Screening for Resistance to Phytophthora Blight of Pigeon Pea

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ABSTRACT

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A simple pot culture technique was used to screen 2,835 pigeon pea (*Cajanus cajan*) accessions and cultivars and seven *Atylosia* spp. for resistance to *Phytophthora drechsleri* f. sp. *cajani*. Seventy-seven germ plasm accessions, three cultivars, and two species of *Atylosia* were found to be resistant. The resistance of 75 of the accessions and cultivars was confirmed under field conditions.

Phytophthora stem blight of pigeon pea (*Cajanus cajan* (L.) Millsp.) was first reported in India in 1966 (4). Since then, the disease has been identified in several pigeon pea-growing areas and has been considered serious (3,5). During the rainy season, disease incidence becomes severe and plant mortality is high.

Recently, Kannaiyan et al (2) studied several isolates of the pigeon pea blight organism from different parts of India and called the fungus *Phytophthora drechsleri* f. sp. *cajani*. A similar disease caused by *P. parasitica* has been reported recently from Puerto Rico (1).

The most effective way to control Phytophthora blight would be to develop resistant cultivars. In a limited screening, Pal et al (3) identified pigeon pea lines AS-3, 2357, and 4419 as moderately resistant. We used a pot culture technique to screen a large number of germ plasm accessions and identified several sources of resistance.

MATERIALS AND METHODS

For each accession, a plastic pot 20 cm in diameter was filled with natural red soil of the Alfisol group (60% sand, 33% clay, 7% silt) and sown with 25 seeds. Altogether, 2,835 pigeon pea accessions and cultivars and seven species of the wild relative *Atylosia* (*A. albicans* Benth., *A. cajanifolia* Haines, *A. lineata* W.&A., *A. platycarpa* Benth., *A. scarabaeoides* (L.) Benth., *A. sericea* Benth., and *A. volubilis* Gamb.) were screened. A blight-susceptible cultivar of pigeon pea (HY-3C) was used as the susceptible check.

The P_2 isolate of *P. drechsleri* f. sp. *cajani* was grown in petri dishes on V-8 juice agar. A 5-mm disk of a 1-wk-old culture was transferred to each of several 250-ml flasks containing 100 ml of V-8 juice broth. The cultures were incubated at 28–30 C for 15 days. Mycelium was collected by filtering the substrate, and the resulting fungus mats were macerated intermittently for 2 min in a Waring Blendor with distilled water.

Macerated fungus suspension was diluted with tap water to a final inoculum dilution of one mycelial mat per 200 ml of water. Inoculum (100 ml) was poured around seedlings 5–10 days old in a pot. All pots were watered three times daily to assure adequate development of the disease.

Ten days after inoculation, the percentage of blighted seedlings was calculated. Cross-pollination is common in pigeon pea, and many collections are heterogeneous. Lines with 10% or less blight were considered resistant.

All accessions found to be resistant in pot screening were planted in the field in 1978–1979 and 1979–1980. The inoculum used for field screening was increased on V-8 juice agar for 1 wk at 28–30 C. The fungus and the medium were mixed well with gloved hands after adding 600-mesh Carborundum (0.2%). Inoculum was rubbed by hand on the collar region of individual seedlings 30 days old. The field was flood-irrigated twice (1 wk apart) to create conditions for disease development.

Typical blight symptoms appeared within 10 days of inoculation. One month after the first inoculation, disease-free plants were reinoculated to minimize the chances of escapes. The effectiveness of the inoculation was also monitored by planting the susceptible cultivar HY-3C after every 10 test rows. Final observations of disease incidence were made 1 mo after the second inoculation.

RESULTS

Pot screening. The susceptible check HY-3C always had 90–100% mortality. Eighty pigeon pea accessions and cultivars were found to be resistant in two successive tests: ICP-28, 113, 231, 339, 580, 752, 913, 934, 1088, 1090, 1120, 1123, 1149, 1150, 1151, 1258, 1321, 1529, 1535, 1586, 1788, 1950, 2153, 2376, 2505, 2673, 2682, 2719, 2736, 2974, 3008, 3259, 3367, 3741, 3753, 3840, 3861, 3867, 3868, 3891, 3899, 3937, 3945, 4135, 4141, 4168, 4699, 4752, 4765, 4866, 4882, 5450, 5656, 5860, 6865, 6952, 6953, 6956, 6974, 7057, 7065, 7151, 7182, 7185, 7232, 7269, 7273, 7414, 7533, 7624, 7657, 7701, 7754, 7910, 8101, 8127, 8132, 8139, 8147, and 8151. Of these, Pusa Ageti (ICP-28), Pant A-3 (ICP-6974), and BDN-1 (ICP-7182) are improved cultivars. *A. platycarpa* and *A. sericea* were also resistant to the fungus.

Ten of the blight-resistant accessions (ICP-4765, 4866, 5656, 7414, 8101, 8127, 8132, 8139, 8147, and 8151) have also been found to be resistant to sterility mosaic, another major disease of pigeon pea (M. V. Reddy and Y. L. Nene, *unpublished*).

Field screening. Seventy-five of the 80 accessions and cultivars that were resistant in pot screenings also proved resistant in the field. The remaining five accessions (ICP-3741, 5450, 5860, 8127, and 8139) showed higher incidence of disease (23.8–57.1%) in the field tests.

DISCUSSION

Of 2,835 pigeon pea germ plasm accessions and cultivars screened, 80 were resistant to Phytophthora blight in pot screenings. Resistance of 75 of these was confirmed in field screening. These resistant materials vary considerably in morphology, maturity, and several other characters. Descriptive information and seeds are available on request from the Genetic Resources Unit of ICRISAT.

These accessions and cultivars should be useful in pigeon pea breeding programs. At our Institute, several lines have already been used in the breeding program. Interestingly, *A. platycarpa* and *A. sericea* are also resistant, although there appears to be no urgent need to transfer this resistance to *Cajanus*.

The pot culture technique is rapid: seedlings can be screened within 3 wk, while field screening requires a full season (4–7 mo, depending on genotype). The disease is seen in the field after wet spells that occur any time within 2 mo of sowing. Thus, screening at the seedling stage is appropriate.

Lines found resistant to both Phytophthora blight and sterility mosaic will be useful in developing multiple disease resistance.

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Epidemiology of Phomopsis Seed Decay of Soybean in Illinois

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ABSTRACT

SHORTT, B. J., A. P. GRYBAUSKAS, F. D. TENNE, and J. B. SINCLAIR. 1981. Epidemiology of Phomopsis seed decay of soybean in Illinois. Plant Disease 65:62-64.

In a 3-yr study of seed decay of soybean (*Glycine max*) caused by *Phomopsis* spp. in Illinois, disease incidence was highest in 1977, lowest in 1976, and intermediate in 1975. A low positive correlation was found between temperature and disease incidence, but no consistent continuum of disease from north to south within the state was apparent. The highest incidence of Phomopsis seed decay occurred along major waterways in the wet years of 1975 and 1977. A high positive correlation was found between disease incidence and rainfall during pod fill, indicating that moisture, rather than temperature or geographic area, is the dominant environmental factor in disease development. Maturity dates of cultivars interacted with changing weather conditions to affect disease incidence. In our studies, cultivars in maturity group II had the highest level of Phomopsis seed decay. Cultivars used in seed production in Illinois should be grown at latitudes where they will mature late in the season and escape conditions conducive to high incidence of seed decay.

Phomopsis seed decay of soybean (*Glycine max* (L.) Merr.) is part of a disease complex caused by species of *Diaporthe* and their *Phomopsis* anamorphs (5). The disease is endemic in Illinois and causes reduced germination, vigor, yield, and quality of soybean and other large-seeded legume seeds (3,7,8). High moisture and temperature have been reported to increase disease severity. Lehman (7) observed that high humidity and warm temperatures were conducive to seed infection by *Phomopsis* spp., and Kmetz et al (6) and Hepperly and Sinclair (4) demonstrated that *Phomopsis* conidia are disseminated by splashing rain. High levels of seed infection also have been associated with delayed harvest (10).

The Illinois Crop Improvement Association (ICIA), Urbana, has monitored the incidence of Phomopsis seed decay in certified soybean seedlots grown in Illinois for several years. Though previously observed, the relationships among rainfall, temperature, and disease severity have not been quantified, and the relationship between geography and disease incidence is poorly understood. We report on the effects of rainfall, temperature, location, and maturity group on the occurrence of Phomopsis seed decay of certified soybean seeds grown throughout Illinois in 1975–1977.

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MATERIALS AND METHODS

Illinois-grown soybean seedlots harvested in 1975–1977 and eligible for certification by the ICIA were assayed for seed quality. Four 100-seed samples from each seedlot were placed on a moist 48-cm square cellulose pad (Kimpac, Graham Paper Co., St. Louis, MO) and incubated under continuous fluorescent light at 95% relative humidity and 22 C.

After 7 days, the percentages of germination, vigorous seedlings, and Phomopsis seed decay were recorded. A seed was considered germinated if the radical was 2.5 cm or longer. A seedling was considered vigorous if during germination the cotyledons were lifted 1 cm or more from the surface of the cellulose pad.

Because more than 8,000 seedlots were assayed, microscopic identification of each *Phomopsis*-decayed seed was impossible. Seeds decayed and killed by *Phomopsis* spp. were recognized by a characteristic thick, white coating of mycelium with or without typical *Phomopsis* pycnidia. *Phomopsis* is by far the predominant cause of soybean seed decay in Illinois and can be distinguished from other seed inhabitants by the color, texture, and growth habits of the mycelial mat. Other pathogens of soybean seeds were infrequently observed. Therefore, we believe that the experimental error from basing our identifications on gross fungal morphology is very low.

The data were collected from 2,708, 2,713, and 2,699 seedlots harvested in 1975, 1976, and 1977, respectively, and were analyzed with the Statistical Analysis System prepackaged computer programs (2) at the University of Illinois, Urbana. The Environmental Data Service of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, supplied rainfall and temperature records from stations throughout Illinois.

RESULTS

The assay using cellulose pads efficiently detects Phomopsis seed decay—ie, those seeds killed by *Phomopsis* spp. before or during germination—but does not detect *Phomopsis* infections in viable seeds. Thus, the disease levels detected in this study generally underestimate the total incidence of *Phomopsis* spp.

Seed quality. Quality of the seedlots as measured by germination, vigorous seedlings, and decayed seeds varied among years (Table 1). Seedlots produced in 1975 and 1976 had moderate and low disease incidence, respectively, with levels

Table 1. Percentages of germination, vigorous seedlings, and Phomopsis seed decay among soybean seedlots grown in Illinois

Measure of seedlot quality	Year[a] 1975	1976	1977	FLSD[b]
Germination	96.0	86.8	81.3	0.35
Vigorous seedlings	79.2	80.9	73.4	0.45
Seed decay	5.5	0.8	10.3	0.35

[a] Based on four replicates of 100 seeds from each of 2,708, 2,713, and 2,699 seedlots produced in 1975, 1976, and 1977, respectively.
[b] Fisher's least significant difference ($P = 0.05$).