Gibbago trianthemae, a Recently Described Hyphomycete with Bioherbicide Potential for Control of Horse Purslane (*Trianthema portulacastrum*)

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ABSTRACT

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Gibbago trianthemae, the causal agent of leaf spot on horse purslane, was isolated from diseased plants collected in Brazos County, TX, in 1984. Plants sprayed with conidia at 1×10^5 spores/ml or more were killed within 9 days. In host-range studies, the fungus was pathogenic only to horse purslane and not to 18 other crop and weed species in 11 plant families. Results of both pathogenicity and host-range studies demonstrate that this fungus may be a useful agent for the biological control of horse purslane.

Additional key words: mycoherbicide, weed control

Chemical herbicides are the most effective immediate solution to most weed problems but are not the only solution available (3). Recent commercialization of two biological herbicides illustrates another weed control strategy with potential (4,6–8). In the fall of 1984, a fungus identified as *Gibbago trianthemae* Simmons was isolated from foliar lesions on mature horse purslane (*Trianthema portulacastrum* L.) plants collected in Brazos County, TX. The fungus was causing extensive defoliation of horse purslane plants growing in a fallow field previously planted with peanuts. *G. trianthemae* has several characteristics similar to those of the genera *Stemphylium* and *Alternaria* but is distinct from them. The fungus has been recently described by Simmons (5) as a new genus and species. The objectives of this study were to assess the host range and effectiveness of this fungus as a bioherbicide for the control of horse purslane.

MATERIALS AND METHODS

Pathogen isolation and culture. Single conidia of *G. trianthemae* were isolated from sporulating lesions on horse purslane using a heat-sterilized dissecting probe under a stereomicroscope and transferred to potato-dextrose agar (PDA). Stock cultures were maintained on PDA slants under mineral oil at 4 C and at −80 C in a skim milk/glycerol medium. For inoculum production, *G. trianthemae* was incubated on V-8 agar in petri dishes for 7–14 days at 26 C under fluorescent lights (1:1, Gro-Lux:cool-white) adjusted to a 14-hr photoperiod.

Host-range studies. Test plants were grown on greenhouse benches at 25–30 C in 7.5 × 9.0 cm plastic pots (two plants per pot) containing pasteurized field soil and inoculated at ages ranging from 1 to 3 wk postgermination. Each treatment consisted of eight plants, and the experiment was replicated twice. An aqueous conidial suspension of the fungus amended with Tween 20 (0.02%, v/v) was prepared and standardized at 2×10^5 spores/ml with a hemacytometer. Plants were inoculated by spraying the leaf and stem surfaces to runoff with the conidial suspension of the fungus using an artist's airbrush atomizer (58.5 kg/cm^2). Controls were sprayed with water plus surfactant only. Inoculated plants were air-dried and placed into a dew-deposition chamber at 25 C in the dark. After 16 hr, the plants were removed and returned to the greenhouse bench for observation.

Pathogenicity tests. Seeds of horse purslane were provided by B. D. Bruton (USDA-ARS, Weslaco, TX). Plants ranging in height from 5 to 10 cm were grown as previously described and inoculated at concentrations of 5×10^4 to 5×10^5 spores/ml. Each treatment consisted of eight plants, and the experiment was replicated twice. After 2 wk, plants were excised at the soil

Fig. 1. Leaf spot of *Trianthema portulacastrum* caused by *Gibbago trianthemae*.

Table 1. Response of various crop and weed species tested for susceptibility to *Gibbago trianthemae* in greenhouse inoculation studies

Family Scientific name, cultivar	Disease reaction[a]
Aizoaceae	
Mollugo verticillata L.	R
Trianthema portulacastrum L.	S
Amaranthaceae	
Amaranthus retroflexus L.	R
Chenopodiaceae	
Chenopodium album L.	R
Compositae	
Xanthium strumarium L.	R
Cucurbitaceae	
Cucumis melo var. *cantalupensis* Naud. 'Perlita'	R
Cucurbita pepo L. 'Jack O'Lantern'	R
Gramineae	
Sorghum bicolor (L.) Moench 'Funks G-1516BR'	R
Triticum aestivum L. 'Coker 68-15'	R
Zea mays L. 'Silver Queen'	R
Leguminosae	
Aeschynomene virginica (L.) B.S.P.	R
Arachis hypogaea L. 'Tamnut-74'	R
Cassia obtusifolia L.	R
Glycine max (L.) Merr. 'Lee 74'	R
Malvaceae	
Gossypium hirsutum L. 'Deltapine 41'	R
Sida spinosa L.	R
Onagraceae	
Jussiaea decurrens (Walt.) DC.	R
Portulacaceae	
Portulaca oleracea L.	R
Solanaceae	
Lycopersicon esculentum Mill. 'Beefmaster'	R

[a] R = resistant, S = susceptible.

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Table 2. Effect of *Gibbago trianthemae* inoculum levels on horse purslane control (percent biomass loss) 2 wk after inoculation

Inoculum concentration (spores/ml)	Percent biomass loss
5×10^5	100
2×10^5	100
1×10^5	100
5×10^4	52
Control (water-sprayed)	0

surface, oven-dried at 100 C for 24 hr, and weighed to determine the percentage of biomass loss [(control-inoculated)/control] × 100.

RESULTS AND DISCUSSION

G. trianthemae caused extensive damage to horse purslane. All of the 18 other plant species in 11 families tested were immune to the pathogen (Table 1). To date, the pathogen has not been found to cause disease on any other plant species. Horse purslane inoculated with 5×10^4 spores/ml of *G. trianthemae* developed irregularly shaped water-soaked lesions on both the stems and the leaves 4 days after inoculation. Seven days after inoculation, necrotic straw-colored lesions with maroon margins were apparent (Fig. 1). The lesions often coalesced and the leaves abscised, resulting in premature defoliation. Plants sprayed with inoculum levels of 1×10^5 spores/ml or greater were killed within 9 days. Other foliar bioherbicides, such as *Colletotrichum gloeosporioides* (Penz.) Sacc. f. sp. *aeschynomene* (1) and *C. malvarum* (A. Braun & Casp.) Southworth (2), require inoculum levels of at least 1×10^6 spores/ml to achieve equivalent levels of control over their respective weed hosts. Weed growth was reduced by about 50% at the lowest concentration of spores tested (5×10^4 spores/ml) (Table 2). Additional studies are needed on the impact of the field environment and application technology on the efficacy of this pathogen as a bioherbicide.

LITERATURE CITED

1. Daniel, J. T., Templeton, G. E., Smith, R. J., Jr., and Fox, W. T. 1973. Biological control of northern jointvetch in rice with an endemic fungal disease. Weed Sci. 21:303-307.
2. Kirkpatrick, T. L., Templeton, G. E., TeBeest, D. O., and Smith, R. J., Jr. 1982. Potential of *Colletotrichum malvarum* for biological control of prickly sida. Plant Dis. 66:323-325.
3. McWhorter, C. G., and Chandler, J. M. 1982. Conventional weed control technology. Pages 5-27 in: Biological Control of Weeds with Plant Pathogens. R. Charudattan and H. L. Walker, eds. John Wiley & Sons, Inc., New York. 293 pp.
4. Ridings, W. H., Mitchell, D. J., Schoulties, C. L., and El-Gholl, N. E. 1976. Biological control of milkweed vine in Florida citrus groves with a pathotype of *Phytophthora citrophthora*. Pages 224-240 in: Proc. Int. Symp. Biol. Control Weeds 4th. T. E. Freeman, ed. University of Florida, Gainesville.
5. Simmons, E. G. 1986. *Gibbago*, a new phaeodictyoconidial genus of hyphomycetes. Mycotaxon 27:107-111.
6. Templeton, G. E., Smith, R. J., Jr., TeBeest, D. O., Beasley, J. W., and Klerk, R. A. 1981. Field evaluation of dried fungus spores for biocontrol of curley indigo in rice and soybeans. Arkansas Farm Res. 30:8.
7. Templeton, G. E., TeBeest, D. O., and Smith, R. J., Jr. 1976. Development of an endemic fungal pathogen as a mycoherbicide for biocontrol of northern jointvetch in rice. Pages 214-216 in: Proc. Int. Symp. Biol. Control Weeds 4th. T. E. Freeman, ed. University of Florida, Gainesville.
8. Woodhead, S. H., Ridings, W. H., Schoulties, C. L., Clark, R. K., and El-Gholl, N. E. 1981. Field efficacy of *Phytophthora palmivora* for control of milkweed vine. (Abstr.) Phytopathology 71:913.