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VARIATION FOR YIELD COMPONENTS IN TWO WINTER SOWN LENTIL CULTIVARS (*LENS CULINARIS* MEDIC.)

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Abstract

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This study was carried out at the experimental field of Agricultural Faculty of Eskisehir Osmangazi University, Eskisehir, Turkey in 2006-2007. Variation in yield components of two lentil cultivars (Kayi-91 and Sazak-91) were investigated. The mean values recorded for Kayi 91 were better than Sazak 91. Positive and highly significant correlations determined for the characteristics.The regressions for harvest index, the grain yield per plant and biological yield per plant with root dry weight were possitive.

Key words: lentil, yield components, correlation, regression

Introduction

Malnutrition one of the major problem in Turkey is mainly due to protein deficiency in daily diets. Pulses are cheaper source for protein as compared to meat. The production of puls cultivars with high yielding, disease resistant and environmentally adaptable are the key to overcome the malnutrition problem (Amanullah, 2000).

Lentil (*Lens culinaris* Medic.) contains 28.6% protein, 3.1 % ash, 4.6 % crude fiber, 44.3 % starch, 36.1 % amylose, 63.1 % total carbonhydrates and 420 cal 100 g^{-1} gross energy (Bhatty and Wu, 1974; Sahi et al., 2000). The high level of protein together with a lower level of anti- nutritional factors and a shorter cooking time than most of other pulses, make lentil very suitable for human consumption (Williams et al.,1993; Sahi et al., 2000). It may be deep fried and consumed as snack, or mixed with cereal flour for preparing breads and cakes, young pods and leaves are used as vegetable in some countries. The straw and pod wall residues from threasing have good feed value, containing 4 % protein. Lentil is occasionally used as fodder and as green manure crop (Amanullah, 2000).

Lentil is the second most important pulse crop of Turkey only next to chickpea.It is grown in 439.900 hectares with production of 622.684 tones and average yield of 1415 kg ha^{-1} (Anonymous, 2006). It is widely grown in southeast and Central Anatolian regions of Turkey.

This study was carried to determine variations yield components and relationships among these characteristics in lentil.

Materials and Methods

This study programmed as two part. One of its

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was carried in the research field of Agricultural Faculty of Eskisehir Osmangazi University, Eskisehir, Turkey in 2006-2007. The cultivars Sazak-91 and Kayi-91 were used as experimental materials. They are well adapted to the ecological conditions of Central Anatolia. Both of are classified in the large- grained group (Sehirali, 1988). The approximate grain yield of Kayi 91 is 170 kg/da, Sazak 91 is 150 kg/da. Both of its has tolerence to major lentil diseases.

The field experiment was conducted in randomized complete block with four replications. Each plot was 5.4 m^2 in size. Lentil seeds were sown on October, 9, 2006, by hand with 30 cm row spacing and 5 cm depth. The basal fertilizer application at the sowing was 20 kg N and 60 kg P_2O_5 ha^{-1}. After stand establishment, weeds were controlled by hand. Harvest time of lentil was on 28, June, 2007. Biological yield per plant (g)(BYP), plant height (cm) (PH), first pod height (cm) (FPH), number of pod per plant (NPP), number of seed per plant (NSP) and grain yield per plant (g) (GYP) were recorded on 15 plants which were randomly taken from each plot. Harvest index (%) (HI) and biological yields (g m^{-2}) (BY) were determined at each plot in the 0.25 m^{-2} area.

Afterwards each plot was harvested and grain yield (g m^{-2}) (GY) and 100 seed weight (g) were estimated.

Another part of the study was conducted as pod trial which was set up using randomized block design with ten replications (stem and root dried weights were replicated four times). Plants were harvested after ten days of sowing and plant height (PH) (cm), number of leaves (NL), root height (cm) (RH), stem fresh weight (SFW) and root fresh weight (g) (RFW) were recorded. Stem dry weight (SDW) and root dry weight (g) (RDW) were also determined after drying at 78 ^{0}C for 24 h.

The avarege size of seeds was measured in a sample of 20 seeds which were randomly selected. Measurements of three major perpendicular dimensions of seeds were taken with a micrometer to an accuracy of 0.01 mm.

Correlation and regression analysis were used to evaluate of relationships between the characters.

Results

Some of the yield components such as grain yield and harvest index were lower than expected (Table 1). They were affacted by unsuffucient climatic conditions prevailed at flowering time. Low temperatures as 7.6 ^{o}C and 9.4 ^{o}C and drought (total rainfall: 1.4 mm) were affacted pollination negatively and caused poor seed setting and seed filling.

According to data recorded for biological yield per plant (g), first pod height (cm), number of seed per plant, grain yield per plant (g), grain yield (g m^{-2}) and harvest index (%) Kayi 91 has better performance than Sazak 91 (Table 1).

The means of plant height, number of leaves, root lenght, stem fresh weight, stem dry weight of Kayi 91 were also higher than Sazak 91 (Table 1). Nonsignificant differences were found for means of root fresh and dry weights of the cultivars.

Mean values of kernel size and 100 grain weight (100 GW) of Kayi 91 were better than Sazak 91 (Table 1).

Number of pod per plant and biological yield of Sazak 91 determined as better than Kayi 91. High biological yield gives more stable to use for feed. High number of pod per plant if each of it filled by seed can effect yield positively.

Correlations: In Kayi 91**,** significant and possitive correlations were determined among biological yield and plant height, first pod height and harvest index. Among plant height and first pod height and harvest index. Among first pod height and grain yield per plant, biological yield and harvest index. Among number of pod per plant and number of seed per plant and grain yield. Among grain yield per plant and grain yield and biological yield. Among grain yield and biological yield (Table 2). Among number of leaves and stem fresh weight and stem dry weight. Among root lenght and root fresh weight (Table 3). Among kernel width and kernel height. Among kernel height and kernel lenght (Table 4).

In Sazak 91, significant and possitive correlations were found among plant height and biological yield per plant. Among first pod height and plant height.

Table 1
Means of the characters of the cultivars

	KAYI 91			SAZAK 91		
	Value of characters in field					
	n	range	mean	n	range	mean
Biological yield per plant (g)	28	1.37-8.75	3.84	17	1.26-8.65	3.61
Plant height (cm)	28	18.00-31.00	23.71	17	21.00-29.00	24.88
First pod height (cm)	28	11.00-24.00	16	17	8.00-23.00	14.82
The number of pod per plant	26	6.00-35.00	16.69	17	5.00-43.00	17.29
The number of seed per plant	27	3.00-34.00	10.37	17	2.00-26.00	8.82
The grain yield per plant (g)	28	0.11-1.00	0.41	17	0.12-1.12	0.37
Biological yield (g m^{-2})	4	168.00-323.20	237	4	202.00-344.40	257.7
Grain yield (g m^{-2})	4	3.64-8.55	6.15	4	1.68-3.44	2.4
Harvest index (%)	4	6.78-20071	10.63	4	6.50-8.82	7.26
Value of characters in pods						
Plant height (cm)	29	7.50-21.50	14.15	24	5.50-21.50	11.91
Number of leaves	29	4.00-12.00	7.55	24	0.00-12.00	6.25
Root lenght (cm)	29	3.50-16.00	9.07	24	3.50-18.00	8.58
Stem fresh weight (g)	29	0.06-0.20	0.12	24	0.04-0.20	0.1
Root fresh weight (g)	29	0.01-0.16	0.06	24	0.04-0.14	0.07
Root dry weight (g) ($x10^{-4}$)	4	2.80-2.86	2.83	4	2.80-3.20	3
Stem dry weight (g) ($x10^{-4}$)	4	3.50-3.74	3.67	4	1.80-2.10	2
Value of seed characters						
100 grain weight (g)	4	4.03-4.37	4.25	4	3.37-4.44	4.02
Kernel width	20	4.30-5.26	4.85	20	3.10-4.92	4.27
Kernel height	20	4.50-5.98	5.12	20	3.66-5.10	4.44
Kernel lenght	20	1.16-2.14	1.59	20	1.00-1.68	1.31

n: the number of sample

Among number of pod per plant and first pod height. Among number of seed per plant and first pod height and number of pod per plant. Among grain yield per plant and first pod height, number of pod per plant, number of seed per plant. Among grain yield and biological yield per plant and plant height. Among biological yield and grain yield. Among harvest index and biological yield per plant and grain yield (Table 2). Among number of leaves and plant height. Among stem fresh weight and plant height and number of leaves. Among root fresh weight and plant height and stem fresh weight. Among stem dry weight and plant height and stem fresh weight (Table 3). Among kernel width and 100 grain weight. Among kernel height and 100 grain weight and kernel width. Among kernel lenght and 100 grain weight (Table 4).

Regressions: Statistically significant variations were estimated as 91% in the biological yield per plant, 78% in the grain yield per plant and 45% in the harvest index for Kayi-91. For each "g" of root dry weight were increased the grain yield as 3.16 g per plant and biological yield as 3.83 g per plant. For each percent of root dry weight was increased the harvest index 13.33% (Figure 1).

From the simple regression (Figure 2) it was found that the regression for root dry weight was positively

Table 2
Correlations between the characters evaluated in field (Light: Kayı 91, Dark: Sazak 91)

	BYP	PH	FPH	NPP	NSP	GYP	GY	BY	HI
BYP	1	0,98*	0.98*	0.79	0.62	0.93	0.84	0.9	0.99**
PH	0,99**	1	0.96*	0.88	0.73	0.94	0.89	0.91	0.96*
FPH	0.92	0.96*	1	0.81	0.66	0.97*	0.89	0.95*	0.96*
NPP	0.89	0.93	0.99**	1	0.97*	0.92	0.97*	0.92	0.73
NSP	0.86	0.91	0.98*	0.99**	1	0.82	0.92	0.83	0.53
GYP	0.3	0.85	0.96*	0.98*	0.99**	1	0.98*	0.99**	0.88
GY	0,99**	0.99**	0.91	0.88	0.85	0.78	1	0.98*	0.78
BY	0.98	0.95	0.87	0.85	0.83	0.78	0.97*	1	0.84
HI	0.97*	0.95	0.81	0.77	0.73	0.64	0.98*	0.94	1

*: Significant at 0.05 probability level **: Significant at 0.01 probability level

Table 3
Correlations between the characters evaluated in pods (Light: Kayı 91, Dark: Sazak 91)

	PH	NL	RH	SFW	RFW	SDW	RDW
PH	1	0.63	0.89	0.59	0.91	0.48	0.62
NL	0,96*	1	0.91	0.98*	0.88	0.98*	0.81
RH	0.82	0.85	1	0.88	0.99**	0.82	0.81
SFW	0.99**	0.97*	0.88	1	0.86	0.94	0.9
RFW	0.96*	0.93	0.94	0.98*	1	0.76	0.84
SDW	0.99*	0.92	0.73	0.96*	0.91	1	0.7
RDW	0.82	0.69	0.81	0.84	0.89	0.81	1

*: Significant at 0.05 probability level **: Significant at 0.01 probability level

increased with grain yield per plant (62%), harvest index (57%) and biological yield per plant (44%) for Sazak-91. For each "g" of root dry weight were increased the grain yield as 0.21 g per plant and biological yield as 1.66 g per plant. For each percent of root dry weight was increased the harvest index as 1.96% (Figure 2).

Discussions

In the field experiment the data recorded for Kayi 91 was better than Sazak 91 for most of yield components. This may be related with better tolerance to unsufficient environment. Bakhsh et al. (1991) reported that some genotypes of lentils are more stable and adaptable to changes in environment than others.

In lentil, at the first stages of development, the amount of dry matter used for the root and above the soil organs shows significant differences due to the cultivar, using more food stuff for root development increases and this rises the cultivar's tolerance to negative conditions (Ciftci et al., 1997).

The study of crop root systems has lagged behind that of above-ground plant characteristics. This disparity may be attributed both to the concealment of the root system in the soil and to its variable nature, both of which enormously complicate observation and experimentation. The importance of roots, for regulating plant growth, is well-known: they are the suppliers of water, minerals and growth substances. Developed root systems are increasing drought tolerance and plants are embracing to soil rather tightly.

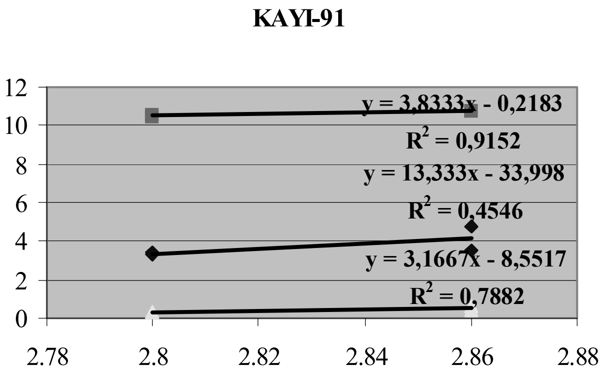

Fig. 1. Regression between root dry weight and other characters (Kayi-91)

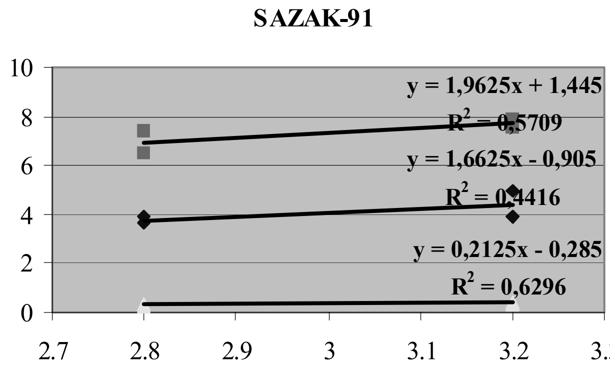

Fig. 2. Regression between root dry weight and other characters (Sazak-91)

Table 4
Correlations among seed characters
(Light: Kayı 91, Dark: Sazak 91)

	100 GW	KW	KH	KL
100 GW	1	0.76	0.89	0.94
KW	0.96*	1	0.95*	0.91
KH	0.96*	0.96*	1	0.99**
KL	0.96*	0.86	0.86	1

*: Significant at 0.05 probability level **: Significant at 0.01 probability level

Root development of the cultivars which was indicated by fresh and dry weight were very close to each other. However root leght of Kayi 91 was longer and this means Kayi 91 is able to obtain more water and minerals from deeper soil layer than Sazak 91. This ability give advantage to Kayi 91 to be more tolerant to adverse conditions and produce more yield. Sarker et al. (2005) reported that the lentil genotypes varied greatly for stem height, stem weight, root lenght and root weight. Ciftci et al. (1997) indicated that root height , plant height and number of leaves of Kayi 91 were found higher than Sazak 91. Gecit et al. (2001) evaluated 3 lentil cultivars for morphologic characters and they found that plant height , root height , root dry weight and stem dry weight were different. With regard to food legumes, little information is available on seedlings shoot and root systems in lentil (Mia et al., 1996). In this study, plant height of Sazak 91 was shorter than Kayi 91. Shortened stems are likely to give rise to a considerable decrease in the total biomass and therefore in grain yield (Madic and Kuburovic, 2003).

Quality seeds of improved varieties are the key to agricultural progress. The production potential and other desirable characteristics of seeds are limits the production. Part of the success of the farmer's production depends on the quality of seed (Srivastava, 1986; Peksen et al., 2004). Lazora et al. (2001) and Bejiga et al. (1996) found that 100 seed weight was the most important character. Kernel size which described by width (KW) , height (KH), lenght (KL) and 100 grain weight considerably important for planting as seed and market for consumers. Larger seeds generally emerge more vigorously and gives good stand establishment that results morphologically beter developed and healty plants which effects the yield possitively.

Lentil seed is a source of high-quality protein for human and its straw and milling wastes are high value animal feed (Kurdali et al., 1997; Gahoonia et al., 2005). In our research, harvest index and biological yield per plant are increased with remaining root dry weight, especially Kayi-91 (Figures 1 and 2).

Conclusions

The ranges between minimum and maximum values of the characters are valuable to decide for homogenesity in plant population and even give idea for stability of the cultivar. Narrower range is better. Ranges for first pod height, grain yield, grain yield per plant, harvest index, plant height, number of leaves, root lenght, stem fresh and dry weight,root fresh and dry weight were narrower in Kayi 91 (Table 1).

Data obtained in this study present that Kayi 91 with most characters had better performance than Sazak 91. In addition to that because of its longer plant height harvest can be easier by machine which effects the farmers decision to grow lentils in large areas. With longer root devolopment gives more tolerance to drought conditions. Soil moisture is better conserved in deeper soil layers, lentil varieties developing larger and deeper root system are advantageous for sustaining yield in nutrient-poor soils of dry areas (Gahoonia et al., 2005).

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