



Correlation and path coefficient analysis in determining the characteristics that affect seed yield in different lentil (*Lens culinaris* Medik.) genotypes in Kahramanmaraş conditions

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ABSTRACT

This research was conducted in 2015 year in Kahramanmaraş province (37°32'09.5"N 36°55'01.2"E) with 3 lentil genotypes (CAGIL, FIRAT-87, and FLIP 2005-20 L). In the research, direct and indirect effects of yield components on seed yield were examined by correlation and path coefficient analysis. The correlation coefficients between the investigated features were found to be insignificant. According to the path coefficients, the highest positive direct effect on seed yield was determined as pod number per plant ($p=4.015$). On the other hand, the highest negative direct effect on seed yield was obtained from plant height ($p=-3.606$). The indirect effect of the seed number per plant over number of days until maturity on the seed yield was determined as the highest positive indirect effect ($p=55.546\%$). The indirect negative highest effect on seed yield was determined in the pod number per plant over thousand seed weight ($p=51.488\%$). As a result, the number of pods per plant should be taken into consideration by the breeders due to direct effect of it was positive and high.

Keywords: Path coefficient analysis, correlation, lens culinaris, lentil, genotype.

INTRODUCTION: Lentil is a cultivated plant since ancient times and it is one of the first domesticated plant species (Harlan, 1992). It has been reported that it has been cultured 8000 years ago. It is known that Mesopotamia is the origin of Lens genus. Lentil has 6.100.922 ha of cultivation area, 103,81 kg/da yield and 6.333.352 tons of production in the world and Turkey has 259.374 ha of cultivation, 136,10 kg/da yield 353.000 tons production value (FAO, 2018). 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). Pulse crops have an important place in plant production. Pulse crops contain 18-36% protein and are rich in vitamins and minerals in dry seeds. In addition, it is superior to cereals in terms of absolutely essential amino acids. In the world, in human nutrition, 22% of vegetable protein and 7% of carbohydrates; 8% of proteins and 5% of carbohydrates in animal nutrition are obtained from pulse crops. In addition, pulse crops are rich in vitamins A, B, C and D, phosphorus, iron and potassium elements. Seed yield in plants occurs as a result of the interaction of physiological and morphological characters. It is extremely important in terms of breeding studies to define these features effective on yield and their impact on each other. Correlation coefficient is used to explain the relationships between yield components, but it does not provide detailed information, and many features have an indirect effect on seed yield. The path coefficient analysis technique, first introduced by (Wright, 1921), was used to determine the properties that affect the yield directly and indirectly. Many researchers have benefited from path coefficient analysis method in lentil (Manggoel *et al.*, 2012; Mekonnen *et al.*, 2014; Sözen and Karadavut, 2017; Sakthivel *et al.*, 2019). In this research direct and indirect effects of factors

affecting seed yield were investigated for a successful breeding study by correlation and path coefficient analysis in lentil genotypes.

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.

MATERIALS AND METHODS: The study was carried out in Kahramanmaraş province (37°32'09.5"N 36°55'01.2"E) conditions according to randomized complete block design (RCBD) with four replications in 2015 year. The plot was 5 m and consists of 6 rows. Planting was done with a drill with 20 cm row spacing and the total plot area was 6 m². On the other hand, 350 lentil seeds were planted per square meter. 3 lentil genotypes (CAGIL, FIRAT-87, FLIP 2005-20L) was used in the treatment. Irrigation was not carried out during the vegetation period. During the cultivation, weed control was done manually mechanically. In the research, seed yield, number of days until flowering, number of days until maturity, plant height, first pod height, branch number per plant, pod number per plant, seed number per pod thousand seed weight characteristics were examined according to IBPGR (1985). The correlation coefficients and path coefficient analysis were calculated with Totemstat statistical analysis program (Acikgoz N, 2004). In the path analysis, seed yield was the dependent variable and the other parameters were independent variables.

RESULTS AND DISCUSSION: Table 1 showed that the correlation coefficients of lentil genotypes. Correlation coefficients between all examined properties were found to be insignificant. Although insignificant, the highest positive correlation value with seed yield was observed in the

first pod height (0.996) and the highest negative correlation value was observed in thousand seed weight (-0.941). On the other hand, it was reported that many correlation coefficients between yield and yield components in lentil plant were found to be insignificant (Mangoel *et al.*, 2012).

The correlation coefficient alone is not enough to interpret the relationship between features. In this case, path coefficient analysis is divided into direct and indirect matrix presenting the correlation in a more meaningful way for better interpretation of cause and effect. The main purpose of the path

coefficient analysis is to reveal relationships that cannot be explained by correlation (Mohsin *et al.*, 2009).

Direct effects of number of days until flowering (5.585%), number of days until maturity (0.663%), pod number per plant (40.818%), seed number per pod (14.360%), thousand seed weight on seed (2.780%) yield are positive and plant height (36.231%), first pod height (0.374%), branch number per plant (10.525%), direct effect on seed yield was determined negatively (table 2 and 3). Erskine *et al.* (1989) reported that pod number per plant is important criterion for selection in breeding studies.

Parameters	SY	NDUF	NDUM	PH	FPH	BNP	PNP	SNP
SY								
NDUF	-0.654							
NDUM	0.896	-0.922						
PH	0.697	0.086	0.307					
FPH	0.996	-0.721	0.933	0.629				
BNP	0.480	0.350	0.041	0.963	0.397			
PNP	0.838	-0.136	0.510	0.975	0.785	0.881		
SNP	0.577	0.240	0.156	0.988	0.500	0.993	0.929	
TSW	-0.941	0.872	-0.994	-0.413	-0.968	-0.154	-0.604	-0.267

Table 1: Correlation Coefficients Matrix for Lentil Genotypes.

SY: Seed Yield, NDUF: Number of days until flowering, NDUM: Number of days until maturity, PH: Plant height, FPH: First pod height, BNP: Branch number per plant, PNP: Pod number per plant, SNP: Seed number per pod, TSW: Thousand seed weight

Parameters	Direct Effect	Indirect Effect							
		NDUF	NDUM	PH	FPH	BNP	PNP	SNP	TSW
NDUF	0.100		-0.092	0.009	-0.072	0.035	-0.014	0.024	0.087
NDUM	0.024	-0.023		0.008	0.023	0.001	0.012	0.004	-0.024
PH	-3.606	-0.311	-1.108		-2.267	-3.474	-3.517	-3.562	1.490
FPH	-0.025	0.018	-0.024	-0.016		-0.010	-0.020	-0.013	0.025
BNP	-0.996	-0.349	-0.041	-0.960	-0.396		-0.877	-0.990	0.154
PNP	4.015	-0.544	2.046	3.916	3.150	3.536		3.730	-2.425
SNP	1.401	0.337	0.218	1.384	0.701	1.392	1.302		-0.374
TSW	0.131	0.114	-0.130	-0.054	-0.127	-0.020	-0.079	-0.035	

Table 2: Path Coefficient Values for Direct and Indirect Effects of Variables on Seed Yield in Lentil Genotypes

NDUF: Number of days until flowering, NDUM: Number of days until maturity, PH: Plant height, FPH: First pod height, BNP: Branch number per plant, PNP: Pod number per plant, SNP: Seed number per pod, TSW: Thousand seed weight.

Parameters	Direct Effect	Indirect Effect							
		NDUF	NDUM	PH	FPH	BNP	PNP	SNP	TSW
NDUF	5.585		2.509	0.087	1.069	0.371	0.138	0.247	1.856
NDUM	0.663	1.253		0.075	0.337	0.011	0.127	0.039	0.515
PH	36.231	17.324	30.080		33.527	36.706	35.755	36.499	31.643
FPH	0.374	1.014	0.640	0.160		0.106	0.202	0.130	0.519
BNP	10.525	19.413	1.114	9.644	5.855		8.919	10.140	3.265
PNP	40.818	30.315	55.546	39.349	46.600	37.359		38.228	51.488
SNP	14.360	18.743	5.917	13.910	10.364	14.709	13.238		7.934
TSW	2.780	6.354	3.531	0.544	1.875	0.214	0.804	0.358	

Table 3: Direct and Indirect Effect Ratios (%) of Some Important Parameters on Seed Yield in Lentil Genotypes

NDUF: Number of days until flowering, NDUM: Number of days until maturity, PH: Plant height, FPH: First pod height, BNP: Branch number per plant, PNP: Pod number per plant, SNP: Seed number per pod, TSW: Thousand seed weight.

Considering the path coefficients, the parameter with the highest positive direct effect on seed yield was determined as pod number per plant (4.015) (table 2). It is reported that the number of pods per plant is a criterion to be considered in selection studies (Singh and Dixit, 1971).

CONCLUSION: According to results, the direct effect on the seed yield, which was positive and high, the number of pods per plant should be taken into consideration by the breeders. In addition, this feature is an important criterion in

selection for breeders due to its high indirect effect on seed yield over a thousand seed weight.

CONFLICT OF INTEREST: Authors have no conflict of interest.

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