



# Plant Pathology Journal

ISSN 1812-5387

**science**  
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## Correlations among Characters and Ascochyta Blight Disease Severities in Chickpea Breeding Lines

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**Abstract:** The yield and yield components, association among characters, direct and indirect effects of various characters on seed yield and Ascochyta blight disease severities of sixty-nine F<sub>4</sub> chickpea lines from FLIP 83-47C x ILC 482 crossing and two parents were investigated at Diyarbakir in 1998. The chickpea lines differed significantly for all characters and minimum-maximum values and coefficient variation of % were determined for each character. The results of association among characters indicated that the seed yield/plant was correlated strongly and positively with number of pods/plant (0.64\*\*) and number of seeds/plant (0.65\*\*). It was also determined that there was a positive significant relationship (0.29\*\*) between Ascochyta blight disease severity and 100 seed weight. Path analysis showed that number of seeds/plant had the greatest positive direct effect on seed yield/plant. Wide variations were observed for the mean Ascochyta blight disease severity in F<sub>4</sub> lines. Disease indices of lines changed from 5.0 to 8.9 and some lines were classified as tolerant.

**Key words:** Ascochyta blight, chickpea (*Cicer arietinum* L.), correlation, path

### INTRODUCTION

The chickpea production in the world is 8.8 million tones. Seventy percent of this is produced by India. In Turkey, it is grown in 625 ha with an annual production of about 595 tones. Chickpeas are consisted of small seeds and short plant height and mixed population in some regions. Ascochyta blight disease, caused by *Ascochyta rabiei* (Pass. Lab.), is one of the most important production problems in the region. When environmental conditions are suitable, fungus makes epidemics and causes considerable crop loss. Although some chemical control methods are known, more emphasis is given to the breeding resistant cultivars. Pathogenicity of the fungus shows wide variation and the susceptibility of chickpea varieties/lines reveals considerable differences<sup>[1,2]</sup>. When the five chickpea genotypes were sown at four different dates, the grain yield was correlated significantly and positively with pods/plant and seeds/plant for all sowing dates and varieties. Seeds/plant had a strong positive direct effect on the grain yield, but the effect of pods/plant was a relatively low<sup>[3]</sup>. In another study; pods/plant, seeds/plant and seeds/pod were found positively correlated with grain yield, but seed weight was negatively correlated with all the characters<sup>[4]</sup>. In this study, correlation among the various plant characters; direct and indirect effect of different plant characters on seed yield and the mean Ascochyta blight disease

severities were investigated in 69 F<sub>4</sub> lines obtained from crossing of ILC 482 and FLIP 83-47C cultivars and two parents.

### MATERIALS AND METHODS

**Correlation and path analysis:** In this study, 69 F<sub>4</sub> lines, from FLIP 83-47C x ILC 482 crossing and two parents totally 71 lines were used. Seeds of lines were sown in a randomized complete block design with three replications, on 17 February 1998 on Research Farm of Faculty of Agriculture at Dicle University in Diyarbakir, Turkey. Each line was a 2 m single-row plot, 40 cm apart, 20 cm distance of plants within row. Observations were taken on every plant for days to 50% flowering, days to maturity, plant height, height of the lowest pod, number of pods/plant, number of seeds/plant, grain yield/plant and 100 seed weight. The mean values of each line were subjected to statistical analysis.

Data was analysed by TARIST program. Variance analysis, correlations between traits and direct and indirect effects of the characters on seed yield were investigated.

**Ascochyta blight disease severity:** 61 chickpea F<sub>4</sub> lines were evaluated against Ascochyta blight. Local chickpea cultivar and ILC 482 were used as susceptible and tolerant checks. Chickpea lines were planted in a randomised block

design on 25 Feb. 1998. Each line was a 1.5 m single-rows plot with 40 cm apart from each other. Distance of seeds within row was 15 cm. After plant height reaches 15 cm, the plants were inoculated with *Ascochyta* fungi adjusted to 850 spores ml<sup>-1</sup>, first on April 19 and second on May 15, 1988. A back sprayer was used for inoculation<sup>[5]</sup>. After inoculation, the plants were kept wet through a morning and evening sprinkler irrigation for two days. The each plant was evaluated on a 1-9 scale on 15 June 1998 and a mean disease index was found for each plot. Data were analysed with MSTATC program.

## RESULTS AND DISCUSSION

The analysis of variance indicated significant ( $P < 0.01$ ) differences among lines for days to 50% flowering, days to maturity, plant height, height of the lowest pod, number of pods/plant, number of seeds/plant, seed yield/plant, 100 seed weight and *Ascochyta* blight disease index (Table 1).

The seed yield/plant range from 1.5 to 29.7 g, days to 50% flowering range between 82.3-104.7 days, Number pods/plant and number seeds/plant between 7.5-59.9 and 6.4-60.6. Plant height and basal pod height varied between 43.2-62.2 and 22.8-43.1 cm. Days to maturity changed from 128.5 to 140.4 days. 100 seed weight varied from 23.4 to 36.8 g. Mean disease index of lines for *Ascochyta* blight ranged from 5.0 to 8.9.

The means FLIP 83-47C and ILC 482 parents were 84.7 and 98.7 days for days to 50% flowering; 49.7 and 60.9 cm for plant height; 24.0 and 47.0 for number of pods/plant and 8.9 and 12.0 g for seed yield/ plant. Some F<sub>4</sub> lines were found earlier, taller and higher yielding than the parents. This indicated that new gene combinations resulted in valuable segregates.

**Ascochyta disease severities in F<sub>4</sub> lines:** The disease symptoms were visible one week after inoculation. The means of disease ratios were 100% for all the lines. The disease indices of lines were given in Table 3. Wide variations were observed for *Ascochyta blight* disease indices in F<sub>4</sub> lines and disease index changed from 5.0 to 8.9 (Table 2,3). Lines II-6-8, II-8-2 and II-10-5 had the lowest disease indices, but the lines I-8-4, II-4-9, I-8-5, II-3-7, II-5-8, II-3-3, II-5-1 and II-4-3 had the highest disease indices. Lines with the low disease indices might be selected as disease tolerant lines when other agronomical characters were also desirable. Similar to these findings, in various studies it was reported that susceptibilities of chickpea cultivars/lines were variable under artificial epiphytic conditions with *Ascochyta rabiei* (Pass.) Lab. fungus<sup>[6,2]</sup>.

**Association among characters:** Association among characters were given in Table 4. The seed yield/plant was correlated strongly and positively with number of pods/plant (0.64\*\*), number of seeds/plant (0.65\*\*) and plant height (0.27\*) and negatively with days to 50% flowering (-0.38\*\*). In the same experiment area seed yield per plant was found positively and significantly correlated with number of pods/plant, plant height, 100 seed weight, number of secondary branches and height of lowest pod in chickpea<sup>[7]</sup>.

Days to 50% flowering were correlated with both days to maturity (0.57\*\*) and 100 seed weight (0.27\*), but this character was correlated negatively with number of pods/plant (-0.42\*\*) and number of seeds/plant (-0.40\*\*). Days to maturity were correlated strongly and positively with plant height (0.49\*\*), height of lowest pod (0.51\*\*) and 100 seed weight (0.47\*\*), but negatively number of pods/plant (-0.26\*). It seems that plant height, height of lowest pod and seed weight tend to increase, but number of pods and seeds/plant tend to decrease in late lines. A strong and positive correlation is determined between plant height and height of lowest pod (0.80\*\*). And these characters are positively correlated with number of pods and seeds/plant. It seems that increase in plant height tend to increase in seed yield. There was a strong association between number of pods/plant and number of seeds/plant (0.98\*\*), but these characters had negative correlation with seed weight. In F<sub>4</sub> lines, there was a significant positive relationship between *Ascochyta* disease index and 100 seed weight (0.29\*). Kusmenoglu and Muehlbauer<sup>[8]</sup> found similar relationships between these two characters in F<sub>2</sub>'s, but, they also stated that the involvement of many genes in the inheritance of seed size<sup>[9]</sup>, might be reason of such correlation in small F<sub>2</sub>'s

**Path coefficient analysis:** Various estimates of the direct and indirect effects of path coefficients were presented in Table 5.

The path analysis revealed that the number of seeds/plant had strong and positive direct effects on seed yield (0.747). The number of pods/plant had strong positive indirect effect via number of seeds/plant on seed yield. Also, plant height and height of the lowest pod had positive indirect effect via seeds/plant. But, days to 50% flowering and days to maturity had a negative indirect effect on yield. This clearly indicated that number of seeds/plant or number of pods /plant might be used as selection criteria for high grain yield. The direct effect of seed weight on seed yield was positive but the indirect effect of seed weight via seeds/plant was negative. This was the reason that there was no correlation between seed size and seed yield per plant. However, one study in India reported 100 seed weight as the most important

Table 1: Analysis of variance in F<sub>4</sub> lines

Sources of variation	df	DF	DM	PH	HLP	NPP	NSP	SYP	SW	AB
Blocks	2	256.56	19.08	1150.24	2050.92	6723.16	7426.37	332.25	35.10	0.09
Lines	70	73.76**	18.93**	45.12**	50.26**	281.16**	272.38**	30.35**	24.85**	1.93**
Error	140	15.64	2.35	15.42	17.31	91.99	93.56	18.54	4.11	0.41

\*,\*\* significant at 0.05 and 0.01 probability levels, respect.

DF: Days to %50 flowering, DM: Days to maturity, PH: Plant height, HLP: Height of lowest pod,, NPP: Number of pods/plant, NSP: Number of seeds/plant, SYP: Seed yield/plant, SW: 100 seed weight and AB: Ascochyta blight

Table 2: The values of minimum and maximum, means and CV (%) in F<sub>4</sub> lines

Characters	Min.-Max.	Means±SE	Coefficient variation (%)
DF	82.3-104.7	92.7±0.47	4.30
DM	128.5-140.4	133.6±0.18	1.10
PH	43.2-62.2	54.6±0.47	7.20
HLP	22.8-43.1	30.6±0.49	13.50
NPP	7.5-59.9	39.8±1.13	24.00
NSP	6.4-60.6	40.6±1.15	24.00
SYP	1.5-29.7	11.7±0.5	36.60
SW	23.4-36.8	28.72±0.24	7.10
AB	5.0-8.9	6.79±0.07	13.65

DF: Days to %50 flowering, DM: Days to maturity, PH: Plant height, HLP: Height of lowest pod,, NPP: Number of pods/plant, NSP: Number of seeds/plant, SYP: Seed yield/plant, SW: 100 seed weight and AB: Ascochyta Blight

Table 3: The distribution of mean *Ascochyta blight* disease indices in F<sub>4</sub> Lines coming from a cross between ILC 482 and FLIP 83-47C, cultivars

Chickpea Lines	Number of lines	Disease index
II-8-2, II-6-8,	2	4.5-5.5
I-9-7, II-1-2, II-2-10, II-2-5, II-5-2,II-6-1, II-6-2, II-6-9, II-10-5	16	5.6-6.5
I-3-3, II-10-2, II-5-4, II-1-6, FLIP 83-47C, II-2-6, I-7-2, I-7-4, I-7-6, II-4-1, II-3-2, I-3-7, I-6-5,	31	6.6-7.5
II-8-3, I-3-2, I-2-7, II-3-4, II-10-8, II-7-2, I-9-8, II-5-3, II-6-10, II-10-7,II-3-11, I-1-5, I-6-4, I-1-3, I-2-1, II-3-6, I-6-7		
II-3-7, II-5-8, II-3-3, II-5-1, II-4-3, I-2-2, I-1-4, II-4-6, II-4-4, ILC 482, I-2-6, II-3-8	12	7.6-8.5

Table 4: Correlation coefficient of nine characters in F<sub>4</sub> lines

Characters	DF	DM	PH	HLP	NPP	NSP	SW	AB
SYP	-0.33**	-0.14	0.27*	0.15	0.64**	0.65**	-0.06	0.06
DF	-	0.57**	0.04	0.16	-0.42**	-0.40**	0.27*	0.12
DM.		-	0.49**	0.51**	-0.26*	-0.21	0.47**	0.14
PH			-	0.80**	0.32*	0.36**	0.19	0.08
HLP				-	0.20	0.25*	0.13	0.07
NPP					-	0.98**	-0.37**	-0.01
NSP						-	-0.38**	-0.03
SW							-	0.29*

SYP: seed yield/plant, DF: Days to %50 flowering, DM: Days to maturity, PH: Plant height, HLP: Height of lowest pod, NPP: Number of pods/plant, NSP: Number of seeds/plant, SW: 100 seed weight, AB : Ascochyta Blight

Table 5: Path analysis in F<sub>4</sub> lines

Investigated characters	Direct and indirect effect								
	Correlation coefficient	DF	DM	PH	HLP	NPP	NSP	SW	
DF	-0.338**	-0.079	-0.041	0.001	-0.005	0.020	-0.305	0.071	
DM	-0.144	-0.046	-0.071	0.013	-0.015	0.013	-0.161	0.124	
PH	0.272*	-0.004	-0.035	0.026	-0.024	-0.015	0.274	0.051	
HLP	0.159	-0.013	-0.037	0.021	-0.030	-0.010	0.193	0.034	
NPP	0.642**	0.034	0.019	0.008	-0.006	-0.048	0.732	-0.097	
NSP	0.650**	0.033	0.015	0.009	-0.008	-0.047	0.747	-0.100	
SW	0.064	-0.022	-0.034	0.005	-0.004	0.018	-0.288	0.261	

DF: Days to %50 flowering, DM: Days to maturity, PH: Plant height, HLP: Height of lowest pod,, NPP: Number of pods/plant, NSP: Number of seeds/plant, SYP: Seed yield/plant, SW: 100 seed weight and AB: Ascochyta Blight

contributor to seed yield per plant<sup>[10]</sup>. Bicer<sup>[7]</sup>, found that number of pods/plant and seed yield per plant were the most important characters that contributed seed yield per unit area.

## ACKNOWLEDGMENT

We are grateful to the Scientific and Technical Council of Turkey for financial support of this research.

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