Controlling invasive weeds

Invasive weeds are attributed to billions of dollars of annual crop loss in North America, and pose serious threats to the natural habitats they invade. Typical methods to manage weeds include mechanical, chemical, and biological (e.g., introducing "natural enemies" of the weeds, so the weeds die of "natural" causes) control. Each of these methods has strengths and weaknesses, so developing novel techniques to control invasive weeds may greatly benefit our ecosystems and economy. Now a UBC research group has proposed a new idea for weed management that uses naturally-occurring mutations in the weeds. The idea involves using what are referred to as "CMS" (male-sterility) mutations, which are commonly found naturally in plants. CMS mutations can reduce or eliminate pollen production (pollen is analogous to sperm production in animals) and are inherited from a plant to their seeds only through ovules (which are analogous to eggs in animals). Most plants are hermaphrodites, and plants that have a CMS mutation will try to avoid the negative effects of self-fertilization by making seeds instead of pollen, leading to an increase in seed production that can allow CMS mutants to spread rapidly in a population. However, we don't typically see plants without pollen production in nature because other mutations that cancel the effect of the CMS mutation become common after the CMS mutation initially spreads. Hodgins et al. (2009) suggest finding naturally occurring CMS mutations in the invasive species, or introducing CMS mutations from another species into individuals of the invasive weed using genetic techniques may provide a means of bio-control for invasive weeds. Then, these CMS-harboring weeds would be introduced into weed populations in the wild. It is expected that the CMS mutation will spread in the weed population because individuals with CMS produce more seeds as long as they receive enough pollen from non-CMS bearing plants to produce these seeds. If CMS becomes common enough and plants that produce pollen are sufficiently rare, the pollen supply may become so low that seed production may cease and the invasive weed may go extinct. Hodgins et al. (2009) developed a mathematical model to test this prediction and assess whether these sterile plant techniques represent a viable means of bio-control. Overall, their analysis suggests that CMS may provide a novel means of managing some weedy plants, but only for species with particular characteristics. For instance in species that need little pollen to produce many seeds, or those that reproduce mainly through outbreeding (as opposed to cloning or self-fertilization), such as the problematic invasive weeds common ragweed and spotted knapweed.

To Learn more:

Hodgins, KA., Rieseberg, L., and S.P. Otto. 2009. Genetic control of invasive plant species using selfish genetic elements. Evolutionary Applications 2: 555-569

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Photo : Canada thistle, one of our oldest invasive species. 2007 CARP. Credit: Marika Godwin