Resistance of Pepper Cultivars and Accessions of *Capsicum* spp. to *Sclerotinia sclerotiorum*

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ABSTRACT

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Sclerotinia stem and fruit rot, caused by *Sclerotinia sclerotiorum* (Lib.) de Bary, is a potentially serious disease of bell peppers (*Capsicum annuum* L.), affecting both seedlings and mature plants. Management options for the disease are limited and information is not available on resistance in *Capsicum* spp. to this pathogen. The level of resistance of 12 commercial pepper cultivars and 110 *Capsicum* spp. accessions to *Sclerotinia sclerotiorum* was determined by using limited-term and ascospore inoculation methods. None of the commercial cultivars tested were resistant to *Sclerotinia* stem rot. Stem rot incidence among the *Capsicum* spp. accessions tested by ascospore inoculation ranged from 0 to 100%. Fifty-eight accessions had significantly less stem disease than the susceptible commercial cultivar Marengo. There was no correlation between results of the limited-term and ascospore inoculation tests. These results demonstrate for the first time that a high level of *Sclerotinia* stem rot resistance exists among the *Capsicum* spp. accessions. Several accessions may be suitable for use in breeding programs to increase resistance in commercial pepper cultivars.

Sclerotinia sclerotiorum (Lib.) de Bary causes disease on a wide range of herbaceous plant species (7), including bell pepper (*Capsicum annuum* L.). Serious losses in pepper attributed to *Sclerotinia* stem and fruit rot have been documented in Ohio (25) and elsewhere (4-6,16-18,21,23). In Ohio, the disease was first documented in the southeastern part of the state (Gallia County) during 1992. Incidence of stem rot in pepper seedlings 10 days after transplanting ranged from 10 to 20% in the affected field. The disease also occurred later in the season on flowering plants and fruit. In August 1992, an estimated 30 to 40% loss due to stem and fruit rot was observed in a 20-acre processing pepper field in Henry County (25). In a 1996 survey of eight pepper fields in northwest Ohio, incidence of stem rot in seedlings ranged from 0 to 26% (24). Stem rot of pepper and tomato seedlings grown on raised beds covered with plastic mulch

was observed in at least two counties in northern Ohio during 2001 and 2002 (S. Miller, unpublished).

Control of *S. sclerotiorum* is difficult under cool, moist environmental conditions, which are common in Ohio at the beginning and end of the pepper-growing season. Currently, no fungicides are registered for control of this disease on peppers. In addition, the ability of sclerotia of the fungus to survive in the soil for three or more years (1) and the wide host range of the fungus make cultural control difficult, emphasizing the need for resistant cultivars. The level of resistance of commercial cultivars is unknown and potential sources of resistance to the pathogen in *C. annuum* and other *Capsicum* spp. have not been identified.

The purpose of this study was to determine the level of resistance to *S. sclerotiorum* in commercial pepper cultivars under growth chamber conditions and to identify sources of resistance to the pathogen among *Capsicum* spp. accessions.

MATERIALS AND METHODS

Seedling production. Seed of 110 accessions of *Capsicum* spp. (Table 1) supplied by the Plant Genetic Resources Conservation Unit (Griffin, GA) and 12 *C. annuum* cultivars from commercial seed companies (Table 2) were sown in the greenhouse. Seed were planted in 128-cell black plastic flats (Landmark Plastic Corp., Akron, OH) filled with Baccto High Density Professional Planting Mix (Michigan Peat Co., Houston, TX) and watered daily or as needed. Flats were placed on

greenhouse benches where the air temperature was maintained at $28 \pm 2^\circ\text{C}$ to facilitate seed germination. Seed typically germinated within 7 to 10 days. After the first true leaf was fully expanded, two or three seedlings were transplanted into 15-cm-diameter plastic pots containing a steamed greenhouse soil mixture consisting of 43% each of Wooster silty-loam and muck soil and 14% peat moss, to which lime at 1.2 kg/m^3 was added. Pots were fertilized weekly with Peter's 20-20-20 (N-P-K) standard fertilizer (454 g/378 liters of water) and watered once per day. Temperature in the greenhouse was adjusted to $24 \pm 2^\circ\text{C}$ during the day and $18 \pm 2^\circ\text{C}$ at night.

Sclerotia production. Isolates Ss3 and Ss6 of *S. sclerotiorum*, recovered from naturally diseased pepper plants collected in northwest Ohio in 1992 and maintained on potato dextrose agar (PDA), were used to produce sclerotia. Disks (5-mm) from the margin of actively growing colonies were transferred to polystyrene petri plates (15 by 100 cm) containing 20 ml of PDA. Cultures were grown at 20°C until mycelia approached the edge of the plate; then, the contents of one plate were chopped and spread on a single contiguous layer of carrot disks per aluminum foil tray (41.9 by 30.5 by 6.4 cm; Handi-Foil Co., Wheeling, IL) previously autoclaved at 121°C for 30 min on each of two consecutive days. Inoculated carrot disks were covered with sterilized aluminum foil and incubated on a laboratory bench at $20 \pm 2^\circ\text{C}$. Mycelia completely covered the surface of carrot pieces within 5 days and sclerotial initials were observed within 10 to 12 days. Sclerotia were harvested 4 weeks after the cultures were seeded by pouring the mycelia, sclerotia, and remains of carrot tissue into a No. 14 soil sieve (12-mesh) and washing under tap water to separate the sclerotia from other materials. Sclerotia that were obtained were dried on paper towels overnight at $22 \pm 2^\circ\text{C}$ and stored in plastic bags at 4°C until used.

Ascospore production. Sclerotia produced on autoclaved carrot discs were surface sterilized in 95% ethanol for 90 s as described by Huang and Kozub (10) and air dried for 15 min in a laminar flow hood. Twenty sclerotia were placed in 9-cm-diameter glass petri plates containing 15 ml of sterile distilled water. Plates were wrapped with parafilm and conditioned at 4°C for 6 weeks in the dark. Then they

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were incubated at 15°C under fluorescent light (47.5 E s⁻¹ m⁻²) for 14 h followed by 10 h of dark/day. Stipes formed on sclerotia 4 weeks after transferring to 15°C, and mature apothecia developed after 1 to 2 weeks. Ascospores were collected from mature apothecia directly on nucleopore polycarbonate filters (type GS, 47 µm; Thomas Scientific, Swedesboro, NJ) as described by Hunter et al. (11) and Steadman et al. (19). Filters with ascospores were stored in glass jars containing calcium chloride (CaCl₂) as a desiccant at -19 or 4°C until used.

Ascospore inoculation. Nucleopore filters containing ascospores of isolate Ss6 of *S. sclerotiorum* were back washed with distilled water and the final ascospore concentration was adjusted to 5 × 10⁴ spores/ml. The suspension was sprayed onto three 8-week-old pepper seedlings with a hand sprayer. Control plants were sprayed with distilled water only. Three replicate pots for each cultivar or accession were arranged in a randomized complete block design on the upper and lower shelves of steel mesh benches in a growth chamber at 20°C with a 12-h photoperiod. Relative humidity of 95 to 100% was maintained by using two humidifiers (Humidifier series 500; Hermidifier Co. Inc. Lancaster, PA) per 2.45-by-1.90-by-2.12-m growth chamber. Beginning 4 days after inoculation, the number of infected stems and dead plants in each pot was recorded every other day for 15 days. Disease incidence was expressed as a percentage of the total number of diseased and dead plants in each accession or cultivar 15 days after inoculation, and disease severity was expressed as the area under the disease progress curve (AUDPC; 8). This experiment was conducted three times.

Limited-term inoculation. Limited-term inoculation (LTI) was performed as described by Hunter et al. (12), except that PDA disks colonized with mycelia of *S. sclerotiorum* were used to provide a consistent amount of inoculum to each plant. Isolate Ss6 of *S. sclerotiorum* was grown on PDA for 2 days at 20°C; then, 1-cm-diameter disks were cut from actively growing colony margins with a cork borer. A single disk was attached to the stem of each 8-week-old plant (two disks per 10-cm-diameter pot) above the cotyledonary node by wrapping it with moist cotton pieces. PDA disks were used for noninoculated control plants. There were three replicate pots per cultivar or accession arranged in a randomized complete block design in a humid growth chamber as described above for ascospore inoculations. Inoculum was removed after 24 h and plants were maintained under the same conditions for an additional 4 days. Disease incidence was determined 5 days after inoculation by counting the number of

Table 1. Reaction of 110 accessions of *Capsicum* spp. and the commercial pepper cultivar Marengo tested for seedling resistance to Sclerotinia stem rot by ascospore inoculation

<i>Capsicum</i> spp., accession	Source	Stem rot (%) ^x		AUDPC ^y
		Nontrans	Arcsine	
<i>C. annuum</i>				
PI 294452	Virgin Islands	92	128	31
PI 385961	Kenya	85	117	32
Marengo	Seminis Seed	85	117	28
PI 401729	Brazil	84	116	30
PI 390971	Israel	81	112	29
PI 164564	Spain	81	112	22
PI 124080	India	81	112	20
PI 401728	Brazil	77	107	29
PI 338490	Bulgaria	77	107	27
PI 164565	Spain	74	104	25
PI 159265	United States	74	104	17
PI 164678	India	73	102	26
PI 281330	Costa Rica	73	102	20
PI 281413	Peru	73	102	31
PI 286419	Nepal	70	99	26
PI 291999	Israel	70	99	25
PI 385960	Kenya	59	88	30
PI 102882	China	59	88	15
PI 105338	China	66	95	26
PI 213915	Bolivia	66	95	21
PI 338974	Turkey	66	95	20
PI 169110	Turkey	66	95	19
PI 251622	Yugoslavia	66	95	18
PI 167062	Turkey	66	95	15
PI 184037	Yugoslavia	62	91	22
PI 263106	Russia	59	88	22
PI 275011	Bulgaria	59	88	20
PI 169106	Turkey	55	84	17
PI 167215	Turkey	55	84	16
PI 390437	Ecuador	55	84	16
PI 123164	India	55	84	16
PI 281400	Nicaragua	55	84	15
PI 124540	India	55	84	11
PI 164961	Turkey	55	84	11
PI 281416	Philippines	51	80	18
PI 275009	Bulgaria	51	80	18
PI 263073	Russia	59	88	16
PI 123469	India	59	88	19
PI 159278	United States	48	77	16
PI 184039	Yugoslavia	48	77	16
PI 249907	Portugal	48	77	14
PI 262905	Spain	48	77	13
PI 169112	Turkey	48	77	10
PI 131352	Hungary	44	73	14
PI 390436	Ecuador	44	73	14
PI 164562	Spain	44	73	11
PI 289762	Turkey	37	65	10
PI 162608	China	37	65	16
PI 169102	Turkey	37	65	13
PI 123166	India	37	65	11
PI 127445	Afghanistan	37	65	10
PI 103048	China	37	65	9
PI 138561	Iran	37	65	7
PI 164561	Spain	33	61	11
PI 257049	Colombia	33	61	10
PI 273429	United States	33	61	10
PI 390970	Israel	33	61	9
PI 135826	Afghanistan	33	61	6
PI 102881	China	29	57	11
PI 148626	Iran	29	57	7
PI 257187	Peru	26	54	11
PI 162607	China	26	54	5
PI 297456	Spain	22	49	5
PI 263074	Russia	15	40	4

(continued on next page)

^x Nontrans = nontransformed and Arcsine = arcsine-transformed. Analysis of variance for percent stem rot was performed on arcsin-transformed data.

^y AUDPC = area under the disease progress curve.

^z LSD = least significant difference between means, calculated using Fisher's protected least significant difference test ($P \leq 0.05$).

collapsed plants. Results were expressed as a percentage of collapsed seedlings in each accession or cultivar. This experiment was repeated twice.

Statistical analyses. Data from the three experiments for each inoculation technique were averaged and transformed using arcsin transformation prior to analysis. Transformed data were analyzed using analysis of variance (ANOVA). Differences between treatment means

were detected using Fisher's protected least significant difference test ($P \leq 0.05$). The AUDPCs for percent stem rot and plants killed were computed by the method of Campbell and Madden (8). Linear regression analysis was used to determine the relationship between ascospore inoculation and LTI methods. All analyses were performed using a SAS statistical package (release 6.04; SAS Institute, Cary, NC).

RESULTS

***Capsicum* spp. accessions.** Disease incidence varied from 0 to 100% among the 110 accessions inoculated with ascospores (Table 1). *C. annuum* accession PI 281327 and *C. galapagoense* accession PI Grif 1567 did not develop stem symptoms. Of the 110 accessions tested, 58 had significantly lower incidence of stem rot than the susceptible cultivar Marengo (85%). These 58 accessions represented seven different *Capsicum* spp. and *Tubocapsicum anomalum*. Thirteen accessions (11 *C. annuum*, one *C. chacoense*, and one *C. baccatum* var. *pendulum*) had slower disease progress than Marengo, but did not differ from Marengo based on percent stem rot 15 days after inoculation. Accessions PI 159255 and PI 281327 (*C. annuum*), PI 260434 and PI 439396 (*C. baccatum*), PI 511886 (*C. annuum* var. *glabriusculum*), PI 224440 and PI 152217 (*C. baccatum* var. *pendulum*), and PI Grif 1567 (*C. galapagoense*) had 11% or less stem rot and were significantly more resistant than the 70 accessions with 44 to 100% stem disease incidence. There was a positive correlation between stem rot incidence and number of plants killed ($R^2 = 0.89$) and between AUDPCs for stem rot incidence and plants killed ($R^2 = 0.94$). Therefore, only data from stem rot are presented in Table 1.

All of the 12 commercial cultivars screened in the growth chamber using the ascospore inoculation method were susceptible to stem rot (Table 2). Big Bertha was the most susceptible cultivar among those evaluated, while SS 860 was significantly less susceptible than the six most susceptible cultivars (Big Bertha, Astrione, Camelot, Lilac, Pax 2557, and Marengo). Slow disease progress was observed on Tequila, although the final percentage stem rot was not significantly different than that for all but the most susceptible cultivar (Big Bertha).

For commercial pepper cultivars and susceptible *Capsicum* spp. accessions inoculated with ascospores, the earliest symptom, which usually appeared 3 to 4 days after inoculation, was the development of local brown spots on the leaves. Then brownish, irregularly shaped water-soaked lesions were produced. Bud rot also was observed. Leaf lesions progressed to the petioles and expanded up and down the main stem. Subsequently, the seedlings died, usually within 10 to 15 days. White fluffy mycelial growth was observed in the colonized tissues. Almost all stem infection originated from the node, where the petiole of the infected leaf was attached to the stem.

Correlation was poor between the LTI method and the ascospore inoculation method ($R^2 = 0.008$; Fig. 1). Of the 51 accessions tested using the LTI method, 20 had an incidence of stem rot that was within 15% of plants inoculated with ascospores (Table 3). Fifteen accessions had an

Table 1. (continued from preceding page)

<i>Capsicum</i> spp., accession	Source	Stem rot (%) ^x		AUDPC ^y
		Nontrans	Arcsine	
<i>C. annuum</i>				
PI 159255	United States	11	34	4
PI 281327	Colombia	0	0	0
<i>C. annuum</i> var. <i>glabriusculum</i>				
PI 511887	Mexico	100	157	36
PI 511886	Mexico	11	34	6
<i>C. baccatum</i>				
PI 273425	United States	88	122	32
PI 370005	India	66	95	28
PI 370004	India	66	95	25
PI 200729	Guatemala	48	77	18
PI 439364	Brazil	44	73	15
PI 439361	Bolivia	44	73	8
PI 439360	Bolivia	33	61	10
PI 413669	Colombia	33	61	9
PI 260434	Bolivia	11	34	4
PI 439396	Peru	7	27	1
<i>C. baccatum</i> var. <i>baccatum</i>				
PI 260533	Brazil	100	157	42
PI 260567	Bolivia	77	107	28
PI 238061	Bolivia	55	84	19
PI 215699	Peru	48	77	16
PI 281306	Bolivia	33	61	8
<i>C. baccatum</i> var. <i>pendulum</i>				
PI 241679	Chile	59	88	17
PI 203522	Mexico	58	87	18
PI 152234	Peru	51	80	15
PI 257122	Colombia	44	73	11
PI 188803	Philippines	40	68	12
PI 159235	United States	33	61	7
PI 241674	Ecuador	33	61	7
PI 199506	Guyana	22	49	7
PI 238062	Brazil	18	44	7
PI 224440	Costa Rica	7	27	2
PI 152217	Peru	4	20	2
<i>C. baccatum</i> var. <i>praetermissum</i>				
PI 260595	Brazil	22	49	5
<i>C. chacoense</i>				
PI 260431	Bolivia	100	157	31
PI 260430	Bolivia	77	107	26
PI 260427	Argentina	63	92	15
PI 260426	Argentina	40	68	12
<i>C. chinense</i>				
PI 209589	Cuba	88	122	36
PI 152225	Peru	77	107	26
PI 194879	Guyana	55	84	18
PI 152452	Brazil	51	80	16
PI 152222	Peru	33	61	8
<i>C. frutescens</i>				
PI 159238	United States	85	117	30
PI 188479	Vanuatu	63	92	27
PI 123474	India	33	61	7
<i>C. galapagoense</i>				
PI Grif 1567	Netherlands	0	0	0
<i>C. pubescens</i>				
PI 235047	Costa Rica	26	54	9
PI 585266	Ecuador	22	49	6
<i>Tubocapsicum anomalum</i>				
PI 501532	Japan	44	73	15
LSD ^z	...	...	36	11

incidence of stem rot that was 16 to 45% different between the two tests. The remaining accessions differed in incidence of stem rot in the two tests by more than 45%. Two accessions (PI 152217 and PI Grif 1567) were highly resistant in ascospore inoculation tests but highly susceptible when LTI was used. Two accessions (*C. annuum* PI 159255 and *C. annuum* var. *glabriusculum* PI 511886) were highly resistant when inoculated using either method.

All of the plants in the 12 commercial cultivars inoculated using the LTI method were dead at the end of the 5-day incubation period in each of three tests.

DISCUSSION

Reliable and effective disease screening methods are necessary for identification of

resistance to plant pathogens among plant cultivars, breeding lines, and accessions. A reliable screening procedure facilitates accurate differentiation of resistant from susceptible germ plasm. Several techniques have been developed to test plants for resistance to *Sclerotinia* stem rot or white mold. Two screening methods, ascospore inoculation and limited-term inoculation, often used in *Sclerotinia* resistance assays, were compared in this study. Results within each inoculation method were consistent, and different levels of resistance among *Capsicum* spp. accessions were identified. Results of the ascospore inoculation tests concurred with the findings of Tu (22), who reported that ascospores infected prebloom bean plants without an exogenous nutrient base. The

results do, however, contradict the results of other studies (2,9,14,20), in which ascospores did not infect unless senescent tissues (flower petals) or wounds were present.

Factors involved in direct ascospore inoculation of pepper seedlings without a nutrient base (senescent flower petals or dead tissue) are not known. It is speculated

Table 2. Mean incidence of *Sclerotinia* stem rot (percent stem rot and plant death) of seedlings of commercial pepper cultivars inoculated with ascospores of *Sclerotinia sclerotiorum* in a growth chamber*

Cultivar	Stem rot		Plant death	
	Percent ^y	AUPDC ^z	Percent ^y	AUDPC ^z
Big Bertha	100 a	30 a	100 a	26 a
Astrione	96 ab	28 a	92 ab	24 a
Camelot	96 ab	29 a	92 ab	25 a
Lilac	92 abc	29 a	92 ab	25 a
Pax 2557	92 abc	26 ab	92 ab	23 a
Marengo	85 bc	28 a	77 abc	21 ab
Long Hungarian Wax	84 bcd	22 abc	80 bc	17 abc
King Arthur	81 bcd	19 abc	77 abc	16 bc
Tequila	73 bcd	12 c	70 bc	10 c
ORI	66 cd	21 abc	62 c	17 abc
Tiara	66 cd	15 bc	62 c	11 bc
SS 860	51 d	13 c	51 c	10 c

* Means within a column followed by same letter are not significantly different according to Fisher's protected least significant difference test ($P \leq 0.05$).

^y Analysis of variance was performed on arcsin transformed data. Means of non-transformed data are presented.

^z AUDPC = area under the disease progress curve.

Fig. 1. Relationship of percentage of stem rot from ascospore inoculation and limited-term inoculation (LTI) tests for resistance of 51 accessions of *Capsicum* spp. tested under growth chamber conditions.

Table 3. Comparison of stem rot incidence for 51 *Capsicum* spp. accessions averaged over three tests after inoculation using ascospores or the limited-term method

Accession ^z	Stem rot incidence (%) ^y	
	Ascospore	Limited-term
PI 124080	81a	94 ab
PI 164564	81a	100 a
PI 164565	74 ab	89 abc
PI 159265	74 ab	11 ij
PI 164678	73 ab	100 a
PI 251622	66 abc	39 fghi
PI 167062	66 abc	61 c-g
PI 169110	66 abc	72 b-f
PI 184037	62 abcd	45 efgh
PI 102882	59 abcd	83 bcd
PI 263073	59 abcd	61 c-g
PI 263106	59 abcd	50 d-h
PI 169106	55 a-e	78 bcde
PI 164961	55 a-e	72 b-f
PI 124540	55 a-e	67 b-f
PI 167215	55 a-e	56 c-h
PI 215699	48 a-f	50 d-h
PI 159278	48 a-f	94 ab
PI 262905	48 a-f	78 b-e
PI 184039	48 a-f	61 c-g
PI 249907	48 a-f	55 d-h
PI 169112	48 a-f	56 c-h
PI 131352	44 b-g	83 bcd
PI 501532	44 b-g	28 ghij
PI 164562	44 b-g	44 efgh
PI 260426	40 b-h	94 ab
PI 138561	37 c-h	100 a
PI 169102	37 c-h	89 abc
PI 123166	37 c-h	89 abc
PI 289762	37 c-h	61 c-g
PI 162608	37 c-h	28 ghij
PI 127445	37 c-h	94 ab
PI 103048	37 c-h	44 efgh
PI 135826	33 c-h	100 a
PI 123474	33 c-h	94 ab
PI 257049	33 c-h	61c-g
PI 164561	33 c-h	56 d-h
PI 152222	33 c-h	78 bcde
PI 102881	29 d-h	100 a
PI 148626	29 d-h	100 a
PI 162607	26 e-i	28 ghij
PI 235047	26 e-i	22 hij
PI 257187	26 e-i	94 ab
PI 260595	22 e-i	100 a
PI 297456	22 e-i	100 a
PI 263074	15 ghi	28 ghij
PI 260434	11 hij	39 f-i
PI 511886	11 hij	6 j
PI 159255	11 hij	6 j
PI 152217	4 ij	94 ab
PI Grif 1567	0 j	94 ab

^y Ascospore and limited-term inoculation. Data were transformed using arcsin transformation prior to analysis. Nontransformed data are shown. Means within a column followed by same letter are not significantly different according to Fisher's protected least significant difference ($P \leq 0.05$).

^z Species of these accessions are listed in Table 1.

that individual spots formed by germinating ascospores on leaves of susceptible cultivars or lines may stimulate a sufficient amount of exudates on the leaf surface for subsequent hyphal development and infection. Similarly, ascospores caused small necrotic lesions that occasionally developed into rapidly expanding, water-soaked lesions on field-grown clover (13) and greenhouse-grown soybean (20) without supplemental nutrients. Pepper seedlings produced under the conditions of this study were relatively succulent and may have provided exudates with a nutrient base adequate for pathogen growth and development. Succulent tissue may be more susceptible to direct infection by *S. sclerotiorum* than are hardened tissues. Symptoms on *Capsicum* spp. started as local brown spots on leaves of susceptible, as well as some resistant, plants. These spots then developed into water-soaked lesions in susceptible cultivars and accessions, which resulted in complete collapse of seedlings. Water-soaked lesions did not develop in resistant cultivars and accessions. Similar small leaf spot development has been reported in lettuce (15), bean and soybean (20), and sunflower (3) following ascospore inoculations.

There was no correlation between ascospore inoculation and LTI test results in this study. The LTI method was more severe than ascospore inoculation; some of the accessions having 30% or less stem rot after ascospore inoculation had 90% or greater stem rot in LTI tests.

C. baccatum var. *pendulum* accession PI 152217 had 4 and 94% stem rot when inoculated with an ascospore suspension and LTI, respectively. The opposite reaction also occurred occasionally. For example, *C. annuum* accession PI 159265 had 74 and 11% stem rot when inoculated with an ascospore suspension and LTI, respectively. All 12 commercial pepper cultivars were susceptible to *Sclerotinia* stem rot, regardless of inoculation method, although the plants died more quickly when LTI was used than when ascospores were the inoculum. The susceptible *Capsicum* spp. accessions also died more quickly using LTI than with ascospore inoculation. Inoculated plants from *C. annuum* accessions PI 159255 and PI 263074, and *C. baccatum* accession PI 260434 exhibited small brown spots on leaves and stems, which usually did not progress further, regardless of the inoculation method. These restricted spots

or necroses may result from a hypersensitive response by the host to the pathogen in these accessions. Similar types of restricted lesions were reported on the soybean cultivars Corsoy, Williams, and Union when inoculated using the LTI method (10). *C. galapagoense* accession PI Grif 1567 showed no symptoms when inoculated with ascospores but was highly susceptible when tested using the LTI method. PI Grif 1567 has a hairy leaf surface, which may prevent ascospore attachment and penetration by the germ tube. This plant surface feature may have formed a physical barrier that prevented infection, thus protecting the plant. Inoculation of plants by wrapping the fungal mycelium around the stem may eliminate this barrier and also may injure the numerous trichomes on the stem, resulting in potential direct points of entry into the epidermal cells.

The results obtained in this study demonstrate for the first time that a high level of *Sclerotinia* stem rot resistance exists among the *Capsicum* spp. accessions. Resistance screening programs should, however, include both inoculation methods. Some of the most resistant accessions were *C. annuum* lines; therefore, barriers to hybridization associated with several of the species evaluated would not be an issue. Genetic resistance may be a feasible alternative for management of this very severe disease.

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