Sakar (2008) reported that genotypes from ICARDA had taller than local check. As lentil sown in large area, tall genotypes should consider in plant selection for mechanic harvest. Genotypes that exceed 25-30 cm can be evaluated for this purpose. Large seeded had generally a longer flowering and maturing period, and they generally susceptible to cold, and the result has reported by Erskine (1996). Genotypes ILL10827, ILL10831, ILL10833, ILL10906, ILL10913, ILL10917, ILL10960, ILL10966, ILL10969, ILL10971, ILL6002 and ILL7979 were selected for drought. These genotypes founded hopeful for drought trials in the region.

2. Early-2012: total thirty-six genotypes were tested for days to maturity, seed yield plant^{-1}, plant height, number of pods plant^{-1}, 1000 seed weight and grain yield. Genotypes ILL10802 and ILL10830 were selected for seed trait and high yielding, also, ILL10830 was determined as a genotype quite early and cold intermediate tolerant. Although ILL10809 and ILL10811 were killed by cold, they had average vigor and good seed trait. ILL10921 had moderate yield, average vigor and acceptable stand. ILL10949 had earlier and high pods per plant. These genotypes were selected for next trails. ILL10808, ILL10900, ILL10947, ILL10948, ILL10951, ILL10961, ILL10965, ILL10970 and ILL10971 were discarded in the field. Local variety was late flowered and matured, the results agree with earlier researchers (Bicer and Sakar 2007), they reported that genotypes from ICARDA for flowering and maturity were earlier than local variety.

3. Red-2012: total thirty-three genotypes were tested. Genotypes ILL10778, ILL10794, ILL10823 and ILL10922 discarded in field due to cold damage. Bicer and Sakar (2008) reported that in this region, lentil genotypes were affected by cold. Genotypes ILL10749, ILL10756, ILL10773, ILL10783, ILL10790, ILL10795 and ILL10800 were selected due to some traits such as 1000 seed weight, seed uniformity and vigor.

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