



Weed Warrior

CSU Scientist Investigates Biological Controls of Knapweeds

*D*iffuse knapweed (*Centaurea diffusa*) and spotted knapweed (*Centaurea maculosa*) are exotic species that readily displace native vegetation, and now Ruth Hufbauer, assistant professor in the Department of Bioagricultural Sciences and Pest Management at Colorado State University, and her colleague Shanna

Carney, assistant professor in the Department of Biology, are finding evidence that suggests these plants may be hybridizing.

Diffuse and spotted knapweed compete with other plants for sunlight, water, and nutrients and release chemicals from their roots that may act as herbicides on other plants (referred to as allelopathy). In addition, animals grazing aren't very interested in knapweed, which is a poor forage plant, but pollinators may be more attracted to knapweed than other flowering plants. Knapweed forces land managers to remove land from cattle production and institute expensive and indiscriminate herbicide spraying programs.

There are more than 80,000 acres of diffuse knapweed in Colorado and 3.5 million acres across the west. Spotted knapweed is less common in Colorado, with only 2,500 acres, but it may just be a matter of time until spotted knapweed gains more of a foothold in the state, as there are more than seven million acres of spotted knapweed across western North America. Knapweed has become so prevalent in certain areas that some residents can easily identify the plants. Diffuse knapweed has white flowers and spiny bracts. Spotted knapweed has purple flowers and spotted or black-tipped bracts. "But more and more, people have reported plants that sound like a hybrid of the two: plants with

pink flowers, spots, and spines," Hufbauer says. These reports inspired Hufbauer to call in Carney, an expert on plant hybridization, to help investigate the source of the intermediate plants. With special funding provided to the Agricultural Experiment Station by the Colorado legislature for the express purpose of researching invasive plants, Hufbauer and Carney are investigating whether spotted and diffuse knapweed are hybridizing, and the researchers are trying to find the exact origin of the plants for the purpose of identifying possible biological controls.

Using DNA markers, the researchers are examining the levels of genetic variation in North American populations of spotted and diffuse knapweed. Hufbauer and Carney have discovered that many diffuse and spotted knapweed plants share the same chloroplast DNA sequence. "There may not be a lot of barriers between the spotted and diffuse knapweed hybridizing," Hufbauer explains.

Field and lab research supports Hufbauer and Carney's genetic research. Graduate student Robin Marrs recently found what seems to be a natural hybrid swarm. The population contained spotted knapweed, diffuse knapweed, and intermediate phenotypes spanning the spectrum between them that match descriptions of hybrids. The implications of this hybridization could be positive and negative. Hufbauer points to Jorge Vivanco's catechin research. Catechin is the "natural herbicide" released by the roots of spotted knapweed that inhibits the germination and growth of other plants. Diffuse knapweed secretes a distinct chemical, 8-hydroxyquinolone, which has similar effects. Catechin is toxic to diffuse knapweed, and 8-hydroxyquinolone is toxic to spotted knapweed. Hufbauer and her team were

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concerned that the hybrid plants could be “superinvaders” that produce and detoxify both chemicals. However, when Marrs characterized the chemical exudates of the plants from her hybrid swarm, she found that the intermediate plants produced very little of either chemical. This could make the hybrids less competitive than the parent plants. “However, hybrids might be either more or less susceptible to specialized herbivores than the parent plants,” Hufbauer says.

Now, Hufbauer hopes to identify a more exact origin for the weeds.

Although it has been assumed that knapweed came over from Eurasia in the 19th century, probably in ship’s ballast or straw, the exact origin of Colorado knapweeds are still unknown. European *Centaurea* samples are being sent to Hufbauer by René Sforza, a USDA employee working overseas. “It is particularly important



to find where the weeds originated so that proper biological controls can be found and investigated. Insects or pathogens that might feed on the plant and arrest its growth in its native land might work to control

the *Centaurea* populations in Colorado better than the current biological control options,” Hufbauer says. “However, these controls need to be thoroughly investigated before they are applied. Once a biological control is put out in an environment, it can’t be taken back. However, it can introduce a host of other problems.”

It is this painstaking process of making

sure that a decision is right not just for the next three years but for the next 50 years or more that attracted Hufbauer to studying biological control. Hufbauer is optimistic that carefully investigated biological control can be an important tool in weed management.

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More About Diffuse and Spotted Knapweeds

Diffuse knapweed is a biennial. In the plant’s first year of growth, it only produces a rosette of foliage, but in its second year of growth, it produces a seed stalk. Diffuse knapweed spreads its seed by falling over when mature and tumbling in the wind across the land.

Although spotted knapweed infestations are not as severe in Colorado as diffuse knapweed, spotted knapweed has the potential of spreading over large areas in a short period of time. Each plant produces up to 25,000 seeds that are dispersed by wind, animals, and people, and seeds may remain viable for eight years. Spotted knapweed tolerates dry conditions, similar to diffuse knapweed, but will survive in higher moisture areas as well.

Knapweeds are poisonous to horses, causing chewing disease for which there is no cure.