Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:
Biological Control of Ground Ivy Using a Rust Fungus

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Type of grant:
Biological control and pest biology

Project location(s):
Central New York, possibly the entire state

Abstract:
Ground ivy or creeping Charlie (*Glechoma hederacea*) is a creeping perennial in the Mint Family that forms dense prostrate patches in turfgrass, damp shady meadows, and disturbed sites. The control of ground ivy using chemical and mechanical methods has largely been unsuccessful in turfgrass where it is considered a major weed. Thus, there is an urgent need to develop and evaluate alternative approaches for the control of ground ivy in turfgrass that are effective and environmentally sound. Several rust fungi have been reported to infect ground ivy in its native Eurasian range. In 1998, one of these rusts, *Puccinia glechomatis*, was found in North America including on ground ivy plants growing in Syracuse, NY. Research to date has demonstrated that this rust fungus infects only plant species within the genus *Glechoma*. The goal of this study was to (1) determine the distribution of the *Puccinia glechomatis* rust on turfgrass ground ivy populations in the Ithaca, NY area and surrounding counties, (2) assess the potential of the rust to effectively suppress ground ivy in turfgrass, and (3) determine whether the rust infects non-host plant species in turfgrass. Field surveys during the 2001 growing season indicate that the rust has infected ground ivy plants in the Ithaca, NY area as well as several surrounding counties. In field trials within naturally infected turf, the rust reduced ground ivy coverage nearly 30% by mid-September compared with coverage in late May before disease symptoms were observed. Disease symptoms were not observed on any of the turfgrass species or other non-target plants in infected plots. These preliminary findings suggest that the selective rust, *Puccinia glechomatis*, may be a

promising biocontrol candidate for suppressing ground ivy in turfgrass and warrants further research.

Background and justification:

Ground ivy (*Glechoma hederacea* L.) is a creeping perennial in the Labiaceae or Mint Family that forms dense prostrate patches in turfgrass, damp shady meadows, and disturbed sites. Reproduction is primarily by stolons and less commonly via seed and rhizomes. Ground ivy is native to Eurasia but has been introduced and become widespread in North America, especially in the northeastern and north-central USA (Uva et al., 1997). The control of ground ivy using chemical and mechanical methods has largely been unsuccessful in turfgrass where it is considered a major weed (Mitich, 1994; Turgeon, 1994; Lamboy *et al*., 2000). Thus, there is an urgent need to develop and evaluate alternative approaches for the control of ground ivy in turfgrass that are effective and environmentally sound. Biological control using selective fungal pathogens may be a potentially effective and safe strategy for suppressing this troublesome weed.

Several rust fungi have been reported to infect ground ivy in its native Eurasian habitat range. Recently, one of these rusts, *Puccinia glechomatis*, was found in North America (Scholler, 2000). The rust was detected on ground ivy plants growing in Syracuse, NY in August 1998 and on plants growing in shady, frequently mowed private lawns west of Lafayette, IN in October 1999. Other U.S. States where this rust has been found include Pennsylvania, Virginia, West Virginia, Kentucky and Ohio (Boellmann and Scholler, 2001). The specific mode of introduction into North America is not known. Research to date has demonstrated that *P. glechomatis* infects only species within the genus *Glechoma* (Scholler, 2000).

The presence of the *P. glechomatis* rust on diseased ground ivy plants collected in August 2000 from several locations in Dryden, Tompkins county, NY has been confirmed. Disease incidence and severity of affected populations was extremely high (DiTommaso, A., personal observation). Turfgrass species did not appear to be affected by the rust. It was expected that the rust would re-infect remnant ground ivy populations in these same sites in 2001 and possibly spread to adjacent areas in coming years. Before this research was undertaken there was little information on the incidence of disease caused by this rust on host ground ivy populations in Tompkins and surrounding counties of Central New York. There was also limited data on the severity of disease caused by the rust or its impact on ground-ivy growth and development. Moreover, the host range of this rust would require a more accurate assessment before any consideration of this pathogen as a potential biological control agent for ground ivy is further evaluated.

The proposed research addresses one of the NYS IPM priorities in Ornamentals and Turfgrass, namely the development of enhanced methods of biological control of problem weeds in turfgrass.

Objectives:

1. Determine the distribution of the *Puccinia glechomatis* rust on turfgrass ground ivy populations in Tompkins and surrounding counties
2. Assess the effect of disease caused by *P. glechomatis* on ground ivy growth and development
3. Determine whether this rust infects non-host plant species in turfgrass
4. Project Evaluation: Assess the potential of this newly observed rust pathogen to effectively and selectively suppress ground ivy in turfgrass.

Procedures:

Objective 1. *Surveys.*
During the 2001 growing season, we carried out surveys in Tompkins and surrounding counties to determine the extent of ground ivy populations that were infected by the *Puccinia glechomatis* rust. Cornell Cooperative Extension educators in several of the counties aided in selecting locations for the surveys. Different habitats where ground ivy was suspected to be present were sampled including private lawns and city parks. To be able to monitor disease progression in these natural populations, surveys were carried out on two separate occasions: 1) early June and 2) early August. A total of 11 sites, one in each of 11 Central New York counties was sampled (Table 1). At each of the sites, the percentage ground ivy coverage within four randomly located 0.25m^2 (50 cm x 50 cm) quadrats was visually estimated as was the percentage of ground ivy leaf tissue that was diseased. Plant tissue suspected of being infected by *P. glechomatis* was collected and brought to Dr. Kathie Hodge of the Cornell Department of Plant Pathology for identification.

Objectives 2 and 3. *Field microplot research***.**
To assess the impact of disease on ground ivy growth and development, the proposal called for the establishment of field microplots in two Dryden, NY private lawn sites where *P. glechomatis* infection had been confirmed in 2000. However, because of health concerns expressed by the property owner of one of the sites to the use of a fungicide, the site was not used for experimentation in 2001. At the site where the trial was performed, twelve 0.25m^2 (50 cm x 50 cm) quadrats were established in mid-May. Quadrats were separated by at least 0.5 m. Within 4 of the quadrats, the protectant fungicide, mancozeb (Manzate® 75DF) was applied at a rate of 10 lbs/175 gals/acre at 2-week intervals (mid-May to mid-September) to inhibit rust infection of ground ivy plants. In 4 of the quadrats, water was applied at the same spray volume as for the fungicide treatment such that rust infection of ground ivy plants was allowed to progress naturally. The remaining 4 quadrats were established in an adjacent area having ground ivy populations but which had shown no rust infection during the 2000 and early 2001 growing seasons. At each of 5 sampling dates (i.e., May 30, June 15, July 15, August 15, September 15), the following data were collected from each of the 0.25 m^2 quadrats:

1) percentage ground area occupied by ground ivy
2) percentage ground ivy leaf area diseased
3) identification of other plant species infected by the rust
4) symptomology of infected ground ivy
Plots were mowed to a height of 10 cm (4") after each sample period.

Objective 4. *Project evaluation*. This research is a critical first step to the possible development and deployment of this potential biocontrol agent for ground ivy in turfgrass. The short-term success of the project would be to confirm the presence of the rust in Tompkins and adjacent counties and to demonstrate the selective deleterious impact of *P. glechomatis* on ground ivy growth and development.

Results and discussion:

Field surveys during the 2001 growing season indicate that the *Puccinia glechomatis* rust has infected ground ivy populations in 4 of 11 counties surveyed (Table 1). However, given that diseased populations have been found in Dryden, Tompkins county but not in the nearby towns of Lansing or Cortland suggests that its current distribution in Central New York is quite

sporadic. In those sites where the rust was confirmed, the level of disease was relatively low with less than 30%of the ground ivy leaf area diseased.

Table 1. Locations in Central NY State where disease surveys were carried out in early June and August 2001 to determine the presence of the rust *Puccinia glechomatis* on ground ivy

City/Town	County	Presence of *P. glechomatis*
Binghamton	Broome	Yes
Auburn	Cayuga	No
Elmira	Chemung	No
Cortland	Cortland	No
Cazenovia	Madison	No
Skaneateles	Onondaga	No
Watkins Glen	Schulyer	Yes
Lodi	Seneca	Yes
Waverly	Tioga	No
Lansing	Tompkins	No
Dundee	Yates	Yes

In the 2001 microplot trials within naturally infected turf, the rust reduced ground ivy coverage by 30% from the first sample period in late May (48%) to the last sample period in mid-September (18%). In contrast, ground ivy cover in the nearby uninfected plots remained nearly unchanged (50%) between the May and September sampling periods. Disease development was gradual through the season with the highest levels of foliar necrosis observed in late July and early August. Leaf tissue close to the soil surface appeared to be most severely infected and premature leaf senescence was common. Disease symptoms were not observed on turfgrass nor on other non-target plants within infected plots. Interestengly, areas within infected plots left vacant by the death or reduction in size of diseased ground ivy plants were rapidly colonized by favorable turfgrass species. Ground ivy plants within all four plots treated with fungicide also exhibited disease symptoms. Several factors may have been responsible for the poor control of the rust within fungicide-treated plots. It is possible that ground ivy plants were already infected by the rust when the first fungicide application was made in late May. Given that mancozeb is a protectant fungicide, disease present on host plants before it is applied will not be controlled. It is also plausible that the 2-week interval between spray applications may have been too long to prevent infection during the growing season.

The findings from this research indicate that the selective rust, *Puccinia glechomatis*, is present in Tompkins and surrounding counties of Cenral New York State although its distribution appears intermittent. More extensive surveys should provide more detailed and reliable information on the distribution of this recently introduced rust pathogen. Results from the turfgrass microplot work show that *P. glechomatis* is not only host specific to ground ivy, but can substantially reduce coverage of this troublesome weed in turfgrass. This finding is especially relevant and timely because of the limited number of safe and effective non-herbicidal options available in turfgrass for managing problem weeds. Additional research on this promising biological control candidate is required to more fully assess the impact of disease on ground ivy growth under different growing conditions. This work will also enhance our understanding of the specific environmental conditions required for optimizing disease severity and spread.

References:

Boellmann, J. and M. Scholler. 2001. Preliminary studies on the spread of the rust fungus *Puccinia glechomatis* in North America. Phytopathology 91: S104.
Lamboy, J., L.A. Weston, and F. Rossi. 2000. Weeds in Your Lawn. Cornell Cooperative Extension and NYS IPM Community Program, Cornell University.
Mitich, L.W. 1994. Ground Ivy. Weed Technology 8: 413-415.
Scholler, M. 2000. Rust on ground-ivy found for the first time in North America. Plant Disease 84: 371.
Turgeon, A.J. 1994. Turf Weeds and Their Control. ASA Inc. & CSSA Inc., Madison, WI.
Uva, R.H., J.C. Neal, and J.M. DiTomaso. 1997. Weeds of the Northeast. Cornell University Press, Ithaca, NY.

Samples of materials:

A website (http://ppathw3.cals.cornell.edu/CUPpages/rust.html) has been created that expands on this research and also provides the public with colored images of both the host plant and the rust fungus. Visitors to the website are also encouraged to send suspected diseased ground ivy plants to either the co-investigators of this Cornell research team (for NY State residents only) or to our colleague, Dr. Markus Scholler, at Purdue University.

Publications:

DiTommaso, A., L.A. Weston, V.R. Walker, and K.T. Hodge. 2002. Occurrence and impact of the rust *Puccinia glechomatis* on ground ivy in New York State. Northeastern Weed Science Society of America Abstracts, *in press*.