

## **Evidence of Rapid Evolution from Weed Biological Control Introductions**

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### **Abstract**

A capacity to measure and the potential importance of real time rapid evolution in species is starting to revolutionize evolutionary biology turning it from a theoretical to a more empirical or even applied science. An increasing number of examples are being found of species that have been shown to be evolving rapidly and adaptively in response to selection pressures in empirically measurable timeframes. This has been particularly true for insect herbivores and the plants they feed on, most notably seed beetles and soapberry bugs. This potentially questions the argument that biological control agents and their targets have a low risk of evolving to the detriment of either biological control efficacy or increased non-target impacts within management relevant timescales. Biological control releases have been ongoing now for more than 100 years, which based on other observations of rapid evolution, should have provided ample time for rapid evolution in the agents released or their target weeds. It would seem that introducing agents onto target host plants in totally new environments should provide multiple new evolutionary adaptive pressures on each trophic level, through their ongoing “arms race”, via the changed circumstances of their ecological interactions. This paper will review the evidence of post-release rapid evolution in weed biological control agents and their target weeds (particularly where effective biological control may be breaking down), studies that have looked for such post-release rapid evolution, and theoretical studies that suggest when adaptive evolution might be likely. Finally we will discuss evidence found in the context of systems that are showing such evolution, and suggest future science directions for rapid evolution research with practical relevance to weed biological control programs.