

*Critic's Choice Essay***ALLELOPATHY**Reprinted from *Gaillardia*, Summer 2004

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An ONPS member sent an interesting article from the *New York Post* dealing with allelopathy. (I've received several copies since.) This Botany Bay is dedicated to that person, still active Charter Member Marcy Robinowitz. Marcy, thank you for thinking of me.

The *Post* article dealt with spotted knapweed (*Centaurea maculosa*), an invasive exotic introduced from Caucasia. The author reports, "...it is thought to have been introduced in North America as a contaminant in crop seed or in dirt used as ship's ballast and then dumped." The species is a recognized problem over much of the contiguous United States. Many western Colorado highways are virtually lined with pure stands.

In 1920, but one county in western Montana reported the presence of this species. In 1940, five western counties and by 1982, it was reported in all counties, having spread across the entire state. I recall the concerted effort my son and I made to eradicate the plant from a small abandoned horse pasture in the western part of the state. The following year, scattered patches appeared on the site, but a few years later, spotted knapweed was once again abundant.

Although spotted knapweed has not been reported in Oklahoma, it is a widely scattered pest of the Great Plains. We must be alert for

it in the state; it seems to have the ecological potential to invade our western grasslands.

However, there is another noxious, caucasian weed of that genus which should concern us. Russian knapweed (*Centaurea repens*) is reported over much of Oklahoma. This species was introduced to North America in 1898 and has become established as a pernicious weed throughout the country.

Close your eyes for a moment and consider the following question: 'Why do so many exotic species successfully overwhelm native species?' Many readers probably suggested success is due to leaving predators and pathogens behind by moving. It is possible an earlier aggressive herbivore kept the population under control or a pathogen or perhaps in the new habitat the species is able to out-compete others for light, water, minerals or soil nutrients. Recent research reported in the *New York Post* article suggests another factor. Researchers now attribute success in numerous cases to allelopathy.

For many the term allelopathy is new. An excellent definition is the one given by the University of Oklahoma's late Dr. Elroy Rice in his book *Allelopathy*. He defined it as "...any direct or indirect harmful effect by one plant (including microorganisms) on another through the production of chemical compounds that escape into the environment."

Consider that definition for a moment. It opens a whole new can of worms in our world of botany. Notice it does not involve the over utilization of an essential environmental factor such as water, sunlight, or nutrients. That would be competition. Dr. Rice suggests the term interference might be used to encompass both allelopathy and competition.

To many, the foregoing may appear complex, but then most are already familiar with a classic case of allelopathy, one reported in botanical literature in the 19th Century. No doubt, vegetable gardeners were aware of it much earlier. The example is that garden crops will not survive under or near a black walnut (*Juglans nigra*) tree. Early workers suggested the trees were able to exhaust the soil of vital nutrients. It was subsequently discovered the trees were producing a chemical compound which, when released into the soil, is toxic to other green plants, even black walnut seedlings. Biochemists have since identified that compound and named it juglone, a takeoff on the black walnut genus *Juglans*. If you are a skeptic, plant some seedlings under a black walnut and observe them. The survival value of the allelopathic phenomenon is evident. Eliminate competition! Even parent walnut trees do not compete with nearby offspring. It has been known for years that walnut trees will injure and sometimes kill adjacent apple trees.

The *Post* article reports spotted knapweed's ability to overwhelm native species and establish itself in pure stands as allelopathic. Workers found the knapweed in question synthesizes a poison which, when released through the roots, will eliminate competing neighbors. Researchers at Colorado State University report the toxin acts so quickly it will initiate a sequence of chemical reactions resulting in the death of root cells within ten seconds of contact. They also reported, "In one hour the roots die" and "The whole plant dies in a matter of days."

Currently there are no known native species resistant to the toxins secreted by spotted knapweed.

On the other hand, allelopathic toxins need not be lethal. Rice reported that in some cases they serve to inhibit populations of nitrogen fixing microorganisms in the soil, resulting in the lowering of available nitrogen below that required by native species. An invasive species may hold competing species at bay by simply maintaining a less favorable environment.

Rice also reported that in the early 1900s apple trees were observed to be injured by surrounding grass. Initially it was thought the harm was due to competition for minerals or utilization of soil oxygen by grass, thus suffocating tree roots. Laboratory tests were carried out in which apple trees were provided abundant oxygen but subjected to chemicals secreted by the grass. The results supported the hypothesis that allelopathy is responsible.

Experiments have also shown a number of crop plants, including cultivated wheat, exude an inhibitory substance that functions on seedlings of the same species. That presents another aspect to the question of mineral exhaustion and crop rotation. Perhaps it is not mineral depletion but an accumulation of toxic compounds secreted by the plants.

The *Post* report brings to mind a short article that appeared in the *Readers Digest* many years ago. If I recall correctly, the title was simply "War in the Garden," and it introduced the concept of allelopathy to the lay person. Keep your eyes open for allelopathy in your yard; I suspect it is there. It is a vicious world in nature.

