

Evaluation of wild *Cicer* accessions for resistance to wilt and root rots

M V REDDY T N RAJU AND R P S PUNDIR

International Crops Research Institute for the Semi Arid Tropics
(ICRISAT), Patancheru 502 324

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Fusarium wilt (*Fusarium oxysporum* Schlecht emend Snyder & Hans. f sp *ciceri* [Padwick] Snyder & Hans) and dry root rot (*Rhizoctonia bataticola* [Taub] Butler) are the major soil borne diseases of chickpea (*Cicer arietinum* L.) grown between latitudes 20°N and 20°S where the climate is relatively dry and warm during the growing season. Several sources of resistance to Fusarium wilt have been identified in the cultivated chickpea and a few wilt resistant and high yielding varieties have been bred (3, 4). A few chickpea lines with resistance of Fusarium wilt and field tolerance for dry root rot have also been identified (2), but high level of resistance to dry root rot is not yet available.

In order to identify lines with combined resistance to fusarium wilt and various root rots in diverse genetic backgrounds, 22 accessions of 8 wild annual *Cicer* species (*C. byugum* K H Rech, *C. cuneatum* Hochst, ex Rich, *C. chorassanicum* (Bge) M Pop, *C. echinospermum* P H Davis, *C. judaicum* Boiss, *C. pinnatifidum* Jaub et sp, *C. reticulatum* Ladz, and *C. yamashitae* Kitam) were screened in the wilt and root rot nursery at ICRISAT Center, Patancheru (Andhra Pradesh) between 1986 and 1988. These accessions were compared for disease reactions with a fusarium wilt resistant and dry root rot tolerant cv Annigen and a wilt susceptible cv JG 62. This nursery, which is now 15 years old, provides 100 per cent Fusarium wilt and dry root rot incidence in susceptible varieties. Black root rot (*F. solani* [Mart] Appel & Wr) and collar rot (*Sclerotium rolfsii* Sacc) diseases also occur in the nursery but only at low frequencies.

For evaluation of the wild species, 50 seeds of each accession were sown in 4 m long rows between 10 and 15 October. After every two rows of wild *Cicer* accessions, a row of cv JG 62 was sown. During the 1986-87 season, the trial was unreplicated, but in 1987-88 and 1988-89 seasons, two replications were sown in a randomized block design. First observations on mortality was recorded at flowering stage and final observations was recorded during the last week of December when the crop was at podding stage (physiological maturity). Isolations from dead plants, selected at random at flowering and at podding stages, were made on potato dextrose agar to determine the frequency of wilt and root rot pathogens. Accessions with 0-10 per cent mortality were considered resistant, 11-20 per cent moderately resistant and 21-30 per cent tolerant. The presence or absence of vascular discoloration due to Fusarium wilt was recorded by splitting open the plants. The extent of root necrosis due to dry root rot was scored on a 1-9 scale where 1 = no necrosis and 9 = 100 per cent necrosis.

Though the wilt-susceptible check JG 62 showed 100 per cent mortality in all the three seasons, the wild *Cicer* accessions showed considerable variation. In most of the wild *Cicer* accessions and Annigen, the mortality was lower at flowering stage than at podding stage (Table 1). The mortality in some of the wild species was higher in the 1988-89 season than in the 1986-87 and 1987-88 seasons. Some of the wild *Cicer* accessions, such as *C. byugum* (No 201), *C. cuneatum* (SL 157), *C. judaicum* (No 183)

TABLE 1 Reaction of accessions of wild *Cicer* spp. to Fusarium wilt and root rots in the wilt and root rot nursery at ICRISAT Center, between 1986 and 1989

Genotypes	Mortality due to Fusarium wilt and root rots (%)								Vascular discolouration	Extent of root necrosis (1-9 scale) ²
	1986-87		1987-88 ¹		1988-89 ¹		Average			
	FS	PS	FS	PS	FS	PS	FS	PS		
<i>Cicer bijugum</i> (no 200)	0	0	12	18	100	100	37	59	+	7.5
<i>C. bijugum</i> (no 201)	0	5	12	33	0	0	4	19	+	7.0
<i>C. bijugum</i> (JM 2103)	10	17	25	61	50	50	28	43	+	7.0
<i>C. bijugum</i> (JM 2113)	8	8	9	14	50	100	22	41	+	6.5
<i>C. cuneatum</i> (SL 157)	16	32	19	23	0	10	15	22	-	3.5
<i>C. chorasanicum</i> (JM 2230)	22	22	18	28	100	100	47	50	+	NT
<i>C. echinospermum</i> (no 204)	94	94	18	28	100	100	71	74	+	NT
<i>C. judaicum</i>	0	31	9	16	0	43	3	30	+	3.0
<i>C. judaicum</i> (no 182)	21	33	18	25	0	53	13	37	-	3.0
<i>C. judaicum</i> (no 183)	14	21	2	4	0	0	5	8	-	4.0
<i>C. judaicum</i> (no 185)	21	44	11	14	0	50	11	36	-	1.5
<i>C. pinnatifidum</i> (no 188)	21	29	4	8	3	34	9	24	+	8.5
<i>C. pinnatifidum</i> (no 189)	0	11	19	29	6	6	8	15	+	7.5
<i>C. pinnatifidum</i> (no 199)	88	98	18	28	92	100	66	75	+	NT
<i>C. reticulatum</i> (no 205)	98	100	18	28	100	100	72	76	+	NT
<i>C. reticulatum</i> (JM 2100)	100	100	100	100	100	100	100	100	+	NT
<i>C. reticulatum</i> (JM 2105)	88	88	18	28	100	100	72	72	+	NT
<i>C. reticulatum</i> (JM 2106)	85	92	100	100	100	100	95	97	+	NT
<i>C. reticulatum</i> (JM 2106a)	89	100	100	100	100	100	96	100	+	NT
<i>C. reticulatum</i> ¹ (JM 2106a-1)	100	100	18	28	100	100	73	76	+	NT
<i>C. yamashitae</i> (JM 2021)	65	91	75	89	100	100	80	93	+	5.0
<i>C. yamashitae</i> (JM 2022)	73	93	18	28	100	100	64	74	+	NT
<i>C. arietinum</i> cv Annigeri	10	13	17	23	6	29	11	22	+	
<i>C. arietinum</i> cv JG 62	100	100	100	100	100	100	100	100	+	NT
C.D. at 5 per cent	—	—	26.6	30.7	36.6	67.3				3.7

¹Average of two replications, ²1 = No root necrosis; 9 = 100% root necrosis, FS = Flowering stage PS = Podding stage; + = Vascular discolouration present; - = Vascular discolouration absent; NT = Not

and *C. pinnatifidum* (No. 189) showed consistently low mortality (0-34 per cent). Averaged over three seasons, these wild species showed equal or less mortality than the resistant chickpea cv. Annigeri. The mortality in accessions of some species such as *C. bijugum* showed a large variation from season to season. The remaining accessions of the wild species showed higher mortality. *C. cuneatum* (SL 157) and *C. judaicum* (Nos 182, 183 and 185) did not show any vascular discolouration which is an indication of higher level of wilt resistance. The accessions of *C. judaicum* showed least root necrosis due to dry root rot (1.5-4 on 1-9 scale).

The fungi isolated from the dead plants over the three seasons were *F. oxysporum*, *F. solani*, *R. bataticola*, *S. rolfsii* and *R. solani* (Table 2). In a few cases, more than one fungus was isolated from a single dead plant. *Fusarium oxysporum* was the predominant fungus in all three seasons followed by *R. bataticola*, *F. solani*, *S. rolfsii*, and *R. solani*.

TABLE 2 Frequency of wilt and root rot fungi isolated from dead plants in wilt and root rot nursery at ICRISAT Center, between 1986 and 1989

Year	No. of colonies (per cent)																			
	No. of plants used for isolation		Foc		Rb		Fs		Sr		Rs		Mixed infection		Other organisms		No. of fungus			
	FS	PS	FS	PS	FS	PS	FS	PS	FS	PS	FS	PS	FS	PS	FS	PS	FS	PS		
1986-87	100	100	71	81	8	8	4	4	2	0	0	0	0	7	6	0	0	8	1	
1987-88	87	107	48	72	0	12	5	9	20	0	14	0	0	0	0	2	3	11	4	
1988-89	72	98	58	79	18	9	3	1	0	0	3	1	13	6	7	3	1	1	1	

FS = Flowering stage, PS = Podding stage, Foc = *F. oxysporum* f sp. coccin, Rb = *R. bataticola*, Fs = *F. solani*, Sr = *S. rolfsii*, Rs = *R. solani*

The frequency of *F oxysporum* during 1987-88 was, however, low. The frequency of *S rolfsii* and *R solani*, especially at the flowering stage, was much higher in 1987-88 season than in the 1986-87 and 1988-89 seasons.

It is interesting to note the very large variation in mortality of test lines though the wilt susceptible check JG 62 showed 100 per cent mortality in all the three seasons. This variation is suspected mainly due to variation in dry root rot incidence. JG 62 is highly wilt susceptible cultivar that gets killed within a month after sowing. Mortality due to dry root rot during the first month is negligible though the infection can occur. Hence, JG 62 is unable to reflect the differences in dry root rot incidence which occurs mainly during the podding stage. To some extent, the resistant cultivar Annigen is able to indicate the differences in dry root rot incidence across the seasons. The variations in the reaction of the wild *Cicer* accessions across seasons could also be due to interactions between wilt and root rot pathogens, and soil temperature and moisture. Low moisture and warm temperatures are known to increase the incidence of these soil borne diseases, especially dry root rot.

Different disease reactions were noted for accessions of some species, two accessions of *C pinnatifidum* (No 188 and No 189) showed low mortality (0.34 per cent) but another accession (No 199) showed very high mortality (28.100 per cent). As the predominant fungi isolated from dead plants were *F oxysporum* f. sp. *ciceri* and *R bataticola*, we consider the evaluation to be more effective against these two fungi than against others. Nene and Haware (1) screened accessions of 9 wild *Cicer* species against *Fusarium* wilt in pots and reported collections of *C judaicum* to be resistant. This is probably the first report on identification of combined resistance to wilt and root rots in wild *Cicer* spp. In view of the occurrence of different physiologic races in *F oxysporum* f. sp. *ciceri*, we feel the additional resistance sources available in the wild species could be useful in future resistance breeding work.

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