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Biotic interference of biological control of purple loosestrife (*Lythrum salicaria*)

Abstract: Iowa State University has reared and released two European leaf-feeding beetle species to control purple loosestrife in Iowa wetlands. Expected reductions in loosestrife have not occurred, and biotic mortality factors may explain the failure of the beetles to curb the loosestrife.

Question & Answer

Q: Purple loosestrife is an invasive weed that impairs wetland functioning and biocontrol methods using beetles didn't seem to reduce the problem?

A: The research shows that the beetle eggs are probably eaten by other predators and they might survive better in more diverse wetlands.

Background

Over the last decade, Iowa State University has reared and released more than 1.4 million *Galerucella pusilla* and *G. calmariensis* beetles in an effort to stem the spread of purple loosestrife, an invasive wetland weed species that can live up to 22 years. Populations of the leaf-eating European beetles have been established in several Iowa wetland sites, however, expected reductions have not been observed in the densities of purple loosestrife. Biotic mortality factors of the *Galerucella* species in wetland habitats were examined to determine why survival of these beetles is lower than expected. Two common predatory species *Chrysoperla carnea* and *Coleomegilla maculata*, have been frequently observed in purple loosestrife infested wetlands in Iowa. In purple loosestrife-infested wetlands, naturally occurring predators of the *Galerucella* species could interfere with biological control and indirectly enhance purple loosestrife.

Approach and methods

The suitability of *G. pusilla* eggs for development and survival of two species of insect predators, *Chrysoperla carnea* and *Coleomegilla maculata*, was quantified by measuring preimaginal development, survival, and adult weight. All experiments and rearing of *G. pusilla* were conducted in growth chambers. Because *G. pusilla* eggs may be utilized by these predatory species as alternative prey during periods of low availability of suitable prey, this predation could affect the biological control of loosestrife.

Purple loosestrife (*L. salicaria*) densities were measured at three release sites where beetles had been released since 1995, two sites at which beetles had been released recently, and two sites at which no beetles had been released. All plants in randomly selected release areas were cut at ground level and classified as purple loosestrife or other species. The mass of purple loosestrife and other plant species was measured on a portable electric balance.



Galerucella spp. (photo by Betsy Matos)

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Budget:

\$12,040 for year one
\$8,290 for year two
\$8,290 for year three

Results and discussion

Egg predation. Thirty-seven percent of *C. carnea* larvae completed development on *G. pusilla* eggs. The greatest decline in survival within a life stage (50 percent) was during the second instar stage. *G. pusilla* eggs were not suitable prey for 95 percent of *C. maculata* larvae, with especially high mortality for *C. maculata* in the second instar stage.

Estimates of *L. salicaria* biomass. Biomass estimates were made at Black Hawk Wildlife Area and Little Storm Lake for four years. At these sites, loosestrife biomass decreased between 1994 and 2000, but increased in 2001 to a level comparable to 1994. At Black Hawk, other biomass types increased, dropped, and increased for the final two years. Little Storm Lake saw two years of decreasing biomass of other types, and slight increases in 2001 and 2002. Biomass was collected from Sunken Grove Marsh in 1994 and 1999 and from Shade's Pond in 2000, 2001, and 2002. At Sunken Grove Marsh, loosestrife biomass increased from 1994 to 1999, whereas biomass of other species was similar in 1994 and 1999. At Shade's Pond, loosestrife biomass was relatively low in 2000 and increased slightly in 2001, while other plant species biomass increased from 2000 to 2001, but declined in 2002. Shade's Pond had the greatest variation of all sites in all varieties of biomass.



Galerucella spp.

Biomass samples were taken at eight additional *L. salicari*-infested wetlands in 2000 and 2001. Compared to 2001, loosestrife totals were lower in 2000 for all but two sites, and other biomass also tested lower for all sites sampled. The percent biomass of other plant species was inversely related to the aboveground biomass of *L. salicaria*.

Conclusions

Predicted reduction in *L. salicaria* abundance in Iowa wetlands (based on earlier research done in other states) did not materialize. No relationship was observed between biomass of purple loosestrife and numbers of *Galerucella* individuals released at a wetland.

One source suggests that multiple natural enemy species would have greater success in the field than any single species, and in Iowa additional species of natural enemies may need to be established to complement the activities of the two *Galerucella* species. Another possibility is that biological control may be achieved more quickly in mixed plant communities where plant competition is greater. In Iowa, most releases of *Galerucella* species have been made in wetlands dominated by *L. salicaria*, with only the Shade's Pond release site in this study showing a diverse mixed plant community.

Impact of results

A consistent, long-term sampling program is needed to assess the biological control of *L. salicaria* in Iowa. A suggested monitoring program would include these activities:

- Randomly selected and permanently marked areas within each wetland would be established and sampled twice each year. The first sample would be in early spring to evaluate the overwintering of *Galerucella* and the second would be in mid- to late August to obtain *L. salicaria* biomass.
- Based on our experiences in the field, ten quadrants would be marked at each site and fresh biomass data would be collected for all plants in the quadrant. Since destructive methods would be used to obtain the biomass samples, quadrants would be randomly selected within a 10 to 20 m radius from the permanently marked spot.

Education and outreach

Presentations on the biological control of purple loosestrife in Iowa were made in several ISU entomology classes and at a summer workshop for elementary and secondary school teachers. Scientific journal articles based on the project results have appeared in the *Journal of the Iowa Academy of Science*, *Journal of the Kansas Entomological Society*, and *Biological Control*.

(Photos on these two pages by Iowa State University, Department of Entomology, Biological Control Laboratory.)



L. salicaria- infested wetland

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