W-2185 (2007-2012)

Biological Control of Pests in Plant Systems

This project provided successful, cost-effective, and sustainable pest control in agricultural and natural settings by releasing, manipulating, and conserving the predators, parasites, and pathogens that attack harmful insect and weed pests.

Who cares and why?

Insect and weed pests cause serious damage to agricultural and natural areas, resulting in economic losses, environmental damage, and human health hazards. Pest populations are expanding and new pests continue to arrive in the western U.S. every year. Many of these pest populations have or will become permanently established. Growers often rely largely on chemical pesticides to control pests, but an integrated pest management (IPM) approach considers additional or alternative tactics to keep pest densities below levels that cause economic or environmental harm. One tactic is biological control, which uses native and foreign natural enemies (e.g., parasites, predators, and pathogens) to suppress pests. Biological control is a natural process, but can be enhanced by releasing natural enemies in a new area where a target pest occurs, supplementing or manipulating natural enemies already present, and/or modifying the environment to give existing natural enemies the upper hand. Biological control is a high-priority alternative because of the potential benefits to agriculture, rural communities, and consumers. Biological control allows farmers to reduce pesticide use and cut costs. Lower pesticide use also reduces risks of air, water, and soil contamination, thereby protecting the quality of life for farm workers, area residents, and native wildlife. This makes biological control a particularly useful option for organic farming, which continues to increase at roughly 20% per year in the U.S. Still, successful biological control has to overcome many challenges. To comply with federal regulations, scientists must carefully select the appropriate natural enemy species, so that they control the target pests but do not harm non-target species or the environment. In-depth studies and rigorous data are needed to support practical biological control recommendations. Furthermore, because target pests often occur in more than one state or area, research and biological control approaches must be highly coordinated.

The banana aphid (top right) is a costly pest of banana and other tropical/subtropical food and ornamental plants. By feeding on plant tissues, these aphids can kill the plant, suppress growth, and/or transmit devastating plant diseases. Scientists have discovered that *Endaphis fugitiva* parasitizes banana aphids. Field and laboratory observations have shown that adult flies lay eggs on plant leaves near aphid colonies (left). Hatched fly larvae pierce aphid bodies and continue to develop inside. Aphids die shortly after the parasite re-emerges. Scientists have also found an effective biological control agent for another insect pest, Erythrina Gall Wasp (bottom right), which defoliates and destroys coral trees in Hawaii and Florida. Photos by Russell Messing, University of Hawaii.

What has the project done so far?

The W-2185 project has formed a network for exchanging information, collaborating on research projects, and coordinating biological control efforts. W-2185 scientists have studied pests and their natural enemies in both their native habitats and the areas where they have been newly introduced. Based on this information, researchers have released a variety of predators, parasites, and pathogens that biologically control vine mealybug, red imported fire ant, Diaprepes root weevil, spotted knapweed, purple loosestrife, and other insect and weed pests. Scientists have developed standard procedures for raising, storing, and releasing natural enemies, as well as ways to genetically or physically enhance them. Scientists have also protected naturally occurring pest enemies by

making changes to habitats and agricultural practices. To understand which methods are sustainable, the group has evaluated non-target environmental and economic impacts and has consistently monitored which efforts succeed and which ones fail. W-2185 publications, presentations, websites, and policy recommendations have provided government agencies, agriculture industries, and farmers with the latest news, findings, and recommendations.

Impact Statements

Formed a network of scientists, agencies, and industry members that worked directly with farmers and initiated informed, coordinated, and tailored biological control efforts.

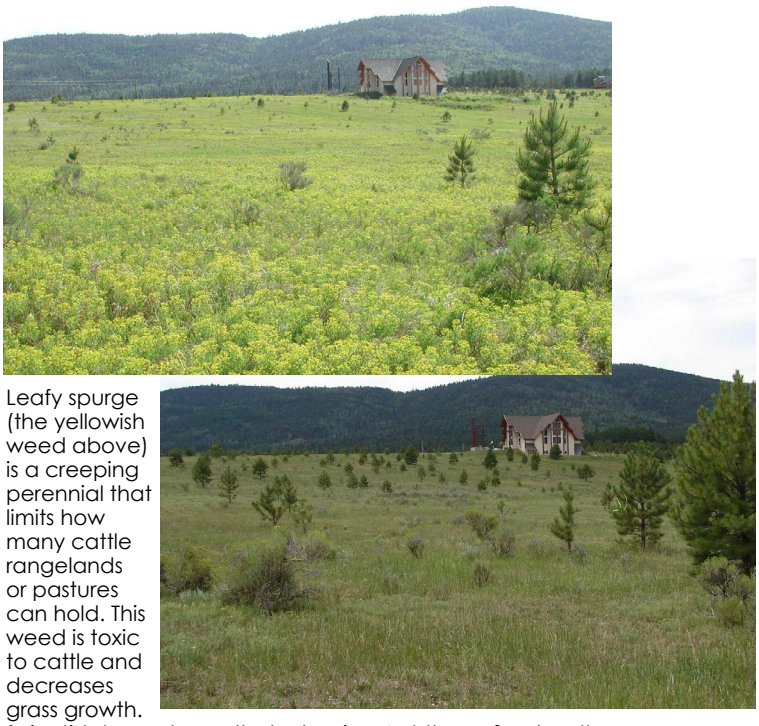
Increased acceptance for biological control efforts among farmers and government agencies by sharing updated knowledge about the environmental and economic impacts.

Reduced risks of air, soil, and water contamination and human exposure to potentially harmful chemicals by decreasing chemical pesticide use in the western U.S.

Helped farmers cut costs. From 2007 through 2010, property owners/managers in the northwestern U.S. saved an estimated $500,000; in 2011 alone, they saved $250,000 by biologically controlling weeds. Over the last 16 years, an IPM program that incorporates natural enemy conservation saved Arizona cotton growers $388 million by reducing crop loss and chemical pesticide use. In turn, farmer savings can translate into lower prices for consumers.

Introduced natural enemies that limit plant reproduction, but are not fatal. This provides the option to plant certain species for ornamental or other uses (e.g., erosion control, hedgerows) without risking serious infestation and damage.

Protected food security, biodiversity, and cultural heritage on Samoan islands by introducing predatory beetles to control pests that damage breadfruit trees—a traditional food source and major component of the island landscape.



Leafy spurge (the yellowish weed above) is a creeping perennial that limits how many cattle rangelands or pastures can hold. This weed is toxic to cattle and decreases grass growth. Scientists have shown that releasing *Aphthona* flea beetles can control leafy spurge by feeding on roots and foliage. These photos show the same field before (top) and after (bottom) flea beetles were introduced. Photos by David C. Thompson, New Mexico State University.

What research is needed?

Despite many advances in recent years, the understanding of success and failure in biological control efforts falls short of meeting certain current and future requirements. Ideally, scientists need to better predict the appropriate species or biotype(s) to release for control of a target pest in a given situation as well as potential environmental impacts resulting from the use of exotic species for biological control. Furthermore, conservation biological control requires detailed ecological understanding of the production system so that growers can be given very specific and practical advice on how to conserve existing beneficial species in that system.

Want to know more?

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Compiled and designed by Sara Delheimer