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Phytopath. medit., 1992, *31*, 59-66

Multilocation evaluation of chickpea germplasm and breeding lines for resistance to *Ascochyta* blight (*)

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Summary. One hundred ninety-one chickpea lines comprising 40 desi (ICC) and 31 kabuli (ILC) germplasm accessions and 120 kabuli breeding (FLIP) lines were evaluated for *Ascochyta* blight resistance at 48 disease-endemic locations in 20 countries in the period 1983-1989. Though there was a considerable variation in the reaction of the lines across seasons and locations, 18 lines including ILC 72, ILC 182, ILC 201, ILC 202, ILC 2380, ILC 2956, ILC 3279, ILC 3868, ILC 3870, ILC 4421, FLIP 82-191C, FLIP 83-46C, FLIP 83-49C, FLIP 83-72C, FLIP 83-97C, FLIP 84-85C, FLIP 84-93C, and ICC 3932 showed resistance in 50% or more of the locations or tests in which they were evaluated. These results suggest that the kabuli germplasm has better resistance to *Ascochyta* blight than the desi germplasm. Based on the reaction of six common lines to blight, the 48 locations could be categorised into 13 groups.

Riassunto. Valutazione della resistenza all'antracnosi di germoplasma e di incroci di Cece in diversi ambienti. È stata valutata la resistenza all'antracnosi di 191 linee di accessioni di germoplasma (comprendenti 40 "desi" e 31 "kabuli") e di 120 linee di incroci di Cece, in 48 ambienti in cui la malattia risulta endemica (appartenenti a 20 Paesi), nel periodo 1983-1989. Una sensibile variazione di comportamento del materiale in valutazione è stata riscontrata in accordo all'ambiente e all'epoca stagionale, tuttavia 18 linee comprendenti ILC 72, ILC 182, ILC 201, ILC 2380, ILC 2956, ILC 3279, ILC 3868, ILC 3870, ILC 4421, FLIP 82-191C, FLIP 83-46C, FLIP 83-49C, FLIP 83-72C, FLIP 83-97C, FLIP 84-85C, FLIP 84-93C, and ICC 3932 hanno manifestato resistenza alla malattia nel 50%, o più, degli ambienti e dei saggi di valutazione. Questi risultati indicano che il germoplasma "kabuli" possiede un migliore livello di resistenza all'antracnosi rispetto al germoplasma "desi". I 48 ambienti in cui la malattia risulta endemica, sulla base delle reazioni di sei linee comuni di infezione, possono essere catalogati in 13 gruppi.

Introduction

Ascochyta blight [*Ascochyta rabiei* (Pass.) Lab.] is the most important foliar disease of Chickpea (*Cicer arietinum* L.). Though it is reported from 31 countries (Nene *et al.*, 1989), it is particularly important in the Indian subcontinent and in the countries around the Mediterranean sea. Chickpea in the Indian subcontinent is grown mainly as a rainfed crop in the post-rainy season (Winter and Spring) under receding soil moisture conditions. The occasional rains that are usually received in the growing season are beneficial in alleviating the drought stress, but they also bring in Ascochyta blight. In the Mediterranean countries, chickpea is grown in the Spring season after cessation of Winter rains to escape from blight but invariably suffers from moisture and heat stresses. Advancing sowing date from Spring to early Winter increases yield by 50%-100% provided Ascochyta blight is controlled (Hawtin and Singh, 1984). Hence the control of Ascochyta blight is essential for increasing the yields of Chickpea either in

(*) Joint contribution from ICRISAT, Patancheru, India and ICARDA, Aleppo, Syria. **Journal Article n. 1289.**

the Indian subcontinent or in the Mediterranean region.

The work on the use of host-plant resistance and fungicides for the control of Ascochyta blight has been recently reviewed (Nene and Reddy, 1987; Singh, 1987; Singh and Reddy, 1991). The progress in the past 60 years on the development of resistant cultivars was limited due to lack of high-level and stable sources of resistance. The presence of a large variability in the blight pathogen *A. rabiei* has also hindered the progress on resistance breeding (Vir and Grewal, 1974; Reddy and Kabbabeh, 1985; Singh, 1990). Though several effective fungicides for seed dressing and foliar application have been identified, their application in susceptible cultivars is neither practical nor economical (Reddy and Singh, 1990). A large number of foliar sprays are needed, and most of the fungicides effective for blight at present are of contact type, making them less useful for application during rains.

Recently a few chickpea germplasms lines having high-level and multi-location resistance have been identified (Singh *et al.*, 1981; Reddy and Singh, 1984; Singh *et al.*, 1984; Singh and Reddy, 1990). Using these sources of resistance in the hybridisation programme, several high yielding lines resistant to blight were developed in the joint ICARDA-ICRISAT Kabuli Chickpea Project. Germplasm accessions and breeding lines found resistant against races prevalent in Syria were evaluated internationally through the Chickpea International Ascochyta Blight Nursery (CIABN). The results of multilocation evaluation of kabuli and desi germplasm accessions and the newly bred lines for resistance to blight in the blight-endemic countries during 1983-1989 are reported in this paper.

Materials and methods

The desi and kabuli germplasm accessions that were resistant to Ascochyta blight in the field evaluation of the world collection of chickpea germplasm at ICARDA, Syria (Singh *et al.*, 1981; Reddy and Singh, 1984; Singh and Reddy, 1990), and the newly blight-resistant kabuli lines at ICARDA were included in the evaluation. Some of the germplasm accessions that showed multi-location resistance in the earlier multilocation evaluation were also included (Singh *et al.*, 1984). The evaluation was carried out between 1983 and 1989 through the Chickpea International Ascochyta Blight Nursery (CIABN). A prior circular was sent to pathologists and breeders in the blight endemic countries regarding the availability of the trial and the nursery was supplied to those who requested for it. Any line that was susceptible at the majority of locations in any given year was excluded from the trial and new lines were added. Lines showing resistance at the majority of the locations were continued in the trial for two to three more seasons. The seed of the lines included in CIABN was multiplied under blight-free conditions at ICARDA's principal research station at Tel Hadya, Syria.

During a period of seven years (1983-1989), a total of 191 lines comprising 40 desi (ICRISAT Chickpea - ICC) and 31 kabuli (International Legume Chickpea - ILC) germplasm accessions, and 120 breeding (Food Legume Improvement Program - FLIP) lines were tested in 20 countries. Evaluation of the lines for blight resistance was carried out in the field during the Winter season either under natural epiphytotic conditions or by inoculating the nursery with diseased debris or spore suspension of the fungus multiplied in the laboratory (Reddy and Singh, 1984; Singh *et al.*, 1984). For each line, a 4 m row was sown with 40 seeds in two replications. The inter- and intra-row spacings followed were 45 and 10 cm, respectively. After every two test lines, a row of known blight susceptible cultivar ILC 1929 or ILC 263 was sown as an indicator-cum-spreader row.

The lines were scored for blight severity using a 1-9 scale, where, 1 = free from disease damage and 9 = plants killed (Singh *et al.*, 1981). The lines with 1-4 score were categorised as resistant; 5 moderately resistant; and 6-9 susceptible. A line was considered resistant at a location only when it was resistant in all the years in which it was tested. When there was variation in the reaction of the line over the seasons, the highest disease score was considered. The evaluation at any location or season was considered effective only when the susceptible check cultivar showed susceptible reaction (6 or higher disease score) and data from only these locations were used for analysis.

Results

Over a period of seven years (1983-1989), 84 disease screening nurseries were evaluated in 48 disease-endemic locations in 20 countries (Table I). The number of years for which the trial

TABLE I. - Chickpea kabuli (ILC) and desi (ICC) germplasm accessions and kabuli breeding lines (FLIP) evaluated for resistance to *Ascochyta* blight at 24 or more of locations and the number of locations and tests in which they were resistant, 1983-1989.
TABELLA I. - *Accessioni di germoplasma di Cece kabuli (ILC) e desi (ICC) e linee di incroci kabuli (FLIP) valutate per la resistenza all'antracnosi in 24 o più ambienti e numero di località e di saggi nei quali esse sono risultate resistenti. Periodo 1983-1989.*

Name of line/resistant	n. of locations		% resistant	n. of locations		% resistant	Name of line/resistant	n. of locations		% resistant	n. of locations		% resistant
	tested	resistant		tested	resistant			tested	resistant		tested	resistant	
ILC 72	47	31	66	89	65	73	FLIP 83-22C	32	13	41	48	22	46
ILC 182	31	17	55	52	33	63	FLIP 83-46C	40	21	53	70	44	63
ILC 200	43	21	49	72	45	63	FLIP 83-47C	40	15	38	70	36	51
ILC 201	37	20	54	52	32	62	FLIP 83-48C	43	21	49	70	44	63
ILC 202	47	32	68	89	55	62	FLIP 83-49C	28	13	46	39	23	59
ILC 2380	18	9	50	21	12	57	FLIP 83-72C	28	12	43	39	22	56
ILC 2506	38	17	45	59	34	58	FLIP 83-97C	28	14	50	39	25	64
ILC 2956	38	21	55	58	37	64	FLIP 84-22C	25	11	44	30	16	53
ILC 3279	47	24	51	91	61	67	FLIP 84-78C	28	13	46	39	23	59
ILC 3856	44	21	48	76	45	59	FLIP 84-79C	27	12	44	38	22	58
ILC 3868	46	24	52	83	51	61	FLIP 84-80C	28	11	39	39	22	56
ILC 3870	27	16	59	42	27	64	FLIP 84-81C	25	12	48	30	17	57
ILC 4421	45	24	53	82	53	65	FLIP 84-83C	28	10	36	39	19	49
ILC 5928	28	13	46	39	23	59	FLIP 84-85C	25	13	52	30	18	60
FLIP 81-70C	29	13	45	45	21	47	FLIP 84-86C	25	10	40	30	15	50
FLIP 81-293C	31	12	39	52	11	21	FLIP 84-87C	28	12	43	39	12	31
FLIP 82-1C	29	11	38	45	20	44	FLIP 84-91C	28	12	43	39	21	54
FLIP 82-64C	29	11	38	45	20	44	FLIP 84-29C	28	15	54	39	15	38
FLIP 82-74C	29	14	48	45	25	56	FLIP 84-93C	28	14	50	39	24	62
FLIP 82-150C	40	15	38	69	38	55	FLIP 84-182C	28	12	43	39	21	54
FLIP 82-172C	25	9	36	30	14	47	ICC 3932	25	14	56	40	23	58
FLIP 82-186C	25	10	40	30	15	50	ICC 6495	28	13	46	46	25	54
FLIP 82-191C	29	15	52	45	26	58	Susceptible check:						
FLIP 82-259C	29	12	41	45	19	42	ILC 1929	25	0	0	36	0	0
FLIP 83-7C	31	13	42	48	22	46	ILC 263	33	0	0	52	0	0

TABLE II. - Chickpea kabuli (ILC) and desi (ICC) germplasm accessions and kabuli breeding lines (FLIP) with multi-location resistance (resistance in 50% or more of the locations and trials) to *Ascochyta* blight (1983-1989).

TABELLA II. - *Accessioni di germoplasma di Cece kabuli (ILC) e desi (ICC) e linee di incroci kabuli (FLIP) con resistenza in più ambienti (50% e più degli ambienti e dei saggi) all'antracnosi (1983-1989).*

Country	Location	Reaction to *Ascochyta* blight																	
		ILC										FLIP							ICC 3932
		72	182	201	202	2380	2956	3279	3868	3870	4421	82-191C	83-46C	83-49C	83-72C	83-97C	84-85C	84-93C	
Algeria	Khroub	R[a]	NT	R	R	NT	R	R	R	NT	R	NT	R	R	R	R	R	R	R
	Setif	R	NT	NT	R	NT	R	R	R	NT	R	NT	R	R	R	R	NT	R	NT
	Sedi Bel Abbes	S	NT	T	R	NT	T	S	S	NT	T	NT	T	S	S	S	S	S	NT
Bangladesh	Mymensingh	S	S	S	R	S	R	R	R	S	S	T	NT	NT	NT	NT	NT	NT	S
Bulgaria	Toshevo	R	NT	T	S	NT	R	R	R	NT	S	NT	T	R	R	S	T	R	NT
Cyprus	Laxia	R	NT	R	R	NT	R	R	R	NT	R	NT	R	R	R	R	R	R	NT
Egypt	Giza	S	T	T	S	T	S	T	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	S
	Tahrir	R	R	NT	R	NT	NT	T	R	R	S	R	T	NT	NT	NT	NT	NT	NT
France	Montboucher	R	NT	T	R	NT	R	R	S	NT	S	NT	S	T	R	R	T	S	R
	Montpellier	R	R	R	R	R	R	T	T	R	R	R	NT	NT	NT	NT	NT	NT	R
Greece	Larissa	S	R	R	S	T	S	S	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	S
India	Ludhiana-1 (lab)	R	R	R	R	R	R	R	S	NT	R	R	T	R	T	T	T	R	R
	Ludhiana-2 (field)	R	R	R	R	R	R	R	S	NT	R	T	T	R	T	T	R	R	R
Iran	Fasa Fars	T	NT	S	R	NT	R	S	S	NT	S	NT	R	S	R	R	R	R	R
Italy	Basilicata	R	R	NT	R	NT	NT	R	R	R	R	R	R	NT	NT	NT	NT	NT	NT
	Tarquinia	R	S	R	T	NT	R	S	S	S	S	S	S	R	R	R	R	R	NT
Jordan	Marow	S	T	S	S	S	S	S	S	S	S	S	T	S	S	R	R	S	R
Lebanon	Beqa'a	R	R	NT	R	NT	NT	R	R	R	R	R	R	NT	NT	NT	NT	NT	R
	Terbol	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Morocco	Dar Bouazza	S	NT	S	S	NT	S	S	S	NT	S	NT	S	S	S	S	S	S	NT
	Douyet	R	R	R	R	T	R	R	R	R	R	T	NT	NT	NT	NT	NT	NT	R
	Marchouch	R	T	R	R	R	R	T	R	R	R	R	R	NT	NT	NT	NT	NT	R
Pakistan	Chakwal	T	NT	T	S	NT	T	T	S	NT	T	NT	S	T	S	S	T	T	S
	Faisalabad-1	S	S	S	S	T	S	S	S	S	S	S	S	S	S	S	S	S	S
	Faisalabad-2	S	S	S	S	NT	S	S	S	S	S	S	S	S	S	S	S	S	S

Pakistan	Islamabad-1	R	T	S	S	T	S	S	S	S	S	S	S	S	S	S	S	S	S
	Islamabad-2	T	T	NT	R	NT	NT	R	R	R	R	S	R	NT	NT	NT	NT	NT	NT
	Tarnab	T	T	S	S	T	T	T	S	S	R	R	R	S	T	S	T	S	S
Portugal	Elvas	R	NT	T	R	NT	T	S	S	NT	T	NT	T	T	S	T	R	S	S
Spain	Badajoz	T	NT	NT	T	NT	T	T	T	NT	T	NT	T	S	T	T	NT	T	NT
	Cordoba-1	R	T	NT	R	NT	NT	R	S	T	T	S	T	NT	NT	NT	NT	NT	NT
	Cordoba-2	R	R	NT	R	NT	NT	R	R	R	R	R	R	NT	NT	NT	NT	NT	NT
Syria	Al Ghab	R	NT	R	R	NT	R	R	R	NT	R	NT	R	R	R	R	R	R	NT
	Gelline	NT	NT	R	NT	NT	NT	NT	R	NT	NT	NT	R	NT	NT	NT	NT	NT	NT
	Jableh	R	T	R	R	T	R	T	T	T	S	R	S	NT	NT	NT	NT	NT	S
	Jindiress	R	R	R	R	R	R	R	R	R	R	R	NT	NT	NT	NT	NT	NT	R
	Lattakia	R	R	R	R	R	R	R	R	R	R	R	R	NT	NT	NT	NT	NT	T
	Tel Hadya	R	R	T	R	R	T	T	T	R	S	T	R	T	R	R	NT	R	R
Turkey	Amasya	T	NT	T	T	NT	T	R	S	NT	S	NT	S	S	S	S	T	S	NT
	Ankara	R	T	R	R	NT	R	NT	R	T	R	R	R	R	R	R	R	R	NT
	Eskisehir	T	NT	R	T	NT	T	R	S	NT	S	NT	S	S	S	S	S	S	NT
	Izmir	R	R	R	R	NT	R	R	R	R	R	R	R	R	R	R	R	R	NT
Tunisia	Beja	R	R	R	R	R	R	R	R	R	R	R	NT	NT	NT	NT	NT	NT	R
	Oued Meliz	R	NT	R	R	NT	T	T	R	NT	R	NT	R	R	S	R	R	R	NT
	Tunis-1	S	S	NT	S	NT	NT	S	S	S	S	S	S	NT	NT	NT	NT	NT	NT
	Tunis-2	R	NT	S	R	NT	S	R	R	NT	R	NT	R	R	R	R	R	T	NT
USA	Highmore	R	R	NT	R	NT	NT	R	R	R	R	T	R	NT	NT	NT	NT	NT	NT
	S. Dakota	R	R	NT	R	NT	NT	S	R	R	R	T	R	NT	NT	NT	NT	NT	NT
n. of locations tested		47	31	37	47	18	38	46	46	27	45	29	41	28	28	28	25	28	25
n. of locations resistant		31	17	20	32	9	21	24	24	16	24	15	21	13	13	14	13	14	14
n. of locations tolerant		7	8	8	4	7	9	10	4	3	5	6	9	4	4	4	6	3	1
% of locations resistant		66	55	54	68	50	55	52	52	59	53	52	51	46	46	50	52	50	56
% of locations tolerant		15	26	22	9	39	24	22	9	11	11	21	22	14	14	14	24	11	4

(a) R = Resistant (1-4 score on 1-9 scale); T = Tolerant (5 score); S = Susceptible (6-9 score); NT = Not tested.

TABLE III. - Grouping of the locations based on the reaction of six chickpea genotypes to *Ascochyta* blight.
TABELLA III. - *Raggruppamento degli ambienti sulla base della reazione di sei genotipi di Cece all'antracnosi.*

Chickpea genotype	Location groups												
										10	11	12	13
ILC 72	R	S	S	S	R	R	R	R	R	R	R	R	R
ILC 202	R	S	R	R	S	R	R	R	R	S	R	R	R
ILC 2956	R	S	R	R	R	NT	R	R	R	R	R	S	NT
ILC 3279	R	S	S	R	R	R	R	R	S	R	S	R	S
ILC 3868	R	S	S	R	R	R	S	S	S	S	S	R	R
ILC 4421	R	S	R	S	S	S	S	R	S	R	R	R	R

Group 1 = (21 locations) Khroub, Setif, Laxia, Montpellier, Basilicata, Beqa'a, Terbol, Douyet, Marchouch, Badajoz, Cordoba-2, Al Ghab, Gelline, Jindiress, Lattakia, Ankara, Faisabalad-2, Izmir, Beja, Oued Meliz, Highmore; **Group 2** = (8 locations) Giza, Larissa, Marow, Dar Bouazza, Islamabad-1, Islamabad-2, Faisalabad-1, Tunis-1; **Group 3** = (1 location) Sidi Bel Abbes; **Group 4** = (1 location) Mymensingh; **Group 5** = (1 location) Toshevo; **Group 6** = (3 locations) Tahrir, Jableh, Tel Hadya; **Group 7** = (3 locations) Montboucher, Amasya, Eskishehir; **Group 8** = (3 locations) Ludhiana-1, Ludhiana-2, Cordoba-1; **Group 9** = (2 locations) Fasa Fars, Tarquinia; **Group 10** = (2 locations) Chakwal, Tarnab; **Group 11** = (1 location) Elvas; **Group 12** = (1 location) Tunisia-2; **Group 13** = (1 location) South Dakota.
R = Resistant; S = Susceptible; NT = Not tested.

was conducted at a location varied from one to five. At Tel Hadya in Syria and Terbol in Lebanon, the trial was conducted for five years. At Tarquinia in Italy, the trial was conducted for four years. At Elvas in Portugal, Islamabad and Tarnab in Pakistan; Izmir in Turkey; Jableh and Lattakia in Syria; and Montboucher in France, the trial was conducted for three years. At eight other locations the trial was conducted for two years and in the remaining 30 locations for only one year.

The number of lines evaluated at a location ranged from 9 to 159. Except at Gelline in Syria where only 9 lines were evaluated, at all other 47 locations, 41 or more lines were evaluated. The number of lines found resistant at a location ranged from 0 to 147 Except at Dar Bouazza in Morocco, a few to several lines were found either resistant or moderately resistant at all the other locations. Except at Chakawal and Faisalabad in Pakistan, and Tunis in Tunisia (where only lines with moderate resistance could be found), at all other 44 locations, a few to several lines were resistant.

A relatively large number of lines were resistant in repeated tests at Terbol in Lebanon followed by Tel Hadya and Lattakia in Syria, Tarquinia in Italy, and Izmir in Turkey. Very few lines were resistant at Eskisehir in Turkey and Marow in Jordan. Lines were found resistant or moderately resistant at the other 30 locations in one year screening but they need confirmation.

The lines that were tested at 24 or more of the 48 locations and the number of trials and locations in which they were resistant are given in Table 1. Fourteen kabuli germplasm lines, 31 breeding lines and two desi germplasm lines were tested at 24 or more locations and 20 of these were resistant at 50% or more locations and 35 in 50% or more tests. Eighteen lines including ILC 72, -182, -201, -202, -2380, -2956, -3279, -3868, -3870, -4421, FLIP 82-191C, -83-46C, -83-49C, -83-72C, -83-97C, -84-85C, -84-93C, and ICC 2932 showed resistance in 50% or more of the locations, and can be considered with multilocation resistance. The kabuli germplasm lines, ILC 72 and ILC 202, showed resistance at the maximum number of locations (31 and 32 out of 47 locations, respectively). These two lines also had the highest frequency of resistance (73%).

Discussion

As the chickpea lines evaluated for blight resistance at multilocations included kabuli and desi germplasm accessions and newly bred kabuli lines from ICARDA, it provided an opportunity to study their comparative performance against blight. The kabuli accessions performed well

across the locations for blight resistance (10 out of the 31 accessions tested showed multilocation resistance) followed by the newly bred lines (7 out of 120) and desi germplasm accessions (1 out of 40). These results further support the earlier view that the kabuli germplasm has higher resistance to Ascochyta blight than the desi germplasm (Reddy and Singh, 1984).

The reaction of the lines varied greatly among locations (Table II). The populations of *A. rabiei* from chakwal and Faisalabad in Pakistan, Giza in Egypt, Tunis in Tunisia, Sidi Bel Abbes in Algeria, and Dar Bouazza in Morocco appeared to be highly virulent as none of the lines tested were resistant. Only a few lines were resistant or tolerant against the isolates of the blight fungus at Eskisehir in Turkey, Islamabad in Pakistan, Larissa in Greece, Marow in Jordan, Tarnab in Pakistan and Badajoz in Spain. At remaining locations, the number of lines resistant was larger.

Though inoculum level, temperature and relative humidity could have played a role in the large variation observed in the reaction of the lines to the disease across locations and seasons, the variation in the blight pathogen also contributed to it. Based on the reaction of six lines, ILC 72, ILC 202, ILC 2956, ILC 3279, ILC 3868, and ILC 4421, which were tested at most

TABLE IV. - Origin, pedigree and some morpho-agronomic characters of chickpea kabuli (ILC) and desi (ICC) germplasm accessions and kabuli breeding lines (FLIP) with multi-location resistance to *Ascochyta* blight.
TABELLA IV. - *Origine, albero genealogico e qualche carattere morfo-agronomico di germoplasma di Cece "kabuli" (ILC) e "desi" (ICC) e di linee di incroci "kabuli" (FLIP) con resistenza manifestantesi in molti ambienti all'antracnosi.*

Germplasm accession/ FLIP No.	Pedigree	Origin	Days to 50% flower	Days to maturity	Height (cm)	Growth habit	100-seed weight (g)	Seed shape	Seed colour
ILC 72	Lot No. 4	USSR	148	185	73	SE (a)	28	Pea (b)	Orange
ILC 182	Teninakanskij 031	USSR	142	182	57	SE	20	Pea	Yellow
ILC 201	VYR 32	USSR	130	177	50	SS	26	Owl	Orange
ILC 202	VYR 32	USSR	148	183	70	SE	28	Pea	Orange
ILC 2380	P 9655	USSR	142	181	50	SS	20	Pea	Orange
ILC 2956	K 1481	USSR	148	183	75	SE	30	Pea	Orange
ILC 3279	Stenoj 1	USSR	149	183	71	SE	28	Pea	Orange
ILC 3868	Plovdiv 8	Bulgaria	149	183	53	SS	25	Pea	Yellow
ILC 3870	Sinapovo 3	Bulgaria	146	183	62	SE	23	Pea	Yellow
ILC 4421	—	USSR	144	182	60	SS	19	Pea	Yellow
FLIP 82-191C	ILC 191 x ILC 496	ICARDA	149	182	55	SE	31	Owl	Yellow
FLIP 83-46C	ILC 72 x ILC 215	ICARDA	144	183	61	SE	33	Owl	Beige
FLIP 83-49C	ILC 3279 x ILC 1108	ICARDA	144	182	67	SE	30	Owl	Beige
FLIP 83-72C	ILC 72 x ILC 215	ICARDA	146	183	61	SE	34	Owl	Orange
FLIP 83-97C	ILC 72 x ILC 215	ICARDA	144	183	57	SE	33	Owl	Orange
FLIP 84-85C	ILC 72 x ILC 215	ICARDA	146	180	68	SE	36	Owl	Orange
FLIP 84-93C	ILC 72 x ILC 215	ICARDA	144	182	60	SE	35	Owl	Orange
ICC 3932	P-4630	Iran	145	180	46	SS	10	Angular	Black

(*a*) SE = Semi-erect; SS = Semi-spreading.
(*b*) Pea and owl-shaped seeds are classified as kabuli, and angular desi.

locations the 48 locations could be categorised into 13 groups (Table III). There was no relation between the reaction of the lines at a location and its geographic distribution. For example the reactions at Faisalabad in Pakistan and Tunis in Tunisia were categorised into the same group (Table III).

These lines were exposed to natural populations of *A. rabiei* at different locations. The populations are different in space and can also change with time. The components of pathogen populations could interact (cross protection) and the host pathogen system acts under diverse environmental conditions that can affect differently the response of each chickpea genotype.

The present evaluation clearly brings out the fact that at present there are no germplasm or breeding lines with resistance to all the prevailing populations of *A. rabiei* indicating the need for continued efforts to identify or develop better sources of resistance. Variability in *A. rabiei* has been reported from most of the important chickpea growing countries such as India, Pakistan, Turkey, and Syria (Acikgoz, 1983; Qureshi, 1986; Reddy and Kabbabeh, 1985; Vir and Grewal, 1974; Singh, 1990). However, there is a need for a more comprehensive study under controlled conditions involving the isolates of *A. rabiei* from all the chickpea growing countries to properly characterize the variability present in the fungus. Such information is essential for developing a suitable breeding strategy. Furthermore, in absence of lines resistant across the locations, it is suggested to initiate a project to pyramid genes for resistance from the lines resistant among the 13 groups.

All the kabuli germplasm accessions with multi-location resistance originated either from the U.S.S.R. or Bulgaria (Table IV). They are all late maturing (177-185 days to maturity), tall (50-75 cm plant canopy height), semi-erect or semi-spreading type with small (18.9-29.8 g 100-seed weight), and pea-shaped seed. The single desi germplasm accession that showed multi-location resistance originated from Iran and had a black seed coat colour. The present study helped in identifying some breeding lines of kabuli type with large, ram-head-shaped and beige-coloured seeds. The 100-seed weight of the newly bred (FLIP) lines ranged from 30.4 to 35.6 g with an average of 33.2 g compared to 24.6 g of the germplasm accessions. These lines will be easily accepted by the farmers and consumers in countries growing the kabuli type chickpea. Five of the seven newly developed FLIP lines that showed multi-location resistance originated from ILC 72 as one of the parents, indicating the ILC 72 not only has multi-location resistance but also is a good general combiner.

Acknowledgements

We thank Mr. G. Khalaf for assistance in seed preparation of the nursery and to Mr. S. Hajjar for compilation of results. We express our sincere gratitude to cooperators in 20 countries for evaluating chickpea lines for resistance to *Ascochyta* blight.

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