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A Research on determining the factors affecting on seed yield in different lentil lines and cultivars (*Lens culinaris Medik.*) in adiyaman conditions by correlation and path coefficient analysis

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ABSTRACT

This study was conducted in 2010 year in Adiyaman province Besni district (37°41'36.0"N 37°51'39.3"E) with 9 lentil lines (FLIP 2007-58L, FLIP 2007-133L, FLIP 2006-41L, FLIP 2005-20L, FLIP 2007-52 L, FLIP 2007-79L, FLIP 2005- 31L, FLIP 2006-39L, FLIP 2007- 106L) and two lentil cultivars (FIRAT-87 and CAGIL). In the research, direct and indirect effects of plant height, first pod height, branch number per plant, pod number per plant, seed number per pod, seed number per plant, thousand seed weight properties on seed yield were examined by correlation and path coefficient analysis. According to the correlation coefficients, a strong positive relationship was found between the number of seeds per pod and the number of seeds per plant (r=0.792). It is necessary to consider the relationship between the number of pods per plant and the number of seeds per pod in breeding studies in terms of seed yield in lentil.

Keywords: Lentil, Path Coefficient Analysis, Correlation.

INTRODUCTION: Lentil, which has an important place in human and animal nutrition among pulse crops; it is one of the oldest cultivated plants. It is known that lentil cultivation has been done since 8000 years ago (Pellet, 1988). In the region from Turkey to Iraq, there are wild lentil genotypes. Therefore, it has been reported that this region is the natural origin of the Lens genus. According to fao statistics in 2018, lentil has 6.100.922 ha of cultivation area, 103,81 kg/da yield and 6.333.352 tons of production in the world. In Turkey 259.374 ha of cultivation, 136,10 kg/da yield 353.000 tons a production value. The five most lentil producing countries in the world are: Canada (2.092.136 tons), India (1.620.000 tons), United States of America (381.380 tons), Turkey (353.000 tons), Australia (255.185 tons) respectively (FAO, 2018). Local genotypes have adapted to the region since they have been grown in that region for a long time. For this reason, they are an important resource in plant breeding and variety development studies. Especially in self-fertilized plants, they increase the success of the research due to the preservation of genetic characteristics. Path coefficient analysis is an analysis method that reveals the direct and indirect effects of a variable on another variable (Wright, 1921). This method, which is also applied by many researchers, has been included as one of the basic elements in the lentil study (Jain *et al.*, 1995; Vir and Gupta, 2001; Verma *et al.*, 2004; Makkawi *et al.*, 2008; Karadavut, 2009; Olaiya and Adigun, 2010; Manggoel *et al.*, 2012; Sözen and Karadavut, 2017; Sakthivel *et al.*, 2019). In this study, in order to achieve success in breeding, the factors effective on yield traits were tried to be explained using correlation and path coefficient analysis.

OBJECTIVES: The objectives of this study were as follows: (1) to determine the correlation coefficients between traits in different lentil genotypes (2) to reveal the path coefficients of the factors affecting seed yield in different lentil genotypes in Adiyaman / Turkey conditions.

MATERIALS AND METHODS: This research was established in a randomized complete block design (RCBD) with four replications according to factorial arrangement in Adiyaman province Besni district (37°41'36.0"N 37°51'39.3"E) in 2010 year. Plot area during planting; It consists of 6 rows with a length of 5 m. Plantings were made with 20 cm row spacing with plot seeder and total plot area was 6 m2. On the other hand 350 lentils seeds were planted per square meter. 9 lentil lines (FLIP 2007-58L, FLIP 2007-133L, FLIP 2006-41L, FLIP 2005-20L, FLIP 2007-52 L, FLIP 2007-79L, FLIP 2005- 31L, FLIP 2006- 39L, FLIP 2007-106L) and two standard lentil cultivars (FIRAT-87 and ÇAĞIL) was used in the treatment. Since the experiment was carried out for winter and rainfall was sufficient for seed yield, no irrigation was done during vegetation period. During the cultivation, weed control was done mechanically by hand. The harvest was done manually on 05 June 2010. In order to determine the properties that affect the yield directly and indirectly, the path coefficient and also the correlation coefficients were calculated with the help of Totemstat statistical analysis program (Acikgoz N, 2004). In this analysis, seed yield was the dependent variable, and the other parameters are independent variables.

RESULTS AND DISCUSSION: The correlation coefficients of lentil local lines and their varieties are given in the table 1. A positive and very important relationship was found between the number of seeds per pod and the number of seeds per plant (0.792). This situation can be explained by the increase in the number of seeds per pod, the total amount of grain in the plant increases. There is a close relationship between them. The number of seeds per pod should also be taken into account in the breeding studies carried out in order to increase the number of seeds per plant. Similar results and opinions are reported by various researchers (Singh and Dixit, 1971; Kumar *et al.*, 1983; Baylan and Singh, 1986).

Direct effects of first pod height (46.069%), pod number per plant (26.681%), seed number per pod (47.699%) and thousand seed weight (3.247%) on seed yield are positive, plant height (48.137%), branch number per plant (8.571%) seed number per plant (26.956%) direct effect on seed yield was determined negatively (table 2 and 3).

Parameters	Seed Yield	Plant Height	First Pod Height	Branch Number per Plant	Pod Number per Plant	Seed Number Per Pod	Seed Number Per Plant
Plant Height	-0.548^{ns}						
First Pod Height	0.087^{ns}	0.372^{ns}					
Branch Number per Plant	-0.171^{ns}	0.273^{ns}	-0.081^{ns}				
Pod Number per Plant	0.195^{ns}	-0.268^{ns}	-0.264^{ns}	0.161^{ns}			
Seed Number Per Pod	-0.081^{ns}	0.383^{ns}	-0.409^{ns}	0.409^{ns}	0.061^{ns}		
Seed Number Per Plant	-0.047^{ns}	0.289^{ns}	-0.193^{ns}	0.375^{ns}	0.366^{ns}	0.792**	
1000 Seed Weight	0.213^{ns}	-0.555^{ns}	-0.186^{ns}	-0.483^{ns}	0.229^{ns}	-0.369^{ns}	-0.142^{ns}

Table 1: Correlation coefficients matrix for lentil lines and cultivars.

Parameters	Direct Effect	Indirect Effect						
		Plant Height	First Pod Height	Branch Number per Plant	Pod Number Per Plant	Seed Number Per Pod	Seed Number Per Plant	1000 Seed Weight
Plant Height	-1.062		-0.395	-0.290	0.285	-0.407	-0.307	0.589
First Pod Height	0.954	0.355		-0.078	-0.252	-0.390	-0.184	-0.178
Branch Number per Plant	-0.110	-0.030	0.009		-0.018	-0.045	-0.041	0.053
Pod Number Per Plant	0.314	-0.084	-0.083	0.050		0.019	0.115	0.072
Seed Number Per Pod	1.237	0.474	-0.505	0.505	0.076		0.979	-0.457
Seed Number Per Plant	-0.603	-0.174	0.116	-0.226	-0.221	-0.477		0.086
Thousand Seed Weight	0.048	-0.027	-0.009	-0.023	0.011	-0.018	-0.007	

Table 2: Path coefficient values for direct and indirect effects of variables on seed yield.

Parameters	Direct Effect	Indirect Effect						
		Plant Height	First Pod Height	Branch Number per Plant	Pod Number Per Plant	Seed Number Per Pod	Seed Number Per Plant	1000 Seed Weight
Plant Height	48.137		19.061	22.614	24.208	15.698	13.717	39.737
First Pod Height	46.069	16.090		6.062	21.449	15.036	8.228	11.997
Branch Number per Plant	8.571	1.362	0.432		1.502	1.732	1.844	3.583
Pod Number Per Plant	26.681	3.816	4.005	3.932		0.743	5.143	4.840
Seed Number Per Pod	47.699	21.494	24.391	39.391	6.452		43.806	30.824
Seed Number Per Plant	26.956	7.892	5.608	17.617	18.773	18.407		5.772
Thousand Seed Weight	3.247	1.210	0.433	1.813	0.935	0.686	0.306	

Table 3: Direct and indirect effect ratios (%) of some important parameters on seed yield in lentil lines and cultivars.

Similar to our findings, first pod height direct effect on seed yield is positive (Sozen and Karadavut 2017) pod number per plant direct effect is positive Manggoel *et al.* (2012), seed number per pod direct effect is positive Manggoel *et al.* (2012), thousand seed weight direct effect is positive (Sözen and Karadavut, 2017). Number of seed per pod it is an important yield factor and it has been reported that it can be used to increase seed yield in breeding studies (Hamdi *et al.*, 2002). It has been reported that plant height and number of grains per plant have a direct negative effect on grain yield (Manggoel et al., 2012). Considering the path coefficients, the parameter with the highest positive direct effect on seed yield was determined as seed number per pod (1.2365) (table 2). On the other hand, the highest negative direct effect on seed yield was obtained from plant height (-1.0616). These results are in agreement with (Manggoel *et al.*, 2012). The indirect effect of the seed number per pod over seed number per plant on the seed yield was determined as the highest positive indirect effect (43.806%). It is noteworthy that the correlation coefficient of these features is also positive and important. The indirect negative highest effect on seed yield was determined in the seed number per pod over 1000 seed weight (30.824%). Erskine *et al.* (1989), in parallel with our study, reported that the most important criterion in revealing the difference between varieties is the number of pods per plant. On the other hand similar opinions reported by (Singh and Dixit, 1971).

CONCLUSION: Considering both correlation coefficients and path coefficients, the following can be said: features such as the number of pods per plant and the number of seeds per pod are the most important seed yield factors in lentils, and they can be used quite effectively in selection to increase yield in breeding studies.

CONFLICT OF INTEREST: Authors have no conflict of interest.

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