The Evolutionary Response of *Lythrum salicaria* to Biological Control: Linking Patterns in Plant Evolution and Management Efficacy

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Abstract

Like the introduction of invasive species, management programs can impose novel selective pressures in ecosystems. In some cases sufficient variation may exist in populations of invasive species for them to evolve resistance to management techniques. The evolution of resistance to management by herbicide has been repeatedly documented in weedy invasive species. Biological control is becoming increasingly common, and it is possible that invasive species may evolve resistance to biological control agents ultimately reducing the efficacy of these programs. Purple loosestrife (*Lythrum salicaria* L.) is an invasive wetland plant introduced to the U.S. in the early 1800s. In 1992 a classical biocontrol program was launched introducing leaf feeding beetles from Germany to manage invasive populations. As a result of this program, two beetle species have established in Minnesota. Variable success has been achieved in wetlands throughout the state; biocontrol agents have defoliated 90-100% of some purple loosestrife populations and had little to no observed effect on others. We identified three sites that consistently experienced historically high levels of herbivory by the biocontrol agents as well as three sites experiencing low levels of herbivory. In this study we examined the evolutionary divergence of plant vigor, herbivore defense and traits associated with competitive ability between historically high and low herbivory populations. Purple loosestrife from populations subject to greater selective pressure from the biocontrol agents has evolved higher vigor and produces lower concentrations of herbivore defense compounds. Taken together these results suggest that *L. salicaria* is in the process of evolving tolerance to herbivory from biological control agents. In ongoing work, we will 1) investigate the effect of this evolutionary divergence on herbivore preference in colonization, feeding and egg laying and 2) quantify the heritability of plant variation to model the evolutionary trajectory of these traits under continued biological control.