Neth. J. Pl. Path. 99 (1993) 163 – 167

Sources of resistance to ascochyta blight in wild Cicer species

K.B. SINGH[1] and M.V. REDDY[2]

[1] International Center for Agricultural Research in the Dry Areas (ICARDA), P.O. Box 5466, Aleppo, Syria
[2] International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru P.O., A.P. 502 324, India

Accepted 23 September 1992

Abstract

Ascochyta blight [*Ascochyta rabiei* (Pass.) Lab.] is the major foliar disease of chickpea (*Cicer arietinum* L.). In search of better sources of resistance to ascochyta blight, 201 accessions of 8 annual wild *Cicer* species were evaluated in field and greenhouse for 3 years (1988 to 1991) at Tel Hadya, Syria. One accession each of *C. judaicum* Boiss (ILWC 165) and *C. pinnatifidum* Jaub. & Spach. (ILWC 159) were consistently rated resistant in both field and greenhouse evaluations. Another three accessions of *C. judaicum* (ILWC 61, ILWC 154, ILWC 199) and six accessions of *C. pinnatifidum* (ILWC 78, ILWC 88, ILWC 155, ILWC 160, ILWC 162, ILWC 203) were resistant or moderately resistant. The blight-resistant accessions of *C. judaicum* originated from Jordan, Lebanon, Syria, and Turkey; and those of *C. pinnatifidum* from Syria and Turkey. None of the accessions of *C. bijugum*, *C. chorassanicum*, *C. cuneatum*, *C. echinospermum*, *C. reticulatum* and *C. yamashitae* were resistant to blight.

Additional keywords: *Cicer*, *Ascochyta rabiei*, *Cicer arietinum*, resistance.

Introduction

Ascochyta blight [*Ascochyta rabiei* (Pass.) Lab.] is the major foliar disease of chickpea in Northwest India, Pakistan, West Asia, North Africa, and southern Europe. In the past 60 years, considerable efforts have been made to manage the disease through the development of resistant cultivars (Nene and Reddy, 1987; Singh, 1987; Singh and Reddy, 1991). However, the disease continues to cause severe losses in the major chickpea producing countries such as India, Pakistan and Turkey. One of the main reasons for the slow progress in disease-resistance breeding has been the lack of stable and high level of resistance to the disease in the germplasm of cultivated chickpea (*Cicer arietinum* L.) (Singh and Reddy, 1991).

Wild species have not been exploited for the transfer of genes for resistance in any food legumes (Ladizinsky et al., 1988). In the genus *Cicer*, 8 wild annual and 34 wild perennial species are reported to exist (Van der Maesen and Pundir, 1984). Annual wild *Cicer* species have been evaluated for resistance to different biotic and abiotic stresses, including diseases. Nene and Haware (1980) reported resistance in *C. judaicum* to fusarium wilt (*Fusarium oxysporum* f.sp. *ciceri*). *C. judaicum* and *C. pinnatifidum* were found resistant to gray mold (*Botrytis cinerea* Pers. ex Fr.) (Singh et al., 1982). Two hundred and one accessions of 8 annual wild *Cicer* species were evaluated for resistance to ascochyta blight for 3 years in the field and greenhouse. The results of this study are reported in this paper.

Materials and methods

In both field and greenhouse tests, 201 accessions of 8 wild annual *Cicer* species available at the Genetic Resources Unit of ICARDA were evaluated for resistance to ascochyta blight. The wild *Cicer* species evaluated and the number of accessions were *C. bijugum* K.H. Rech. (33), *C. chorassanicum* (Bge) M. Pop. (5), *C. cuneatum* Hochst. ex Rich. (3), *C. echinospermum* P.H. Davis (10), *C. judaicum* Boiss (52), *C. pinnatifidum* Jaub. & Spach. (38), *C. reticulatum* Ladiz. (56), and *C. yamashitae* Kitam. (4). The field evaluation was carried out during the 1988, 1989, and 1991 seasons and the greenhouse evaluation during the 1989, 1990, and 1991 seasons.

In field evaluation, 20 seeds for each accession were sown after scarification in a 2–m–long row in each season. The sowing in all seasons was done between November 15 and December 10. All around the test plots and after every ten test rows, ILC 263, a known blight-susceptible chickpea line, was sown. The trial was inoculated with blight in February 3 months after sowing by scattering diseased-chickpea debris; and in March by spraying with a spore suspension of the mixture of six races of *A. rabiei* from Syria (Reddy and Kabbabeh, 1984; Reddy and Singh, 1984). The inoculum from six races were used because these are the races commonly found in the area and resistance to these races is being incorporated in the breeding lines. The diseased debris used for inoculation had been collected from the previous season's ascochyta blight nursery at ICARDA at the end of the season and stored in a field shelter. The six races of *A. rabiei* were multiplied separately in laboratory on chickpea–dextrose–broth medium (80 g chickpea meal, 20 g dextrose, 1 l water) and a spore suspension having equal proportions of spores of the six races was prepared (100 000 spores per ml water). The spore suspension was sprayed using knapsack sprayers. Depending upon the weather and disease development, the spore suspension was sprayed four to six times at an interval of 10 days. During dry spells, the field was mist-irrigated for 3 h daily. The accessions were scored for blight severity 3 months after inoculation on a 1–9 scale, where 1 = free and 9 = killed when the susceptible check was killed (Reddy and Singh, 1984). The accessions with 1–4 score were considered resistant, 5 moderately resistant, and 6–9 susceptible.

In greenhouse tests, ten seeds for each accession, after scarification, were sown in a 20–cm plastic pot filled with the sterilized field soil. The plants were inoculated by spraying with the spore suspension of the mixture of the six races 6 weeks after sowing and covered with plastic cages (60 cm height) for 1 week. After removal of cages, the plants were irrigated twice a day with a watering can. The temperature of the greenhouse was maintained at 20 $\pm$ 2 ^{0}C. The lines were scored for blight severity 1 month after inoculation. The susceptible lines were discarded and the resistant lines were reinoculated at the podding stage following the procedure described above.

Results

The blight severity in the three field and greenhouse evaluation tests was high, as indicated by the 9 score of ILC 263, the blight susceptible check. Overall, blight severity in the test lines was higher in the greenhouse tests than in the field tests (Fig. 1).

The accessions that showed resistance (1–4 rating) in all the field tests and resistance or moderately resistance (5 rating) in greenhouse tests are listed in Table 1. Accessions ILWC 165 of *C. judaicum* and ILWC 159 of *C. pinnatifidum* were consistently rated resistant in all the 3 years and in both field and greenhouse evaluations. Three accessions of *C. judaicum* (ILWC 61, ILWC 154, ILWC 199) and six of *C. pinnatifidum* (ILWC 78, ILWC 88, ILWC 155, ILWC 160, ILWC 162, ILWC 203) were considered to be tolerant

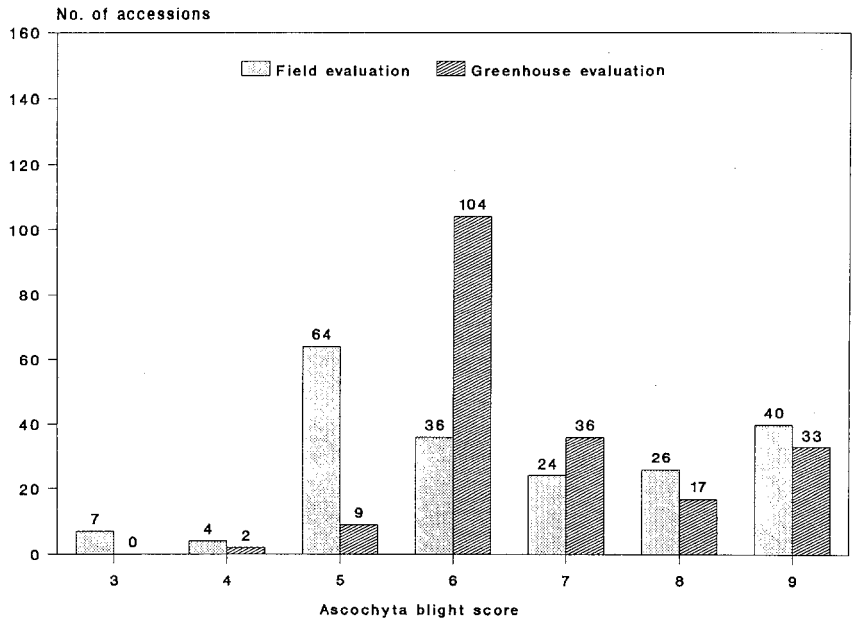

Fig. 1. Evaluation of wild *Cicer* species for ascochyta blight resistance at ICARDA, Syria.

Table 1. Accessions of wild annual *Cicer* species resistant or tolerant to ascochyta blight, Tel Hadya, Syria, 1988–1991.

ICARDA legume wild accession no	*Ascochyta* blight-score on 1–9 scalea					
	Field tests			Greenhouse tests		
	1988	1989	1991	1989	1990	1991
C. judaicum						
ILWC 61	3	2	3	5	5	4
ILWC 154	3	2	3	5	4	4
ILWC 165	3	2	4	4	4	2
ILWC 199	3	2	3	5	5	5
C. pinnatifidum						
ILWC 78	3	3	4	5	5	4
ILWC 88	3	2	3	4	5	5
ILWC 155	3	2	4	5	5	5
ILWC 160	2	2	3	5	5	4
ILWC 162	3	2	3	5	5	4
ILWC 159	3	2	3	4	4	2
ILWC 203	3	2	5	5	5	5
C. arietinum						
ILC 263 (Susceptible check)	9	9	9	9	9	9

[a] 1, 2, 3, 4 = resistant; 5 = tolerant; 6, 7, 8 = susceptible; 9 = killed.

as they showed a rating of 2–5 over the tests. All other accessions of these two species and the remaining six species (*C. bijugum*, *C. chorassanicum*, *C. cuneatum*, *C. echinospermum*, *C. reticulatum* and *C. yamashitae*) were susceptible. The accessions of *C. reticulatum* showed the highest susceptibility in both field and greenhouse tests. Though several accessions of *C. bijugum*, such as ILWC 75, 76, 77, 62, 63, 64, 69, 70, 71, 73, 74, 84 and 85, showed resistance in all the field tests, they showed susceptibility in the greenhouse tests.

Discussion

The evaluation of eight wild annual species of *Cicer* showed a large variation in their susceptibility to ascochyta blight (Fig. 1). The different accessions of these wild species showed similar variation as observed in the 19 300 germplasm accessions of *C. arietinum* (Singh and Reddy, 1993). But, while the variation in accessions of *C. arietinum* was skewed towards susceptibility, it was more nearly normally distributed in the accessions of wild species. A few accessions of *C. judaicum* and *C. pinnatifidum* that showed resistance can serve as additional sources of broad-based resistance to ascochyta blight in resistance breeding programmes.

The resistant accessions of *C. judaicum* originated from Jordan, Lebanon, Syria and Turkey; and those of *C. pinnatifidum* from Syria and Turkey (Table 2) (Singh et al., 1991). The days to 50% flowering of these accessions ranged from 105 to 122 and days to

Table 2. Origin, pedigree and some morpho-agronomic characters of wild *Cicer* species resistant or tolerant to ascochyta blight, ICARDA, Syria, 1988–1991.

ICARDA legume wild accession no.	Pedigree	Origin	Daf	DMa	Hgt	GrH	100W	SSh	SCo
C. judaicum									
ILWC 61	–	Lebanon	114	138	9.1	Sp	1.3	Pea	brown
ILWC 154	No. 189	Turkey	119	157	15.1	Sp	2.7	Ang	beige
ILWC 165	–	Jordan	105	135	9.4	Sp	2.3	Ang	brown
ILWC 199	2974	Syria	116	155	10.6	SSp	1.6	Ang	brown
C. pinnatifidum									
ILWC 78	JM2103	Turkey	120	144	6.3	SSp	2.4	Ang	green
ILWC 88	JM2123	Turkey	118	145	14.0	SSp	2.5	Ang	green
ILWC 155	No.189	Turkey	117	153	13.4	Sp	3.0	Ang	beige
ILWC 160	No. 185	–	117	148	15.8	SSp	2.3	Ang	green
ILWC 162	No. 185	–	119	154	13.8	Sp	2.7	Ang	beige
ILWC 159	No. 185	–	122	157	11.6	P	2.3	Ang	brown
ILWC 203	2686	Syria	109	158	10.0	SSp	2.7	Ang	beige
C. arietinum									
ILC 263 (Susceptible check)	PI 339223	Turkey	146	183	49.0	Sp	35.4	K	beige

ILWC = International Legume Wild *Cicer*; Daf = days to flower; DMa = days to maturity; Hgt = plant height (cm); GrH = growth habit (Sp = spreading, SSp = semi-spreading, P = prostrate); 100W = 100-seed weight (g); SSh = seed shape (Ang = angular, K = kabuli); SCo = seed color.

maturity from 135 to 158. They were mostly spreading type with very small seed size (100-seed weight, 1.3–2.7 g). Thus, these wild species can be only useful for the transfer of genes for resistance. However, at present, neither of these species are crossable with cultivated chickpea, though they all have the same number of chromosomes ($2n = 16$). With the increasing efforts to utilize wild *Cicer* species in the improvement of chickpea and with progress in the area of embryo rescue techniques it may be possible to cross these species with cultigens.

Aknowledgments

We wish to thank Ms Siham Kabbabeh, Mr Samir Hajjar and Mr Gaby Khalaf for their assistance in carrying out the evaluation.

References

Ladizinsky, G., Pickergill, B. & Yamamoto, K., 1988. Exploitation of wild relatives of the food legumes. In: Summerfield, R.J. (Ed.), World crops: Cool season food legumes. Kluwer Academic Publishers, Dordrecht, the Netherlands.

Nene, Y.L. & Haware, M.P., 1980. Screening chickpea for resistance to wilt. Plant Disease 64: 379–380.

Nene, Y.L. & Reddy, M.V., 1987. Chickpea diseases and their control. In: Saxena, M.C. & Singh, K.B. (Eds), The chickpea. CAB International, Wallingford. p. 233-270.

Reddy, M.V. & Kabbabeh, S., 1984. Pathogen variability in *Ascochyta rabiei* inSyria and Lebanon. Phytopathology mediterranea 24: 265–266.

Reddy, M.V. & Singh, K.B., 1984. Evaluation of world collection of chickpea germplasm accessions for resistance to Ascochyta blight. Plant Disease 68: 900–901.

Singh, G., Kapoor, S. & Singh, K., 1982. Screening chickpea for gray mold resistance. International Chickpea Newsletter 7: 13–14.

Singh, K.B., 1987. Chickpea breeding. In: Saxena, M.C. & Singh, K.B. (Eds), The chickpea. CAB International, Wallingford. p. 127–162.

Singh, K.B. & Reddy, M.V., 1991. Advances in disease resistance breeding in chickpea. Advances in Agronomy 45: 191–222.

Singh, K.B. & Reddy, M.V., 1993. Resistance to six races of *Ascochyta rabici* in the world germplasm collection of chickpea. Crop Sience 33: 186–189.

Singh, K.B., Holly, L. & Bejiga, G., 1991. A catalog of Kabuli chickpea germplasm: An evaluation report of winter-sown Kabuli chickpea land races, breeding lines and wild *Cicer* species. ICARDA, P.O. Box 5466, Aleppo, Syria. 398 pp.

Van der Maesen, L.J.G. & Pundir, R.P.S., 1984. Availability and use of wild *Cicer* germplasm. Plant Genetic Resources Newsletter 57: 19–24.