



RESEARCH
SERVICES SECTION

TECHNICAL SUMMARY

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PROJECT COST:

\$110,000



Canada thistle is a tall perennial weed with spiny leaves and lavender flowers.

Biological Control of Canada Thistle

What Was the Need?

Canada thistle is a nonnative, perennial weed common in Minnesota and classified as noxious in 43 states. An aggressive and invasive species that can outcompete native plants, Canada thistle is a costly threat to cropland, pastures and natural ecosystems that have been disturbed or are being restored. It is also the most prevalent noxious weed along roadside rights-of-way, where its occurrence can affect driver safety, pavement maintenance and storm water management. Mn/DOT puts a high priority on controlling these infestations and is required to do so by state and federal law.

Because of its wide and deep root system and propagation via both rhizomes and seeds, Canada thistle is impossible to fully eradicate and very difficult to manage. Current methods for controlling Canada thistle, such as mowing, tillage, burning and herbicides, can be costly and sometimes conflict with Mn/DOT environmental objectives, including the preservation of biodiversity in roadside ecosystems. Alternative approaches for controlling Canada thistle are needed.

Previous research has shown that the phytopathogenic bacterium *Pseudomonas syringae pv. Tagetis*, or PST, infects and strongly reduces the growth of natural populations of Canada thistle by inhibiting chlorophyll formation—killing and curbing the weed without damaging native species.

For this reason, there has been significant interest in investigating PST for use as a cost-effective and environmentally safe biological agent for the long-term management of Canada thistle. Further research was needed to establish techniques for artificially introducing PST into Canada thistle populations and to determine the optimum environment for sustaining high levels of infection.

What Was Our Goal?

This project investigated the effectiveness of the native biological control agent PST for the control of Canada thistle in roadside rights-of-way and in prairie wetland restoration systems.

What Did We Do?

Researchers performed three experiments. In the first, they identified naturally PST-infected Canada thistle patches along roadside rights-of-way in Minnesota, and selectively removed grass and litter consisting of fine dead grasses from these patches to determine whether they were necessary alone or in combination to sustain PST infections.

In the second experiment, grass, litter and soil collected from infected Canada thistle patches or cultured PST were introduced in a Minnesota wetland restoration area with uninfected Canada thistle populations. Researchers periodically measured the growth of and disease incidence in Canada thistle to determine if these introductions caused infection of the thistle, and if environments created by perennial grasses and grass litter increased the rate of these infections.

In the third experiment, researchers tested a number of protocols for developing a polymerase chain-reaction-based DNA test for both sensitivity and accuracy in PST detection in grass and litter not exhibiting symptoms of infection.

What Did We Learn?

Overall, researchers found that an integrated management system based on both the introduction of PST and the establishment of native perennial grasses has significant potential for controlling Canada thistle in roadside rights-of-way and wetland restoration sites.

continued

“Although we did not find the silver bullet, this study is a valuable stepping stone to future efforts to use PST as a cost-effective and environmentally friendly way to manage Canada thistle.”

–Paul Walvatne,
Mn/DOT Roadside
Vegetation Management
Unit Supervisor

“We wanted to know why roadside environments were conducive to the presence of PST, and found that the presence of grass and thatch created environmental conditions that dramatically increased PST infections.”

–Donald Wyse,
Professor, University of
Minnesota Department
of Agronomy and Plant
Genetics

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PST was introduced into a Minnesota wetland restoration area by transplanting grass, litter and soil taken from infected Canada thistle populations on Minnesota rights-of-way.

In the first experiment, researchers found that grass and litter are important environmental factors for sustaining PST infections. Disease incidence decreased when either grass, litter, or grass and litter were removed from areas with populations of Canada thistle already naturally infected with PST, as compared to intact controls.

In the second experiment, researchers found that Canada thistle populations without PST became infected after being treated with grasses from naturally infected Canada thistle. However, nontreated controls were also infected; PST may have dispersed between plots or have been present from the beginning of the experiment. Further, the disease incidence of infected plants was not high enough to impact Canada thistle growth and development in a way useful for Canada thistle management.

In the third experiment, researchers developed a PCR-based DNA test for PST infection, but found that this test needs to be further optimized to be made fully reliable.

What's Next?

This project is a step toward the broader goal of determining whether or not it is feasible to artificially increase the incidence of disease in Canada thistle for managing roadside and natural areas.

However, more information is needed on establishing and maintaining environments that sustain PST populations, and current study sites will be monitored long term to evaluate how environmental factors affect the prevalence of Canada thistle. Researchers will also need to develop an accurate test for reliably detecting PST in asymptomatic grass and litter to understand PST biology and why litter and grass are important to its transmission.

This Technical Summary pertains to Report 2007-38, “Biological Control of Canada Thistle in Wetland Prairie Restoration,” published October 2007. The full report can be accessed at <http://www.lrrb.org/PDF/200738.pdf>.