Host Range of *Cercospora piaropi* and *Acremonium zonatum*, Potential Fungal Biocontrol Agents for Waterhyacinth in Mexico

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The host ranges of *Cercospora piaropi* and *Acremonium zonatum*, fungi native to Mexico and pathogens of waterhyacinth (*Eichhornia crassipes*), were evaluated using 31 plant species (some with several cultivars tested) representing 22 families of economic and ecological importance. The results showed that only waterlettuce *(Pistia stratiotes)*, another abundant weed in Mexico, was infected by *C. piaropi*. The use of those pathogens in the biological control of waterhyacinth would not be expected to affect plants of economic and ecological importance in Mexico.
KEY WORDS: *Eichhornia crassipes*; host range; *Cercospora piaropi; Acremonium zonatum*.

Waterhyacinth *(Eichhornia crassipes* [Mart.] Solms), of South American origin, continues to be one of the most prolific aquatic weeds in the world. Since its introduction into Mexico in the late 19th Century (5), it has become a focus of intense control efforts in that country, as well in others. From a study carried out to identify fungi associated with waterhyacinth in Mexico, two species with biological control potential were identified: *Cercospora piaropi* Tharp and *Acremonium zonatum* (Saw) W. Games (4). Two *Cercospora* spp., *C. rodmanii* and *C. piaropi*, as well as *A. zonatum*, are known to attack waterhyacinth. The host specificity of *C. rodmanii* (previously considered different from *C. piaropi* in conidia morphology) was demonstrated in an evaluation of 58 species (1). Rintz (6) reported that an isolate of *A. zonatum* from Louisiana (USA) attacked 10 of 12 species tested. The aim of our study was to determine the host specificity of *C. piaropi* and *A. zonatum* (isolated in Mexico) in order to evaluate their potential as biocontrol agents for waterhyacinth. The plant species included in the test were selected on the basis of their economic (8) and ecological (7) importance and their relation to the target plant, waterhyacinth (1,8).

Host specificity tests Plants were grown in pots filled with soil treated with methyl bromide. Each pot contained one plant and each species was replicated six times. The experiments were performed twice. Indigenous strains of *C. piaropi* and *A. zonatum* were isolated from infected leaves of waterhyacinth collected in Mexico. Pure cultures were obtained by the single-spore technique (2). *C. piaropi* was grown in potato-dextrose broth (Difco) and *A. zonaturm* in potato-dextrose agar (Difco) supplemented with 0.5% yeast extract. Approximately 300 g of wet mycelia and conidia were ground in a blender and applied using manual sprayers to the plants; controls were sprayed with water. All the plants, including waterhyacinth, were inoculated at the same time during the night. Plants were grown in a greenhouse with an ultrasonic humidifier to maintain the relative humidity near saturation (*ca*

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TABLE 1. Plants included in host-specificity testing of *Cercospora piaropi* and *Acremonium zonatum*

Family	Species and Common Name	Rating for *C. piaropi*	Rating for *A. zonatum*
Apiaceae	*Daucus carota* L.[1] cv. Nateza 618; Carrot	–	–
	Hydrocotyle verticillata L.[2] Water pennywort	–	–
Araceae	*Pistia stratiotes* L.[2]; Waterlettuce	–	+
	Xanthosoma robustum Schott.[3] Elephants-ear	–	–
Asclepiadaceae	*Cryptostegia grandiflora* (Roxb.) R. Br.[3] Impatiens	–	–
Brassicaceae	*Raphanus sativus* L.[1,4] cv. Bartende; Radish	–	–
Cactaceae	*Opuntia tuna* Rose[1,3] cv. unknown; Cactus pad	–	–
Chenopodiaceae	*Spinacea oleracea* L.[1,4] cv. Viroflay; Spinach	–	–
	Sorghum vulgare Pers.[1] cv. unknown; Sorghum	–	–
Ciperaceae	*Cyperus papyrus* L.[2] Papyrus	–	–
Compositae	*Lactuca sativa* L.[1] cv. Great Lakes Lettuce	–	–
Cucurbitaceae	*Cucurbita pepo* Mill[1,4] cv. Succhine Gray; Zucchini	–	–
	Cucumis sativus L.[1,4] cv. Marketer 714; Cucumber	–	–
Fabaceae	*Phaseolus vulgaris* L.[1,4] cv. Ejotero; Bean	–	–
Labiaceae	*Coleus* sp. Mart.[3]	–	–
Lileaceae	*Allium cepa* L.[1,4] cv. Vaugirard 636; Onion	–	–
	Allium sativum L.[1] cv. unknown; Garlic	–	–
Malvaceae	*Hibiscus rosa-sinensis* L.[3] Hibiscus	–	–
Moraceae	*Ficus carica* Stand.[1,4] cv. De Esmirna; Fig	–	–
Musaceae	*Musa sapientum* L.[3] cv. Tabasco; Banana	–	–
Nictaginaceae	*Bougainvillea spectabilis* Willd.[3] Bougainvillea	–	–
Poaceae	*Zea mays* L.[1,4] cv. Pioneer 30R39; Maize	–	–
	Saccharum officinarum[1] cv. Mayarit 55-14, cv. Mx 55-32, cv. Mx 69-290, cv. Cubana; Sugar cane	–	–
Pontederiaceae	*Eichhornia crassipes* (Mart.) Solms[4] Waterhyacinth	+	+
	Pontederia cordata L.[2] Pickerelweed	–	–
Rosaceae	*Fragaria vesca* Schl.[1] cv. Selva; Strawberry	–	–
Rutaceae	*Citrus maxima* Burm.[1] cv. Tresca; Grapefruit	–	–
	Citrus aurantifolium (Christm.) Swingle.[1] cv. Perrine; Lemon	–	–
Solanaceae	*Capsicum annuum* L.[1] cv. Serrano; Chili pepper	–	–
	Lycopersicon esculentum Mill.[1,4] cv. Río fuego; Tomato	–	–
Verbenaceae	*Lantana camara*[3] Lantana	–	–

(1) Plants of economic importance in Mexico. (2) Plants ecologically related to waterhyacinth. (3) Plants of ecological importance in Mexico. (4) Plants reported susceptible to test organisms. + infection; – no infection.

95%). The greenhouse was covered with a 70%-shade screen, and the temperature maintained at *ca* 27°C with an air conditioner. To evaluate the effect of age, the plants were inoculated three times over a 3-month period (May–July). Starting 15 days after inoculation, plants were monitored every week for 3 months to detect the characteristic symptoms of dark-brown, ovate leaf spots with a whitish center caused by *C. piaropi* and the concentric pale-brown leaf spots with dark-brown rings produced by *A. zonatum*. Monitoring was conducted to record the presence or absence of these symptoms.

Back-inoculation experiments Isolates of *C. piaropi* and *A. zonatum* from plants that evinced symptoms were inoculated back onto healthy waterhyacinth to confirm that the symptoms were indeed caused by *C. piaropi* and *A. zonatum.*

One month after the first application of *A. zonatum* alone, waterlettuce (*Pistia stratiotes*) showed characteristic lesions on its leaves. Waterlettuce and waterhyacinth were inoculated with the *A. zonatum* isolate taken from waterlettuce-infected leaves. Microscopic examination and cultures of isolates from waterlettuce and waterhyacinth confirmed that they had been infected by *A. zonatum.* None of the other plants inoculated with *C. piaropi* or *A. zonatum* showed any sings of pathogenicity and therefore are considered to be immune to these pathogens (Table 1).

Spinacea oleracea, *Cucumis sativus* and *Curcurbita pepo* were reported to be susceptible to *C. rodmanii* in the greenhouse test and the damage was observed only on the older, senescing leaves after three applications of the fungus. None of these plants was susceptible to *C. rodmanii* under field conditions (1).

Allium cepa, Raphanus sativus, Cucurbita pepo, Zea mays, Phaseolus vulgaris, Ficus carica and *Lycopersicon esculentum* were shown to be susceptible to *A. zonatum* by Rintz (6). Conversely, a negative host pathogenicity test was reported by Galbraith (3) with an Australian isolate of *A. zonatum.* In Mexico, there is no information on any harmful effects of this pathogen. In our study, none of the plants was infected by our strains of *A. zonatum* and *C. piaropi,* even after three applications.

Laboratory conditions in our study (temperature *ca* 27°C, r.h. 95%, shade 70%) were optimal for infection, and more so than possible in the field. Nevertheless, none of the plants tested (except waterlettuce, another problematic weed in Mexico) was infected by *C. piaropi* or *A. zonatum.* Therefore, based on this host specificity test, the use of *C. piaropi* and *A. zonatum* for biological control of waterhyacinth would not be expected to affect plants of economic and ecological importance in Mexico.

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