Pak. J. Bot., 35(3): 431-437, 2003.

EFFECT OF *ASCOCHYTA* BLIGHT ON THE PRODUCTIVITY OF CHICKPEA

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Abstract

Seven cultivars of chickpea viz., C-44, C-727, CM-72, Dasht, Parbat, NIFA-88 and Punjab-91 were tested to study the genotypic response to *Ascochyta* blight in terms of losses to grain yield and its components. Disease severity index of the cultivars ranged from 44 to 82%. Maximum disease at vegetative stage was recorded on C-727 followed by C-44 and Punjab-91. Minimum disease at vegetative stage was observed on Dasht. Pod infection that varied from 17 to 90% was highest on C-727 and least on Dasht. Minimum (2%) and maximum (42%) seed infection was respectively found in NIFA-88 and C-727. Comparison of data on number of pods per plant, seeds per plant, 100- seeds weight, yield per plant and yield per ha from healthy and diseased conditions revealed that the disease caused more losses to C-727, C-44 and Punjab-91 which were susceptible to blight. Dasht and NIFA-88 appeared to be tolerant to *Ascochyta* blight with minimum loss in yield and yield components.

Introduction

Blight caused by *Ascochyta rabiei* (Pass.) Lab. is the most destructive disease of chickpea (*Cicer arietinum* L.) in the Indian sub-continent and the Mediterranean region (Reddy & Singh, 1990). In Pakistan, blight is a major constraint to chickpea production with 48% reduction in yield (Malik &Tufail, 1984). Though some effective foliar fungicides have been identified but their application is not economical (Reddy & Singh, 1984). Therefore, the use of resistant varieties is the most effective measure to control this disease. Although sources of resistance to blight have been reported (Aziz, 1962; Grewal & Vir, 1974, Kaiser, 1972; Singh *et al.*, 1981; Iqbal *et al.*, 1989, 1994), but resistance based on disease severity and yield loss response is not well documented (Reddy & Singh, 1990; Malik *et al.*, 1991). It is generally believed that the blight resistant varieties have low yield potential than that of blight susceptible varieties. The present study was conducted to compare the susceptible and resistant genotypes for yield potential under diseased and disease free conditions and to assess yield losses caused by *Ascochyta* blight.

Materials and Methods

The experimental material comprised of seven chickpea genotypes viz., C-44, C-727, CM-72, Dasht, Parbat, NIFA-88 and Punjab-91 with varying level of tolerance against *Ascochyta* blight. These genotypes were sown in the experimental field of Pulses programme NARC Islamabad on October 2, 1998 in a split plot randomized complete block design with four replications. Two treatments T1 (disease created artificially), T2 (protected from disease) were placed in main plots and varieties were placed in subplots. The main plots were isolated from each other by growing a tall wheat variety (C-591) between them, which is reported to reduce disease incidence (Tripathi *et al.*, 1988). Each

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subplot consisted of 6 rows of 4 meters length with inter row spacing of 30 cm and plant to plant distance of 10 cm. In T1, plants were inoculated with *A. rabiei* in the form of diseased debris of chickpea coupled with spraying spore suspension @ 5 x 10^5 spore per ml. Plants in T2 were protected from disease with continuous sprays of Daconil fungicide at an interval of 15 days starting one month after germination. In T1, humidity was created by continuous spray of water in the evening for developing the disease conducive conditions.

The blight incidence on vegetative parts was scored on 1-9 scale (Singh *et al.*, 1981) using 20 randomly selected plants from the middle rows of the sub-plot. Disease severity index (DSI) was calculated according to the following formula (Gemawat & Prasad, 1969):

$$DSI = \frac{\text{Total of all disease rating}}{\text{Number of plants observed X maximum disease rating}} \times \frac{100}{\text{Maximum disease rating}}$$

Percent infection on pods and seeds was observed on 200 randomly sampled pods. The data on number of pods/plant, number of seeds/plant and grain weight/plant were recorded on 20 random plants of each plot. Percent loss of yield and other components was calculated on the basis of difference between healthy and diseased plants.

Results

Disease developed uniformly in the inoculated plots (T1) where it was created artificially, whereas, in T2 plants, it was completely free from disease. Analysis of variance revealed significant differences among genotypes for all the characters in both diseased and disease free conditions (Table 1). High portion of genetic variance was attributed by disease that was strengthened by varieties and interaction. Maximum disease was recorded on C-727, whereas minimum on Dasht (Fig. 1). Similarly maximum DSI at vegetative stage was observed on C-727 followed by C-44, Punjab-91 and CM-72, whereas minimum DSI was on Dasht. Pod infection was highest in C-727, followed by C-44 and Punjab-91, while it was lowest on Dasht. In general, the varieties, C-727 and C-44 were susceptible at all three parameters whereas Dasht and NIFA-88 were found tolerant.

Under disease free conditions, C-727 produced maximum grain yield per plant followed by Punjab-91 and CM-72 (Table 2). Grain yield losses due to blight ranged from 13.6 to 17.6% with maximum reduction in grain yield in C-727 followed by Punjab-91, whereas minimum yield loss was in Dasht (Fig. 2). Significant reduction in yield components was observed in diseased plants as compared with healthy. Loss in yield/plant was minimum in Dasht (19.1%) followed by Parbat (39.9%) and NIFA-88 (46.7%). Maximum loss was observed in Punjab-91 (97.1%) and C-727 (91.7%). Maximum loss in 100-grain weight was recorded in C-727 (31.9%) and it was followed by CM-72 with 19.3% loss. The varieties, CM-72, Dasht, Parbat and NIFA 88 gave low reduction in grain yield per plant as compared to others. C-727 and Punjab-91 were the most likely to behave susceptible under disease conditions. Pods per plant, seeds per plant and grain yield per plant were negatively correlated in diseased and healthy plants, whereas 100 seed weight exhibited positive association (Fig. 3).

Table 1. Two-factors analysis of variance for six yield components in chickpea.

SOV	df	Mean Square					
		Plant height	Pods/plant	Seeds/plant	Yield/plant	100-seed weight	Yield/plot
Replications	3	33.34	30.64	13.07	1.24	0.953	0.008
Varieties	6	289.94**	143.68**	169.87**	12.43**	27.21**	0.082**
Disease	1	1692.90**	14950.45**	27192.07**	1198.80**	192.03**	1.472**
Varieties x disease	6	284.12**	645.36**	948.03**	63.09**	10.99**	0.072*
Error	39	19.59	23.90	17.79	2.75	4.09	0.002
SE (Varieties)		1.57	1.73	1.49	0.5863	0.72	0.017
SE (Disease)		0.84	0.92	0.79	0.31	0.38	0.009
SE (Interaction)		2.21	2.45	2.11	0.83	1.01	0.042
CV		6.78%	11.92%	8.93%	15.60%	8.99%	10.57

Table 2. Effect of *Ascochyta* blight on yield and yield components of chickpea cultivars.

Cultivars	Plant height (Cm)		Pods/plant		Seeds/plant		Yield/plant (g)		100-g weight (g)		Yield/plot (Kg)	
	H	D	H	D	H	D	H	D	H	D	H	D
CM-72	61.2	60.05	51.25	28.25	89.5	13.25	17.08	8.63	23.75	19.17	0.6	0.17
C-44	70.58	64.43	61.5	29.25	60.0	25.75	13.97	5.7	26.15	21.7	0.85	0.43
Dasht	69.65	63.7	50.5	31.25	62.25	33.0	11.77	9.52	25.53	25.33	0.44	0.38
Punjab-91	72.22	61.53	76.75	14.0	75.0	5.25	17.25	0.5	24.65	20.17	0.73	0.22
Parbat	76.7	63.47	53.0	33.0	77.5	29.75	13.85	8.33	24.55	21.45	0.41	0.27
NIFA-88	72.88	69.45	49.0	30.25	67.5	30.75	14.27	7.6	22.4	20.75	0.62	0.45
C-727	72.13	35.75	59.5	6.75	53.25	37.75	18.6	1.55	23.48	16.0	0.68	0.16
St. Error	2.36	2.04	3.29	1.29	2.37	1.69	1.12	0.42	1.17	0.91	0.03	0.02
CD-1	7.02	6.07	9.80	3.85	7.03	5.03	3.33	1.26	3.46	2.72	0.08	0.06
CD-2	9.62	8.32	13.43	5.28	9.63	6.89	4.56	1.72	4.75	3.72	0.11	0.08

H- healthy and D- diseased plots.

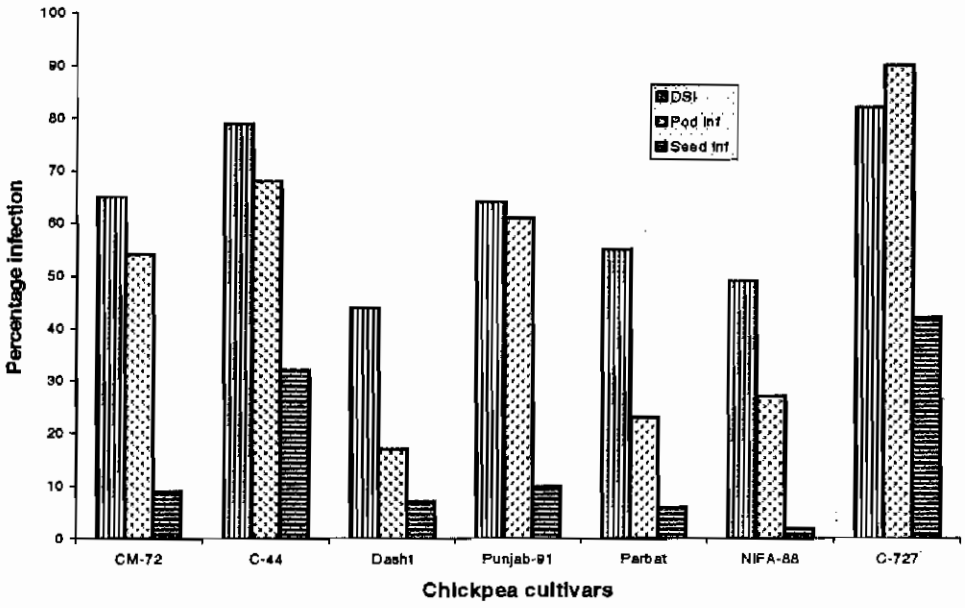

Fig. 1. Response of chickpea cultivars to *Ascochyta* blight.

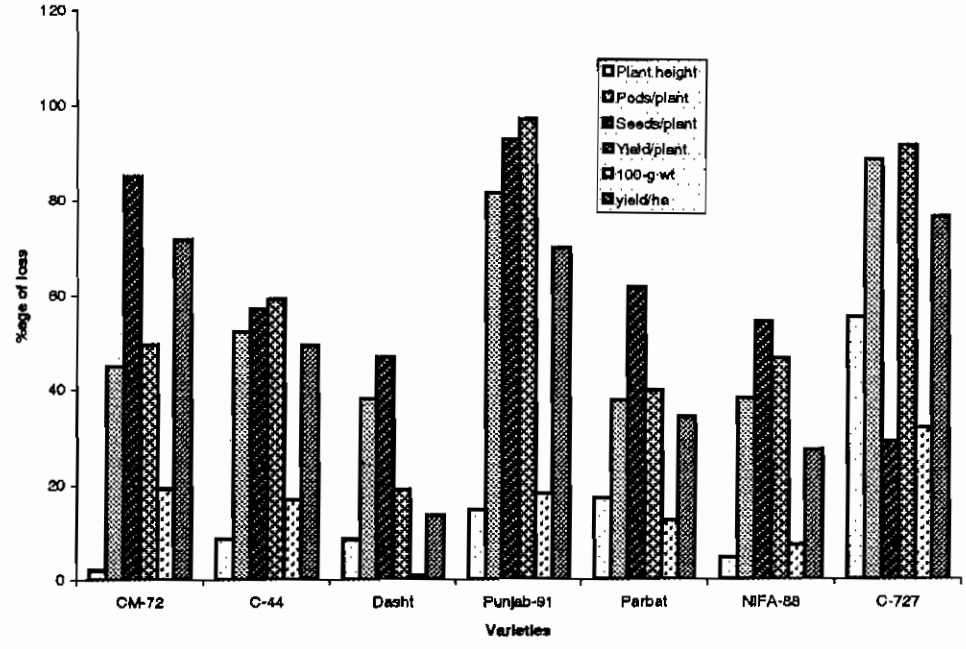

Fig. 2. Percentage of losses in yield parameters of chickpea due to *Ascochyta* blight

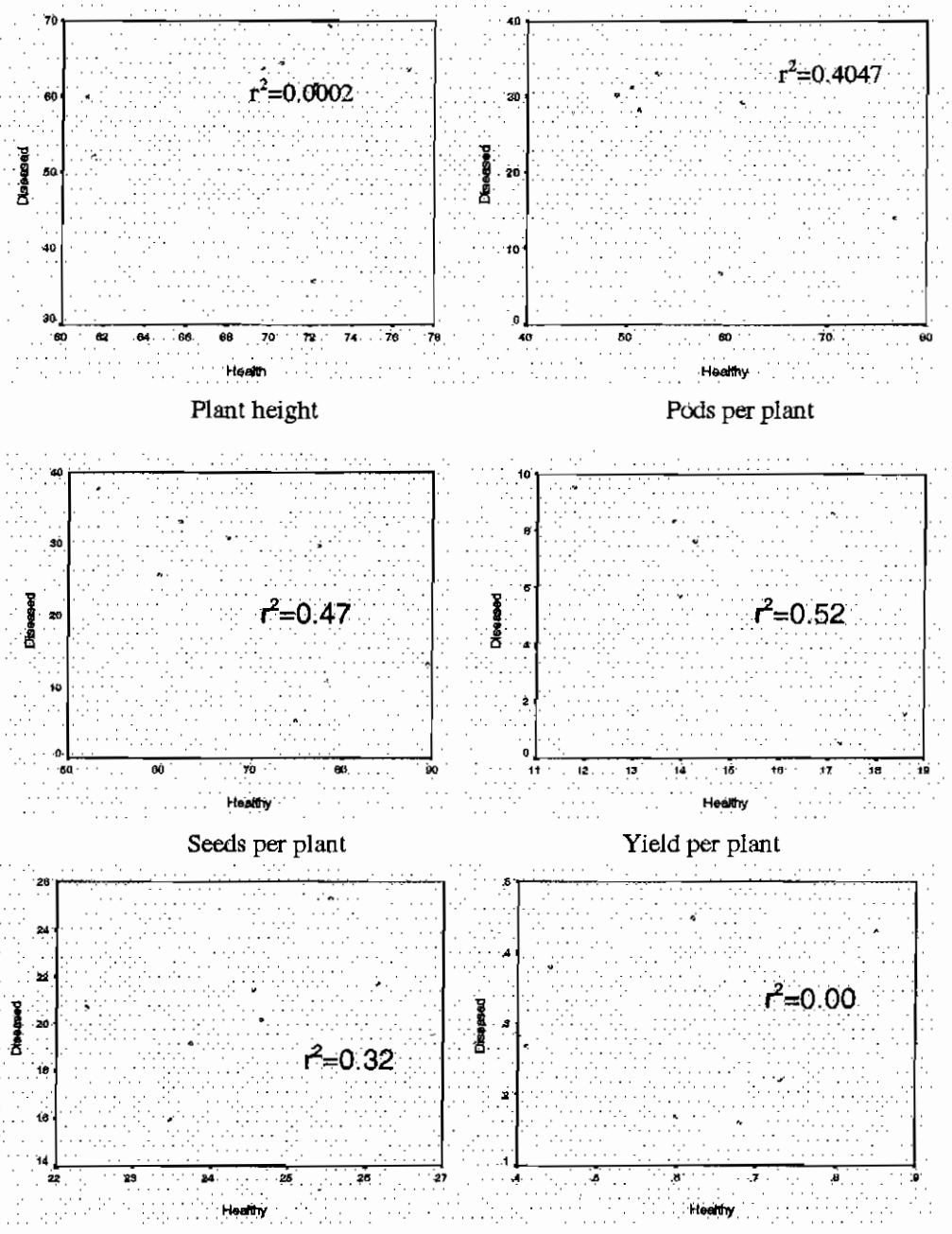

Fig. 3. Relationship between healthy and diseased samples for six characters.

Discussion

On the basis of DSI and percent pod infection, Dasht was found the most resistant and C-727 as the most susceptible among the genotypes used in the study. There was low seed infection in NIFA-88 despite its high pod infection. This may be due to the presence of some mechanism that restricted disease infection to pod level and resisted its penetration down to the seed. Rapid cell necrosis and accumulation of phenolic compounds around the infected spot limit penetration and colonization of the fungus in resistant chickpea cultivars (Hohl *et al.*, 1990).

The variety NIFA-88 was tolerant at reproductive stage, which produced quite a high number of disease free seeds despite infection at pods and vegetative parts. This implies that genotypic response to blight varies at different developmental stages of plants (Reddy & Singh, 1984; Singh & Reddy, 1993; Tripathi, 1985). Loss in grain yield of C-727, CM-72, and Punjab-91was mainly due to reduction in pods and seed number and seed weight. Although, Punjab-91 and C-727 were among the top producers with respect to pod and seed numbers under healthy condition but they could not be selected for wider cultivation due to susceptibility to blight.

Three components (pods per plant, seed weight and number of seeds per plant) were less affected in resistant genotypes, although there was a negative association between diseased and healthy treatments. It also appeared that resistant genotypes could survive for a longer period under high disease pressure as compared to the susceptible. As soon as the disease pressure is reduced they produce new shoots and pods that compensate the loss caused by the disease to a reasonable extent. On the contrary, susceptible genotypes got most of their vegetative parts killed and were unable to compensate the damage either due to complete killing of plants or due to killing of most vegetative parts. Moreover the pod and seed infection in resistant genotypes were superficial causing less damage to the seed. Similar sort of results had been reported by Malik *et al.*, (1991).

The results indicated that blight affected pod number without influencing seeds per plant and seed weight. These findings have practical implications for the chickpea breeders who breed for *Ascochyta* blight resistance (Reddy & Singh, 1990). Generally, segregating populations showing pod infection are almost certainly discarded without looking at seeds, hence the breeding methodologies need to be revised for developing blight resistant chickpea cultivars. The chickpea growing areas of Pakistan fall under three different categories with respect to rainfall (Haqqani *et al.*, 2000). The high rainfall area (Potowar) is a hot spot for blight incidence due to the conducive conditions for blight epidemics and the disease was for the first time reported in this area (Butler, 1918). The varieties, C-727, Punjab-91 and CM-72 that showed up-to 50% yield losses due to blight infection may not be recommended for cultivation in such areas. The yield losses exhibited by these genotypes agree with the reported national yield loss of about 50% recorded in the epidemic years. Due to a continuous break down in tolerance level, resistant chickpea cultivars are needed to be developed after strict screening under high rainfall areas where Potowar had long been identified as natural disease spot (Butler, 1918; Rahman 1987). Resistant varieties like NIFA-88 and Dasht may be recommended for high rainfall areas. However, in low rainfall areas, the genotypes with relatively less resistance and high yield potential may be recommended for cultivation.

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(Received for publication 21 March 2002)