International Testing of Chickpeas for Resistance to Ascochyta Blight

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ABSTRACT

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Chickpea (*Cicer arietinum* L.) germ plasm lines resistant or tolerant to Ascochyta blight (*Ascochyta rabiei* (Pass.) Lab.) isolates prevalent in Syria and Lebanon were tested internationally between 1978 and 1982 to identify lines resistant to blight in other countries and to identify lines with broad-based resistance. A total of 112 lines including both desi and kabuli types were tested through the Chickpea International Ascochyta Blight Nursery (CIABN) in Algeria, Greece, India, Jordan, Lebanon, Morocco, Pakistan, Spain, Syria, Tunisia, and Turkey. The number of resistant lines identified in each country ranged from four to 56. Four lines, ILC 72, ILC 191, ILC 3279, and ILC 3856, were resistant in eight of the 11 countries. The differential reaction of many lines tested in these countries indicates the presence of variability in *A. rabiei*.

Ascochyta blight (*Ascochyta rabiei* (Pass.) Lab.) is one of the major constraints to chickpea production in northwestern India, Pakistan, and the Mediterranean region. The disease has caused nearly 50% loss in yield in Pakistan during the past three seasons (2). In Syria, about 30% damage occurred in the northern parts of the country during the 1982 season (1).

Intensive work has been made to identify blight-resistant lines at ICARDA in Syria and at ICRISAT in India since 1978. Lines resistant to the blight in Syria and Lebanon were tested through the Chickpea International Ascochyta Blight Nursery (CIABN) to share resistant lines identified at ICARDA with the national programs, to identify lines with broad-based or location-nonspecific resistance, and to obtain information on the variability present in the fungus. This paper reports the results of these tests.

MATERIALS AND METHODS

Germ plasm lines that showed resistance or tolerance for at least two seasons to fungal isolates at Tel Hadya, ICARDA's main research center near Aleppo in northern Syria, Lattakia, a coastal site in Syria, and Terbol in the Beqa'a Valley of Lebanon, were tested in blight-endemic countries through the CIABN. These lines consisted of both desi (small, angular, and black, brown, yellow, or green) and kabuli (large, brain-shaped, and beige) types. The acronyms for desi and kabuli were ICC and ILC, respectively. A few lines reported resistant in other countries were also included in the test. CIABN entries originated from Afghanistan, Ethiopia, India, Iran, Morocco, Spain, Tunisia, Turkey, the United States, the USSR, and ICARDA and ICRISAT programs.

CIABN testing was done with the help of ICARDA's cooperators in different national programs. The number of lines tested, countries in which evaluations were done, sets distributed, and number of locations from which results were received each season are presented in Table 1.

During 1978–1979, 30 seeds of each entry were sown in a single row 3 m long. In three subsequent seasons (1979–1980 to 1981–1982), each entry was sown in two replicates with 40 seeds each in a row 4 m long. In all four seasons, a susceptible cultivar, ILC 1929 (Syrian local land race), was sown after every two test rows to serve as spreader-indicator rows. Wherever possible, especially in the Mediterranean countries, sowing was done in the winter (rainy season) to expose materials to higher disease pressure. In a few countries, nurseries were inoculated with diseased debris collected from the same location in the previous season (3–5).

Plants were rated on a scale of 1–9, where 1–4 = resistant, up to 15% breakage of branches and pod infection; 5 = tolerant, 16–40% breakage of branches and pod infection; 7 = susceptible, 41–75% breakage of branches and pod infection; and 9 = highly susceptible, plants killed.

Lines showing susceptibility in most

Table 1. Details of the Chickpea International Ascochyta Blight Nursery (CIABN) conducted from the 1978–1979 to 1981–1982 seasons

Season	No. of lines tested	No. of sets distributed	No. of countries that received nurseries	No. of sites from which results were received
1978–1979	40	26	15	11
1979–1980	50	27	16	12
1980–1981	40	27	12	7
1981–1982	60	40	16	20

Table 2. Number of kabuli and desi chickpea lines resistant to Ascochyta blight in 11 countries from 1978 to 1982

Country	Location	No. of seasons	Resistant[a]	
			Kabuli	Desi
Algeria	Sidi-Bel-Abbes	2	24	12
Greece	Larissa	1	13	3
India	Ludhiana, Delhi	1	2	10
Jordan	Marrow	1	21	16
Lebanon	Terbol	2	28	28
Morocco	Merchouch	1	17	12
Pakistan	Faisalabad, Islamabad, Lahore, Tarnab	3	4	ND
Spain	Cordoba	1	7	ND
Syria	Homs, Jable, Lattakia, Tel-Hadya	4	10	7
Tunisia	Beja, El-Kef, Mateur	1	5	4
Turkey	Eskishehir, Hymana, Izmir	3	18	22

[a] Lines with a 1–4 rating with up to 15% broken branches and pod infection.

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Table 3. Chickpea by location interactions with Ascochyta blight during the 1978–1982 Chickpea International Ascochyta Blight Nursery trials

Germ plasm identification	Number of seasons entry was resistant											Total seasons tested	Total countries tested	Total seasons resistant	Total countries resistant
	Algeria	Greece	India	Jordan	Lebanon	Morocco	Pakistan	Spain	Syria	Tunisia	Turkey				
ILC 72	NT[a]	1	0	1	1	1	2	1	3	0	1	13	10	11	8
ILC 182	2	0	0	1	2	1	0	1	0	1	3	15	11	11	7
ILC 183	2	1	0	1	2	1	0	NT	0	1	3	7	10	11	7
ILC 187	NT	NT	NT	NT	1	1	0	NT	0	1	1	14	6	4	4
ILC 190	2	NT	0	NT	0	NT	0	NT	0	NT	0	6	6	2	1
ILC 191	2	1	1	1	2	1	0	1	0	0	3	7	11	12	8
ILC 192	2	NT	0	NT	0	NT	0	NT	0	NT	0	15	6	2	1
ILC 194	2	1	0	1	2	1	0	0	0	0	3	7	11	10	6
ILC 195	2	1	0	1	2	1	0	0	0	0	3	15	11	10	6
ILC 196	NT	0	0	0	1	1	0	NT	3	0	1	15	9	6	4
ILC 200	2	0	0	1	2	1	0	1	0	0	3	11	11	10	6
ILC 201	2	0	0	1	2	1	0	NT	4	1	3	15	10	14	7
ILC 202	2	0	0	1	2	1	0	1	4	0	3	17	11	14	7
ILC 210	2	NT	0	NT	0	NT	0	NT	0	NT	0	18	6	2	1
ILC 215	2	0	0	0	2	NT	0	NT	0	NT	0	7	8	4	2
ILC 236	0	NT	0	NT	1	0	0	NT	0	0	0	10	8	1	1
ILC 248	2	NT	0	NT	0	NT	0	NT	0	NT	0	8	6	2	1
ILC 249	0	NT	0	NT	1	NT	0	0	0	NT	0	7	7	1	1
ILC 482	2	0	0	1	2	0	0	0	0	0	0	13	11	5	3
ILC 484	0	1	0	1	0	0	0	0	0	0	0	11	11	2	2
ILC 1695	NT	0	0	1	1	0	0	NT	0	0	NT	8	8	2	2
ILC 1757	1	0	0	1	2	0	0	NT	0	0	0	11	9	4	3
ILC 1772	NT	NT	0	NT	1	NT	0	NT	0	NT	NT	4	4	1	1
ILC 2380	1	1	1	1	2	1	0	NT	0	0	2	12	10	9	7
ILC 2459	1	NT	0	NT	0	NT	0	NT	0	0	0	7	7	1	1
ILC 2506	NT	NT	NT	NT	1	1	0	NT	3	0	1	8	6	6	4
ILC 2548	NT	1	0	1	1	1	0	1	0	0	1	10	10	6	6
ILC 2555	NT	0	0	1	NT	NT	0	0	0	NT	NT	6	6	1	1
ILC 2582	1	NT	0	NT	0	NT	0	NT	0	NT	0	6	6	1	1
ILC 2585	1	NT	0	NT	0	NT	0	NT	0	NT	0	6	6	1	1
ILC 2919	1	NT	0	NT	0	NT	0	NT	0	NT	0	6	6	1	1
ILC 2956	NT	1	0	1	1	1	0	NT	3	0	1	11	9	8	6
ILC 3001	1	NT	NT	NT	0	0	0	NT	0	0	0	7	7	1	1
ILC 3257	NT	1	0	1	NT	NT	0	NT	0	NT	0	6	6	2	2
ILC 3274	NT	NT	0	NT	NT	NT	0	NT	3	NT	0	6	4	3	1
ILC 3279	1	1	0	1	1	0	3	1	3	0	2	16	11	13	8
ILC 3340	NT	NT	NT	NT	1	0	0	NT	0	0	0	6	6	1	1
ILC 3342	NT	NT	NT	NT	1	0	0	NT	0	0	0	6	6	1	1
ILC 3346	NT	NT	NT	NT	1	1	1	NT	2	0	1	7	6	6	5
ILC 3400	NT	NT	NT	NT	1	0	0	NT	0	0	0	6	6	1	1
ILC 3856	NT	1	0	1	1	1	2	NT	3	1	1	12	9	11	8
77 MS 73022-2	2	1	NT	1	0	NT	0	NT	0	NT	0	8	7	4	3
77 MS 77131-12	2	NT	NT	NT	0	NT	0	NT	0	NT	0	6	5	2	1
Total	24	13	2	21	28	17	4	7	10	5	17				

[a] NT = not tested.

locations were dropped in subsequent seasons and replaced with new resistant lines identified from additional germ plasm screening.

RESULTS

A total of 112 lines resistant or tolerant in Syria and Lebanon were subsequently tested at 51 sites in 11 countries over four seasons. Results were analyzed only for locations where the susceptible check (Syrian local land race) showed uniform susceptibility. A few to several resistant lines were identified in each country (Table 2). The kabuli lines that were resistant in Algeria, Greece, Jordan, Lebanon, Morocco, Pakistan, Spain, Syria, Tunisia, and Turkey are listed in Table 3.

In addition to the kabuli lines listed in Table 3, the desi lines that were resistant in India were ICC 76, ICC 641, ICC 1467, ICC 1591, ICC 1903, ICC 4107, ICC 7520, and NEC 138-2. Kabuli types are grown in the Mediterranean region, whereas both desi and kabuli are grown in India and Pakistan.

No line tested was resistant in all 11 countries; however, several lines were resistant in multiple locations. Four lines, ILC 72, ILC 191, ILC 3279, and ILC 3856, were resistant in eight countries. Five lines, ILC 182, ILC 183, ILC 201, ILC 202, and ILC 2380, were resistant in seven countries. Another five lines, ILC 194, ILC 195, ILC 200, ILC 2548, and ILC 2956, were resistant in six countries. In Pakistan, comparatively fewer lines were resistant and all were kabuli types.

DISCUSSION

The international testing of lines resistant to Ascochtya blight has helped 11 national programs in Africa, Asia, and Europe identify sources of resistance to this endemic disease in their countries. This program also helped identify lines with broad-based or location-nonspecific resistance. Before this study, such lines were not available. The kabuli types have shown more broad-based resistance than the desi types.

The origins and pedigrees of the 14 lines resistant in more than six countries are shown in Table 4. Twelve lines originated in the USSR and one each from Morocco and Spain. Additional searches for broad-based resistance in materials originating from the USSR might be advantageous to improvement programs.

Table 4. Origins and pedigrees of Chickpea International Ascochyta Blight Nursery germ plasm lines resistant in more than six countries from 1978 to 1982

Line	Pedigree	Origin
ILC 72	Lot no. 4	Spain
ILC 182	Teninakanskij 031	USSR
ILC 183	Teninakanskij 031	USSR
ILC 191	Vysokoroshyj 30	USSR
ILC 194	Vysokoroshyj 30	USSR
ILC 195	Vyrokoroshyj 30	USSR
ILC 200	Stepnoz 1	USSR
ILC 201	Vyr 32	USSR
ILC 202	Vyr 32	USSR
ILC 2380	P9655	USSR
ILC 2548	P957	USSR
ILC 2956	K1481	USSR
ILC 3279	Kravadar Territory 1335	USSR
ILC 3856	Pch 128	Morocco

The large interaction observed between lines and locations indicates that races of the blight fungus exist. For example, such lines as ILC 196, ILC 201, ILC 2506, and ILC 2956 were resistant in Syria but susceptible in Pakistan and India. All

lines that were resistant in India were susceptible to the Syrian isolates. Similarly, many lines, such as ILC 182, ILC 183, ILC 191, ILC 192, ILC 194, ILC 195, ILC 200, ILC 210, ILC 248, ILC 482, ILC 1757, ILC 2380, ILC 2582, ILC 2919, and ILC 3000, were susceptible or tolerant in Syria but resistant in Algeria. The results indicate that isolates of *A. rabiei* in the Indian subcontinent are more virulent than those in Algeria and Lebanon. A collaborative project between ICARDA and the University of Reading, U.K., is in progress to characterize the variability present in *A. rabiei*.

The large interaction observed between lines and locations in this study indicates the need for multilocation testing of chickpea to breed for broad-based resistance to *A. rabiei*.

Resistant lines are being used in genetic improvement programs at centers worldwide. These sources of resistance have been used at ICARDA to increase yield potentials to 4 t/ha. These materials and testing methods have been made available to national programs through the International testing program.

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