

Characterization of chickpea lines for resistance to *Ascochyta* blight

LIVINDER KAUR¹, S. PANDE², J.S. SANDHU³, P.M. GAUR, M. SHARMA² and C.L.L. GOWDA

¹Punjab Agricultural University, Ludhiana – 141 004, Punjab, India; ²International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru – 502 324, Andhra Pradesh, India; ³Indian Council of Agricultural Research (ICAR), New Delhi – 110 014, India; E-mail: livinderk@rediffmail.com

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ABSTRACT

Ascochyta blight (AB) caused by *Ascochyta rabiei* occurs in most of the chickpea (*Cicer arietinum* L.) growing areas of the world. Out of the 930 diverse chickpea germplasm entries evaluated under different years of testing from 1982 to 2010 in the *Ascochyta* Blight Nursery at Punjab Agricultural University (PAU), Ludhiana, identified 131 entries promising with consistent disease resistance to AB. Of the 20 entries originated from India, one entry, 'ICC 1467' was highly resistant and 9 showed resistant reaction to AB. Of the 76 entries from Iran, eight entries 'ICC 2342', 'ICC 3599', 'ICC 3601', 'ICC 4066', 'ICC 4074', 'ICC 4075', 'ICC 4092' and 'ICC 4200' showed highly resistant reaction. Of the five entries from USSR, one entry 'ICC 5033' was highly resistant while two entries 'ICC 1069' and 'ICC6304' were resistant. Of the selection material from breeding trials, 9 entries were resistant and 8 entries were moderately resistant. 'ICC 76' showed stable resistance for 8 years, 'ICC 1069' and 'ICC 6304' for ten years and these have been extensively employed in chickpea resistance breeding for AB. Nine selection lines viz., 'EC 5167007', 'EC 517011', 'EC 517023', 'EC 517025', 'EC 517039', 'EC 516796', 'EC 516850', 'EC 516934' and 'EC 516936' exhibited consistent AB resistance for 3-4 years. 'ICCV 98818' also showed resistance for four years. The lines identified resistant to AB for a number of years can serve as durable sources of resistance for their use in the breeding programme.

Key words: *Ascochyta rabiei*, Chickpea, Resistance, Stable resistance

Ascochyta blight (AB) caused by *Ascochyta rabiei* occurs in almost all the chickpea (*Cicer arietinum* L.) growing areas of the world (Kaiser *et al.* 2000). It is a disastrous biotic constraint and is encountered in 26 chickpea growing countries of the world with cool moist climate (Nene 1982). With more countries going for chickpea cultivation the disease has spread to Canada (Chongo and Gossen 2001), Latin America (Kaiser *et al.* 2000), Australia (Khan *et al.* 1999, Knight and Siddique 2002) and West Asia (Akem *et al.* 2000) causing substantial yield losses.

Virtually, there is no country that is not influenced by this disease. In India the disease is most prevalent and threatening in the North Western Plain Zone and other regions. The disease affects the yield as well as the quality of grain and spreads rapidly under high and prolonged rainfall and temperature around 20-22°C (Gurha *et al.* 2003). Growing

resistant cultivars is the most economical way to manage the disease and to achieve higher grain yields (Pande *et al.* 2005). Thus there is a need to explore germplasm with durable resistance to AB so as the stable AB resistant cultivars of chickpea could be developed. This paper elucidates on diverse sources in chickpea germplasm with stable resistance to AB.

MATERIALS AND METHODS

Nine hundred and thirty chickpea germplasm entries, obtained from diverse sources by ICRISAT and single plant *Ascochyta* blight (AB) resistant selections made from breeding material at ICRISAT were evaluated during 1982 to 2010 for AB resistance at the Research Farm of Punjab Agricultural University (PAU), Ludhiana for quick and reliable screening against AB. About 30 entries composed in 'International *Ascochyta* blight Nursery' trial were received from ICRISAT every year for screening under controlled conditions. The entries found promising were promoted for testing in the following years to identify for stable resistance. Sowings were done in the first fortnight of November every year. Each test entry was sown in one row of 2 m long with 10 cm intra- and 40 cm inter- row spacing and replicated twice in all the years of testing. Susceptible check 'ICC 4991' was sown after every four-test rows to serve as infector-cum-indicator row. To establish uniform disease, all plants of the test entries were spray inoculated with conidial suspension of *A. rabiei* containing 4×10^4 conidia/ml in the evening around 1700 h in the first week of February each year when the crop was in flowering and pod initiation stage i.e. 85-90 days old. Inoculum of *A. rabiei* was multiplied on potato (500 g) dextrose (20 g) broth (water 1lit). Water sprinkling was provided through perfo-spray system operated by 7 H power engine from the following day after inoculation for 15 min after every 2 h from 1000 to 1600 h to maintain > 90 % RH for 21 days.

Disease severity was recorded on 1-9 point scale, where 1 = no lesions on any plant (highly resistant); 3 = lesions visible on < 10% of the plants, no stem girdling (resistant); 5 = lesions visible on up to 25% of the plants, stem girdling on < 10% of the plants, but little damage (moderately resistant); 7 = lesions on most of the plants, stem girdling on < 50% of the plants resulting in death of few plants (susceptible); 9 = lesions profuse on all the plants, stem girdling on > 50% of the plants and death of the most of the plants (highly susceptible). The genotypes were categorized based on the

Table 1. Reaction of chickpea germplasm entries to Ascochyta blight (1982 to 2010)

Entry	Pedigree	Origin	Years of testing	AB rating (1-9 scale)	Entry	Pedigree	Origin	Years of testing	AB rating (1-9 scale)
ICC 12	P-7	India	4	3.2	ICC 4107	P-4890	Iran	3	2.3
ICC 72	P-58	India	2	2.5	ICC 4111	P-4893	Iran	3	3.0
ICC 76	P-60-1	India	8	4.0	ICC 4112	P-4894	Iran	3	3.6
ICC 124	P-100-2	India	3	3.0	ICC 4116	P-4900	Iran	3	3.0
ICC 369	P-273-1	India	2	4.0	ICC4181	P-5009	Iran	3	3
ICC 529	P-412	India	3	3.3	ICC 4187	P-5016	Iran	4	3.5
ICC 601	P-474-2	India	4	3.5	ICC 4192	P-5023	Iran	4	3.5
ICC 607	P-479	India	7	3.8	ICC4200	P-5044-1	Iran	2	2
ICC 641	P-502-1	India	2	3.5	ICC 4208	P-5059	Iran	3	3.0
ICC 1069	P-919	USSR	10	2.9	ICC 4222	P-5092	Iran	3	3.0
ICC 1093	P-960	Iran	4	3.5	ICC 4223	P-5093	Iran	3	3.0
ICC 1400	P-1245-1	India	3	3.3	ICC 4241	P-5127	Iran	3	3.6
ICC 1467	P-1279-1	India	5	1.2	ICC 4294	P-5243-2	Iran	3	3.0
ICC 1468	P-1279-2	India	6	2.9	ICC 4315	P-5268	Iran	3	3.0
ICC 1472	P-1281-1	India	3	3.0	ICC 4319	P-5279	Iran	3	3.0
ICC 1532	P-1314	India	6	3.6	ICC 4324	P-5292-1	Iran	4	3.0
ICC 1903	P-1528-1	Morocco	4	3.1	ICC 4351	P-5327	Iran	3	3.0
ICC 1905	P-1529	India	4	3.0	ICC 4361	P-5338	Iran	3	3.0
ICC 2160	P-1741-1	Mexico	4	2.6	ICC 4362	P-5338-1	Iran	3	3.0
ICC 2165	P-1747-1	Mexico	4	1.8	ICC 4363	P-5342	Iran	3	3.0
ICC 2256	P-1848-1	Iran	2	3.0	ICC 4431	P-5414	Iran	3	3.0
ICC 2270	P-1872	Iran	2	2.5	ICC 4472	P-5491	Iran	2	3.7
ICC 2290	P-1932	Iran	2	3.3	ICC 4475	P-5496	Iran	4	3.1
ICC 2342	P-2031-1	Iran	3	2.0	ICC 4616	P-6207	India	4	3.0
ICC 2364	P-2104	Iran	3	2.6	ICC 4819	P-6574-1	Iran	3	3.0
ICC 3141	P-3661-1	Iran	2	3.0	ICC 4828	P-6596	Iran	3	2.6
ICC 3221	P-3777	Iran	4	3.5	ICC 4936	E-100	Greece	5	3.0
ICC 3377	P-4062-1	Cyprus	4	2.5	ICC 5033	Brown Roseha	USSR	3	1.6
ICC 3404	P-4089	Pakistan	4	3.0	ICC 5124	EC-26446	Israel	4	4.6
ICC 3422	P-4099-1	Israel	4	2.8	ICC 5566	V-136	Mexico	4	3.0
ICC 3481	P-4170	Iran	3	3.0	ICC 5766	Early Gulab-1	India	4	3.0
ICC 3597	P-4267	Iran	5	2.8	ICC 6103	JG-87	India	4	3.9
ICC 3599	P-4268-1	Iran	2	2.0	ICC 6250	NEC-123	Morocco	4	3.0
ICC 3601	P-4270	Iran	3	2.0	ICC 6304	NEC-206	USSR	10	2.2
ICC 3606	P-4274	Iran	3	2.3	ICC 6336	NEC-252	India	5	3.0
ICC 3623	P-4282	Iran	4	3.0	ICC 6373	NEC-325	Iran	7	2.9
ICC 3626	P-4283	Iran	4	3.2	ICC 6813	NEC-983	Iran	2	3.0
ICC 3627	P-4284	Iran	4	3.0	ICC 6981	NEC-1236	Iran	3	3.0
ICC 3634	P-4289	Iran	4	2.5	ICC 7000	NEC-1255	Iran	7	2.8
ICC 3642	P-4294-2	Iran	2	3.3	ICC 7002	NEC-1257	Iran	5	3.3
ICC 3912	P-4593	Iran	4	3.0	ICC 7520	12-071-10054	Iran	2	2.5
ICC 3916	P-4603	Iran	4	3.3	ICC 12952	E 100 Y Mutant	India	2	2.5
ICC 3918	P-4605	Iran	4	3.0	ICC 14911	ILC 195 Vysokoroshyj	USSR	2	5.4
ICC 3919	P-4607	Iran	3	3.6	ICC 14917	ILC 3856/PCH 128	USSR	3	4.2
ICC 3921	P-4610	Iran	2	3.0	ICC 15978	ILC 3870	Bulgaria	2	2.3
ICC 3932	P-4630	Iran	4	3.3	EC 5167003	99315-1009	ICRISAT	3	2.6
ICC 3986	P-4686	Iran	4	3.5	EC 516709	98180-1030	ICRISAT	4	4.1
ICC 3996	P-4698-1	Iran	3	2.6	EC 517011	97039-1012	ICRISAT	4	2.6
ICC 4000	P-4703	Iran	4	3.0	EC 517023	97037-14565	ICRISAT	4	2.6
ICC 4006	P-4707	Iran	4	3.0	EC 517025	97039-1644	ICRISAT	4	2.8
ICC 4014	P-4718	Iran	4	3.5	EC 517039	97-139A*34-99V4001	ICRISAT	4	2.5
ICC 4018	P-4722	Iran	2	2.7	EC 516771	97039-1226	ICRISAT	3	4.2
ICC 4020	P-4724-2	Iran	4	2.9	EC 516792	99067-1013	ICRISAT	4	3.5
ICC 4030	P-4739	Iran	4	3.6	EC 516793	97020-1319	ICRISAT	4	3.5
ICC 4033	P-4742	Iran	4	3.3	EC 516796	98314-1007	ICRISAT	4	2.7
ICC 4038	P-4744-2	Iran	4	3.5	EC 516824	98047-1069	ICRISAT	2	3.2
ICC 4045	P-4758	Iran	3	2.9	EC 516850	97020-1506	ICRISAT	2	2.2
ICC 4055	P-4766	Iran	2	3.0	EC 516878	97-132B-189-99V4002	ICRISAT	3	3.1
ICC 4061	P-4772-2	Iran	2	2.5	EC 516934	98176-1044	ICRISAT	4	2.3
ICC 4063	P-4775-1	Iran	2	3.0	EC 516936	98047-1069	ICRISAT	3	3
ICC 4065	P-4778	Iran	2	5.0	EC 516957	97020-1083-1001	ICRISAT	3	5
ICC 4066	P-4779	Iran	2	2.0	EC 516974	97-139A*28-99V4001	ICRISAT	3	3.6
ICC 4074	P-4797-2	Iran	2	2.0	ICCV 98815	(C235XNEC138-2)X (FLIP87-4XILC4421)	ICRISAT	4	3.3
ICC 4075	P-4798	Iran	3	2.0	ICCV 98818	(C235XNEC138-2)X (FLIP87-4XILC4421)	ICRISAT	4	2.3
ICC 4087	P-4839	Iran	3	3.6					
ICC 4092	P-4846	Iran	2	2.0					
ICC 4093	P-4848	Iran	3	3.3					

*Mean disease rating

scoring as 1-2 highly resistant, 2.1 to 3 resistant, 3.1 to 5.0 moderately resistant, 5.1 to 7.0 susceptible and 7.1 to 9.0 highly susceptible.

RESULTS AND DISCUSSION

Susceptible cultivar 'ICC 4991' had a rating of 9 on 1-9 rating scale in all the years of testing indicating good epidemic development of disease for reliable evaluation. Of the 930 entries evaluated, 131 entries were identified with consistence resistance over number of years. Of these 131 entries, 11 entries rated < 2.0 and characterized as highly resistant where as 63 showed 2.1-3 rating, while 44 showed 3.1 to 5 rating on 1-9 scale on mean basis of total years of testing and thus were resistant to moderately resistant. Only one entry had susceptible (5.1 to 7 rating) reaction to AB (Table 1).

Of the 20 entries originated from India, only one entry, 'ICC 1467' was found highly resistant (1.2 rating on 1-9 scale), 9 had resistant reaction (2.1 to 3 rating) and 10 were moderately resistant (3.1 to 5 rating) to AB. Of the 76 entries from Iran, eight entries 'ICC 2342', 'ICC 3599', 'ICC 3601', 'ICC 4066', 'ICC 4074', 'ICC 4075', 'ICC 4092' and 'ICC 4200' showed highly resistant reaction (< 2 rating), 45 entries had resistant reaction (2.1 to 3 rating) and 23 were found moderately resistant (3.1 to 5 rating) to AB. Of the five entries from USSR, one entry 'ICC 5033' was highly resistant (1.6 rating), two entries 'ICC 1069', 'ICC 6304' had resistant reaction and one entry 'ICC 14917' had moderately resistant reaction. The remaining one entry 'ICC 14911' from USSR was found susceptible to AB. Of the two entries from Israel, one entry 'ICC 3422' was resistant and the other 'ICC 5124' was moderately resistant to AB. Finally one entry collected from each of Bulgaria, Cyprus, Greece and Pakistan was found resistant to AB (Table 1). Of the selection materials from breeding trials and labeled as EC numbers, 9 entries were resistant and 8 entries moderately resistant to AB (Table 1).

Stable sources of resistance/moderate resistance were consecutively found in several entries. Two entries 'ICC 1069' and 'ICC 6304' showed durable resistance for ten years of testing. 'ICC 76', 'ICC 607', 'ICC 1532' showed durable moderately resistant reaction to AB for 8, 7 and 6, years respectively. Some more entries as 'ICC 1468', 'ICC 3597', 'ICC 6336', 'ICC 6373', 'ICC 7000' showed durable resistance for 5-7 years (Table 1). Three genotypes 'ICC 1467', 'ICC 2165', 'ICC 5033' had a disease severity of < 2 rating (1.2 to 1.8 rating) and never exceeded 2 rating during 3 to 5 years of testing. Additionally, 'ICC 1069' was also found resistant to

botrytis grey mold (BGM) and can serve as good source of resistance for both AB and BGM. Similarly, 'ICC 1468' showed <3 rating for six years. 'ICC 1069', 'ICC 4936', 'ICC 6304' have been used in crossing programme at PAU, Ludhiana. Nine selection lines viz., 'EC 5167007', 'EC 517011', 'EC 517023', 'EC 517025', 'EC 517039', 'EC 516796', 'EC 516850', 'EC 516934' and 'EC 516936' exhibited consistent AB resistance for 3-4 years. 'ICCV 98818' also showed resistance for four years. Since the use of resistant cultivars is the most practical way to control *Ascochyta* blight, identification of resistant genotypes and their use in breeding for genetic resistance is a major objective of chickpea improvement programs worldwide (Verma *et al.* 1987). Thus, the lines identified resistant to AB for number of years can serve as durable sources of resistance for use in the breeding for resistance to AB.

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