Resistance in Chickpeas to *Ascochyta rabiei*

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ABSTRACT

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A technique for large-scale screening of chickpeas for resistance to Ascochyta blight involves interplanting a susceptible spreader line, scattering infected debris between rows, spraying with spores from infected plants, and providing high humidity by sprinkler irrigation. By this screening method, in two to three seasons, 21 lines and 36 progenies in the F_4 to F_7 generations were identified as resistant among 9,385 genotypes involving germ plasm lines and segregating populations. Four lines were resistant in three Mediterranean countries. Three accessions, one each of the wild species of *Cicer pinnatifidum, C. montbretti,* and *C. judaicum*, were highly resistant.

Among the diseases of chickpeas (*Cicer arietinum* L.) prevalent in the Mediterranean region, blight caused by *Ascochyta rabiei* (Pass.) Lab. is the most destructive. Severe epiphytotics can cause total losses. Fungicide sprays, disease-free seed, destruction of infected plant debris, and mixed cropping are recommended control measures, but these methods are unreliable and may be uneconomical. The best way to control this disease is through use of resistant cultivars.

Techniques for screening a small number of lines (7,14,15) are of limited use for large-scale screening of germ plasm and breeding material. Sources of resistance to Ascochyta blight have been identified (1–11,13,14,17,18), but their use may be limited by races of *A. rabiei* (6,12,19). Most sources of resistance are in the desi type of chickpea, which has small, angular, colored seeds; however, only the kabuli type, which has larger, brain-shaped, beige seeds, is cultivated in the Mediterranean region.

The purpose of this study was to develop an efficient, large-scale field screening technique to identify stable sources of resistance to Ascochyta blight, and to collect further information on the possible existence of races of the pathogen.

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MATERIALS AND METHODS

During the 1977-1978 season, 1,238 germ plasm lines (1,207 kabuli and 31 desi) and 651 F_4 progenies were screened. In 1978-1979, 3,001 germ plasm lines (2,903 kabuli and 98 desi) were screened. In 1979-1980, 2,331 germ plasm lines (297 kabuli and 2,034 desi), 13 accessions of seven *Cicer* spp., and 2,164 F_3 to F_7 progenies were screened. Germ plasm lines and segregating progenies with resistance were rescreened in the subsequent years.

Seeding in all years was done in November near Aleppo in northern Syria. Fifty seeds of each entry were planted in single rows, 5 m long and 65 cm apart. During 1977-1978, a susceptible line (ILC-1929) was planted as a spreader row after every 20 entries. In 1978-1979 and 1979-1980, this line was planted after every two to four test rows. Susceptible lines were also planted as borders around the field. Seeds of 40 of the resistant genotypes identified during 1977-1978 were distributed to 14 locations in eight countries in the Chickpea International Ascochyta Blight Nursery; data were obtained from four locations in three of the countries.

Ascochyta blight appeared naturally in late February of 1978 but was not uniform throughout the field. To increase the level and uniformity of the disease, plants were sprayed on two occasions with a spore suspension that was applied after 1700 hr on cloudy days. The spore suspension was prepared by soaking diseased plants in water for about 60 min and then shaking them vigorously. The suspension (100,000 spores per milliliter), was strained and applied to the plants (15 ml/m of row) with a knapsack sprayer.

During 1978-1979 and 1979-1980, plots were artificially inoculated during the first week of February by scattering infected debris collected during the previous season. Whenever necessary, plots were inoculated with a spore suspension. High humidity was maintained by sprinkler irrigation.

The material was scored on a 1–9 scale where 1 = no visible lesions on any plants (highly resistant); 3 = lesions visible on less than 10% of the plants, no stem girdling (resistant); 5 = lesions visible on up to 25% of the plants, stem girdling on less than 10% of the plants but little damage (tolerant); 7 = lesions on most plants, stem girdling on less than 50% of the plants resulting in the death of a few plants (susceptible); 9 = lesions profuse on all plants, stem girdling on more than 50% of the plants, and death of most plants (highly susceptible).

RESULTS

The average disease ratings for the spreader rows during 1977-1978, 1978-1979, and 1979-1980 seasons were 8.2, 8.9, and 9.0, respectively. During the 1978-1979 and 1979-1980 seasons, planting of spreader rows at more frequent intervals, supplemented by artificial inoculation with infected debris and sprinkler irrigation, enhanced disease development.

Table 1. Susceptibility to Ascochyta blight of chickpea germ plasm lines and breeding progenies during 1977 through 1980[a]

	1977-1978				1978-1979		1979-1980			
	Germ plasm lines		F_4 Progenies		Germ plasm lines		Germ plasm lines		F_3-F_7 Progenies	
Classification	(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)
Highly resistant	8	0.7	5	0.8	4	0.1	0	0.0	0	0.0
Resistant	37	2.4	76	11.7	18	0.6	36	1.5	36	1.7
Tolerant	176	14.2	80	12.3	59	2.0	57	2.4	242	11.2
Susceptible	199	14.5	55	8.4	847	28.2	160	6.9	216	9.9
Highly susceptible	818	68.2	435	66.8	2,073	69.1	2,078	89.2	1,670	77.2

[a] Based on 1–9 scale. Average ratings for the indicator rows during the 1977-1978, 1978-1979, and 1979-1980 seasons were 8.2, 8.9, and 9.0, respectively. Data from the International Center for Agricultural Research in the Dry Areas, Aleppo, Syria.

During 1977-1978, 13 genotypes were classed as highly resistant and 113 as resistant (Table 1). Of these, 10 lines (ILC-72, -182, -183, -191, -194, -200, -201, -202, -482, -484) and one progeny (77 Ms 73022-2) were resistant in the two subsequent seasons. Of the 3,001 germ plasm lines screened in 1978-1979, 4 and 18 were highly resistant and resistant, respectively, and 10 of these (ILC-2380, -2441, -2548, -2952, -2956, -3279, ICC-2160, -4935, -5127, NEC-1431) were resistant in the subsequent screening. During 1979-1980, 36 of 2,331 germ plasm lines and 36 of 2,164 F_3 to F_7 segregating progenies were resistant.

Of the 13 accessions of the seven *Cicer* spp. tested in 1979-1980, *C. pinnatifidum*, *C. montbretti*, and *C. judaicum* were highly resistant; the other accessions were resistant. Accessions of *C. yamashitae, C. bijugum*, *C. cunneatum*, and *C. reticulatum* were tolerant to highly susceptible. Reactions of different accessions from the same species were different, which emphasizes the need for larger collections of wild species and evaluation of their resistance.

Of the 40 entries included in the 1978-1979 Chickpea International Ascochyta Blight Nursery, 10 were resistant in the subsequent screening. Reactions of these lines were determined at four locations in Algeria, Syria, and Turkey. Lines ILC-191, -200, -201, and -202 were resistant at all four locations; lines ILC-182, -183, -194, and -482 were resistant at three locations and tolerant at one location (Eskisehir, Turkey); and lines ILC-484 and 77 Ms 73022-2 were resistant at some locations but susceptible at others.

DISCUSSION

The screening method followed in Syria during 1978-1979 and 1979-1980 was very useful in our large-scale field search for resistant germ plasm and breeding materials. In the past, lack of a reliable field screening method has limited the development of Ascochyta blight resistant cultivars.

Of the 21 lines identified as resistant near Aleppo, 11 were resistant for two to three consecutive seasons. In our opinion, testing for at least two seasons appears essential because several lines that were identified as resistant in 1977-1978 were rated susceptible during 1978-1979. But all lines that showed resistance in 1977-1978 and 1978-1979 remained resistant in 1979-1980. Most of the lines that were resistant for two seasons were from materials introduced from USSR, Turkey, Iran, and Afghanistan. Additional sources of resistance may be found in other materials originating in these countries. Chickpeas are believed to have originated in this region (16) and have been grown there for several millennia.

Seventeen of the lines that were resistant were kabuli types and the other four were desi types. Most previously reported sources of resistance have been in the desi types. Identification of resistance in the kabuli chickpeas is of considerable importance to the development of high-yielding cultivars for the Mediterranean region and other areas of the world where Ascochyta blight is a serious problem.

The four lines identified as resistant in multilocation testing will be very useful because such stable sources of resistance were not previously available. The differential reactions of lines ILC-484 and 77 Ms 73022-2 indicated possible existence of races of the pathogen. These lines should be useful in future studies on race identification.

We are concentrating our breeding efforts on lines that remain resistant at several locations. Early as well as advanced segregating lines are being distributed to the national programs for selecting material resistant to the race or races prevalent in those countries. About 300,000 F_2 plants from 82 crosses, involving lines that were resistant at several locations, were sown in disease screening nurseries during the 1979-1980 season.

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