Prairie dogs: influencing the accumulation of metals in plants?

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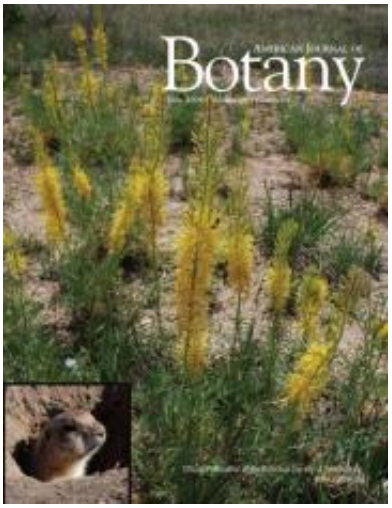

Stanleya pinnata (prince's plume) can hyperaccumulate the toxic element selenium (Se) up to 0.5 percent of its dry mass in its natural habitat in the western United States. In a two-year manipulative field experiment to test whether *S. pinnata* uses Se as an elemental defense against one of its native mammalian herbivores, the blacktailed prairie dog (*Cynomys ludovicianus*), plants with high Se concentrations had higher survival rates and less herbivory than low-Se counterparts when planted in black-tailed prairie dog towns. These results give better insight into the evolution of plant Se hyperaccumulation, suggesting a role for herbivory as a possible selection pressure. From an applied perspective, plants that accumulate Se may be cultivated for phytoremediation or as fortified foods, and this study helps assess the associated risk of Se moving up the food chain. Credit: Colin Quinn, Colorado State University, Fort Collins, Colorado

Prairie dogs may seem like harmless little creatures, but they can inflict serious injury on plants simply by snacking on them. Plants cannot flee from their furry predators, so how do they avoid becoming a prairie dog's lunch?

Dr. John Freeman and colleagues explore the role of metal hyperaccumulation in plant defense in the June 2009 issue of the *American Journal of Botany*. Certain plants species growing on soils with high metal content (such as arsenic, copper, selenium, and lead) accumulate large quantities of metals in their leaves and stems. The purpose of this metal hyperaccumulation is not fully known, but metal hyperaccumulation may increase a plant's ability to respond to drought, compete with other plants, or provide a defense against bacteria, viruses, and animals.

"It is interesting to think about the effect of the prairie dog, which was an amazing ecosystem engineer on a very large scale here in North America," said Dr. Freeman, Colorado State University. "From their prehistoric ancestors the ground squirrel to the modern prairie dog, these animals may have driven the evolution of selenium hyperaccumulation as an elemental defense against herbivory in many different plant species."

Dr. Freeman's research focused on the role of selenium hyperaccumulation in *Stanleya pinnata* (prince's plume), a wildflower related to mustard plants. Although low levels of selenium are essential for many animals, consumption of high levels is toxic. But just because an overdose of selenium is toxic to animals does not mean that the presence of high levels in leaves deters animals from eating the plants; prairie dogs may not know to avoid *S. pinnata* until it is too late. Few studies have addressed this question and whether metal hyperaccumulation actually acts as a deterrent.

After growing two varieties of *S. pinnata* that are known to accumulate varying levels of selenium in soils pre-treated with low or high levels of selenium, Dr. Freeman and colleagues planted the varieties in two prairie dog towns, then assessed levels of herbivory for two years. Populations of *S. pinnata* that had sequestered high levels of selenium in their leaves were not as popular with prairie dogs as those with low levels of the metal; the high levels of selenium in the leaves actually influenced the prairie dogs' appetite.

On the basis of their results, the researchers hypothesized that prairie dogs or other similar small mammals have influenced the evolution of plant selenium hyperaccumulation. Prairie dogs have historically had a large impact on surrounding plant communities. Therefore, selenium hyperaccumulators may have had a selective advantage over other plants in areas with large prairie dog populations.

"Plants have evolved to use materials in their immediate environment to help them survive," Freeman said. "In this case, selenium was readily available and apparently made a good bio-warfare agent against herbivores."

Source: American Journal of Botany