Susceptibility of Weed Species of Convolvulaceae to Root-Infecting Pathogens of Sweet Potato

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ABSTRACT

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Species of Convolvulaceae that commonly occur as weeds in agricultural land in Louisiana (*Ipomoea alba, I. hederifolia, I. hederacea, I. lacunosa, I. purpurea, I. trichocarpa, I. wrightii*, and *Jacquemontia tamnifolia*) were compared with Centennial sweet potato for reaction to *Streptomyces ipomoea, Ceratocystis fimbriata, Fusarium oxysporum* f. sp. *batatas, Plenodomus destruens, Monilochaetes infuscans, Rotylenchulus reniformis*, and *Meloidogyne incognita*. Several species were as susceptible or more susceptible than Centennial for each pathogen and no species was immune to any pathogen. Each host species was susceptible to several pathogens but *I. alba, I. hederifolia*, and *J. tamnifolia* were generally less susceptible to the pathogens than Centennial or the other species.

Sweet potato (*Ipomoea batatas* (L.) Lam.) is susceptible to several pathogens with limited host ranges that are soilborne and/or borne on the vegetative "seed" roots. The soil rot pathogen, *Streptomyces ipomoea* (Person and W. J. Martin) Waks. and Henrici, and the wilt pathogen, *Fusarium oxysporum* f. sp. *batatas* (Wr.) Snyd. & Hans., persist in soil for extended periods in the absence of sweet potatoes (2). The black rot pathogen, *Ceratocystis fimbriata* Ell. & Halst., and the scurf pathogen, *Monilochaetes infuscans* Ell. & Halst. ex Harter, persist only a few years in the absence of sweet potatoes, and the foot rot pathogen, *Plenodomus destruens* Harter, does not overwinter in the soil (2). Sweet potatoes are also susceptible to root-knot nematodes, *Meloidogyne* spp., and to the reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira. Crop rotation has been prescribed as a means of controlling or reducing these sweet potato diseases (2).

Soybeans and cotton, normally grown in rotation with sweet potatoes in Louisiana, are commonly infested with various morning glories and other species of Convolvulaceae. Some fragmentary information indicates that some of these weeds are susceptible to the pathogens that cause scurf, wilt, black rot, or root knot on sweet potato (1,3–5). The objective of this paper was to study susceptibility of Convolvulaceous weeds to sweet potato pathogens.

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MATERIALS AND METHODS

I. trichocarpa Ell., *I. hederacea* Jacq., *I. wrightii* (Wall.) Choisy, and *Jaquemontia tamnifolia* (L.) Griseb. were initially collected in Baton Rouge, LA, and increased for experimental use. Seed of *I. purpurea* (L.) Roth were from accession 63.49 provided by Alfred Jones, U.S. Vegetable Laboratory, Charleston, SC. Seed of *I. lacunosa* L., *I. alba* L., and *I. hederifolia* L. were provided by W. J. Martin, Department of Plant Pathology and Crop Physiology, Louisiana State University, Baton Rouge. Identity of these species was confirmed by D. F. Austin, Florida Atlantic University, Boca Raton, FL.

All tests were conducted using an autoclaved mix of sand and silt loam soil (1:1) in 10-cm-diameter clay pots. Sweet potato controls were planted in each test using terminal vine cuttings measuring 10–20 cm. Four replicate pots were used for each treatment and three morning glory or one sweet potato plants per pot. The cultivar Centennial was used as a susceptible standard in each test except for Fusarium wilt, where Porto Rico was the susceptible standard.

Inoculum of *S. ipomoea* was prepared by growing isolate 78-49 on a sterile mixture of 20 g horse manure and 0.4 g $CaCO_3$ per liter of sand at 28 C for 4–6 wk. Twenty-five cubic centimeters of the inoculum was thoroughly mixed with the soil mix in a 10-cm-diameter clay pot and seed of each species was planted in the infested soil. The cultivar Travis was included as a resistant control.

Seedlings were inoculated with root-knot, *Meloidogyne incognita* (Kofoid & White) Chitwood, or reniform nematodes by applying a water suspension of 5,000 eggs or 2,000 larvae, respectively, to the soil surface around seedlings 8 days after planting.

Seedlings were inoculated with *C. fimbriata, P. destruens, M. infuscans,* and *F. oxysporum* f. sp. *batatas* by dipping seedlings that had been pulled from their original pots in 0.1% agar suspensions of propagules of the appropriate fungus. Conidia of *P. destruens* and endoconidia and ascospores of *C. fimbriata* were obtained by rinsing 2-wk-old potato-dextrose agar (PDA) cultures and conidia of *M. infuscans* from green pea agar cultures. A bud-cell suspension of *F. oxysporum* f. sp. *batatas* was prepared by incubating the fungus in Czapek broth on a shaker. Final densities of the inocula used were: 10^7, 9×10^6, 1.2×10^7, and 8×10^5 propagules per milliliter for *C. fimbriata, F. oxysporum* f. sp. *batatas, P. destruens,* and *M. infuscans*, respectively.

Growth and development of plants was rated periodically after inoculation, and after 4–6 wk, root systems were carefully washed free of soil and final observations made. All plants were rated for root and stem necrosis. Fusarium wilt plants were also rated for vascular discoloration. Soil rot, reniform nematode, and root-knot nematode treatments were also measured for root and shoot fresh weights. Eggs were extracted and enumerated from root systems of nematode-inoculated plants by treating the roots with 0.525% sodium hypochlorite for 4 min. The extract was passed through a 74-μm sieve and eggs were collected on a 25-μm sieve.

Isolations were attempted from plants that did not develop symptoms after inoculation with *F. oxysporum* f. sp. *batatas* or *P. destruens*. Sections of stem about 5 mm long from the hypocotyl-taproot transition region were surface-sterilized in 1.05% sodium hypochlorite for two min and placed on acidified PDA. The segments were incubated at 28 C for 1 wk longer than necessary for isolation from diseased controls.

RESULTS

The reactions of each host species to each pathogen are summarized in Table 1. Two types of reaction were observed on the different species inoculated with *S. ipomoea*. The susceptible reaction of Centennial, *I. hederacea, I. lacunosa, I. purpurea, I. trichocarpa,* and *I. wrightii* was characterized by complete necrosis of the root systems and death of the plants. The intermediate-type reaction of *J. tamnifolia, I. alba,* and *I. hederifolia* resulted in plants surviving but with significantly reduced fresh weight compared with controls and with many necrotic lesions on the fibrous roots.

All species inoculated with *C. fimbriata* were either susceptible or very susceptible. The very susceptible reaction of *I. trichocarpa* and *I. alba* was characterized by rapid total necrosis of the taproot and death of the plants within 2–3 wk of inoculation. The susceptible species developed extensive necrosis of the cortex of the taproot and secondary roots and some were severely stunted but did not die during the 5-wk experiment.

I. lacunosa, J. tamnifolia, I. alba, and *I. hederifolia* were considered symptomless hosts of the wilt pathogen, *F. oxysporum* f. sp. *batatas*, based on the recovery of the pathogen from a majority of the symptomless plants after surface-sterilization. Virulence of the reisolated pathogen to sweet potato was not determined. All plants of the susceptible standard *I. batatas* 'Porto Rico' wilted and died within 2 wk of inoculation, whereas all other plants were observed for 4 wk after inoculation. Some plants of the intermediate Centennial, *I. hederacea, I. trichocarpa,* and *I. wrightii* developed foliar chlorosis, wilting, and vascular discoloration. The resistant *I. purpurea* did not develop any symptoms and only two of 12 plants harbored the pathogen.

The susceptible reaction to foot rot exhibited by Centennial, *I. lacunosa,* and *I. trichocarpa* consisted of extensive cortical necrosis of the taproot, minor cortical necrosis on secondary roots, stunting of plants, and subsequent death of about half of the plants. The intermediate *I. wrightii* had cortical necrosis of about half the taproot surface area but was not visibly stunted. The resistant *I. hederacea* developed superficial, longitudinal, necrotic flecks on the taproot but was not stunted. *P. destruens* was recovered from surface-sterilized segments of Centennial within 5–7 days and from symptomless plants of *I. purpurea, I. alba,* and *I. hederifolia* 10–14 days after attempted isolation.

Extensive superficial discoloration developed covering the entire taproot on *I. hederacea, I. lacunosa, I. purpurea, I. trichocarpa,* and *I. wrightii* after inoculation with *M. infuscans*. The susceptible reaction of *I. hederifolia* was characterized by plants varying with superficial discoloration on a portion to all of the taproot. The resistant reaction of *I. alba* consisted of development of several small localized spots of discoloration on taproots of some of the plants. Scurf did not develop on sweet potato, which has been rated susceptible (5).

All species tested supported reproduction of both reniform and root-knot nematodes. Susceptibility of *I. alba, I. purpurea,* and *I. wrightii* was rated intermediate to reniform nematode, based on the egg productions of 6, 11, and 13 per gram of root, respectively. Eggs recovered from Centennial, *I. hederacea, I. lacunosa, I. trichocarpa, J. tamnifolia,* and *I. hederifolia* were 25, 18, 37, 25, 41, and 56 per gram of root, respectively. Susceptibility of *I. hederifolia* was rated intermediate to root knot, based on recovery of 2,876 eggs per gram of root compared with 10,499, 19,492, 11,187, 10,105, 9,931, 8,110, 42,553, and 13,745 for Centennial, *I. hederacea, I. lacunosa, I. purpurea, I. trichocarpa, I. wrightii, J. tamnifolia,* and *I. alba,* respectively.

Table 1. Summary of reactions of certain Convolvulaceous weeds and sweet potatoes to selected sweet potato diseases

	Disease rating[a]						
Species	**Soil rot**	**Black rot**	**Wilt**	**Foot rot**	**Scurf**	**Reniform**	**Root knot**
Ipomoea batatas 'Centennial'	S	S	I	S	R[b]	S	S
I. batatas 'Porto Rico'	···	···	S	···	···	···	···
I. batatas 'Travis'	I–R	···	···	···	···	···	···
I. hederacea	S	S	I	R	VS	S	S
I. lacunosa	S	S	SC	S	VS	S	S
I. purpurea	S	S	R	SC	VS	I	S
I trichocarpa	S	VS	I	S	VS	S	S
I. wrightii	S	S	I	I	VS	I	S
Jacquemontia tamnifolia	I	···	SC	···	···	S	S
I. alba	I	VS	SC	SC	R	I	S
I. hederifolia	I	S	SC	SC	S	S	I

[a] S = susceptible, VS = very susceptible, I = intermediate, R = resistant, and SC = symptomless carrier.

[b] Sweet potatoes have been cited previously as susceptible to scurf but scurf did not develop on Centennial in this test.

DISCUSSION

All sweet potato pathogens tested either incited disease or could be recovered from all the Convolvulaceous weeds tested. The relative extent of disease development differed between species; however, the species considered most related to the sweet potato (*I. hederacea, I. lacunosa, I. purpurea, I. trichocarpa,* and *I. wrightii*) were as susceptible or more susceptible than the sweet potato cultivar Centennial. The distantly related species (*I. alba, I. hederifolia,* and *J. tamnifolia*) were generally less susceptible to the pathogens. These results are in agreement with previous results, except for Fusarium wilt (1). Harter and Field (1) indicated that *F. oxysporum* f. sp. *batatas* was not parasitic on *I. lacunosa* or *I. coccinea* (probably = *I. hederifolia*), whereas we report that these species are symptomless carriers of the pathogen.

The significance of these findings in relation to the ecology of the pathogens and disease incidence differs for pathogens with different host ranges and life cycles. The ability to reproduce on wild morning glories is of little ecological significance for such plurivorous pathogens as reniform and root-knot nematodes because they are able to reproduce on many rotation crops and many weeds unrelated to sweet potato.

The remaining pathogens in this study have host ranges restricted to the Convolvulaceae. *P. destruens* is not thought to survive well in soil from one growing season to the next (2). Thus, the ability to increase on weed hosts does not necessarily overcome the limiting factor of overwinter survival unless the weed host is perennial and the pathogen can survive winter on the perennial host. Two species of *Ipomoea, I. trichocarpa* and *I. pandurata*, are common perennials in Louisiana. *I. pandurata* was not included in this study because of the difficulty in propagating it. These species generally survive perennially outside cultivated fields.

C. fimbriata and *M. infuscans* apparently have a limited ability to persist in soil but may be reduced or controlled by relatively short crop rotations (2). The presence of susceptible wild morning glories may have a significant impact on survival of these pathogens in the absence of sweet potatoes.

S. ipomoea and *F. oxysporum* f. sp. *batatas* are known to persist in soil for varying periods in the absence of sweet potatoes. For these pathogens, ability to increase on Convolvulaceous weeds may aid in survival despite the use of rotation crops.

Although this study reports the susceptibility of wild morning glories to sweet potato pathogens in greenhouse conditions, there have been no reports in the literature concerning natural occurrence of any of the above fungal sweet potato pathogens on wild morning glories.

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