Allelopathy Misconceptions

Dear Editor:

The *How-To-Do-It* by Marcus and Burz (*ABT*, March 1994) contradicted itself in Figure 2. The photo shows numerous lettuce seedlings, yet the caption and text insist that the lettuce failed to germinate! The photos indicate that lettuce seedlings are smaller when grown with radish seedlings than when grown alone. This growth inhibition could be due to allelopathy, but it could also be due to plant competition for water, mineral nutrients, carbon dioxide, or root zone oxygen. It might also be caused by microbes on the radish seeds, or by root zone pH changes caused by radish roots (Hershey 1992). You simply cannot tell which factor(s) is the cause.

Marcus and Burz (1994) present a distorted picture of allelopathy by misrepresenting their own literature citations. Choesin and Boerner (1991) concluded that, "Under our experimental conditions, *B. napus* showed no indication of being allelopathic. . ." Lawrence et al. (1991) warned that, "Although most would agree that some plant species produce noxious compounds detrimental to the growth of other species, it remains to be demonstrated that such compounds are directly responsible for detectable changes in the species composition of plant communities or the genetic composition of associated plant populations."

Like most topics in plant biology teaching, allelopathy has a history of misconceptions. A photo by Muller (1966) purporting to show allelopathy caused by a native shrub appeared in botany textbooks (Cronquist 1971; Salisbury & Ross 1985). A grass-free zone occurred around the shrubs, supposedly caused by allelopathy. Bartholomew (1970) found that fencing the shrubs caused the grass-free zone to disappear. The grass-free zone was caused by rodents that hid in the shrubs and fed on the surrounding grasses. Fencing the shrubs excluded the rodents and allowed the grasses to grow. Raven et al. (1992) has photos of fenced and unfenced shrubs.

Seemingly simple "demonstrations" of allelopathy can very easily lead to incorrect conclusions either due to an unrealistically high dose or a lack of soil. Hibbs and Shumaker (1987) ground up *Kalanchoe daigremontiana* and sprayed the filtrate on other *K. daigremontiana* plants. This was an unrealistically high dose. In nature, plants do not grind themselves up and spray themselves on other plants! *K. daigremontiana* is a drought-tolerant succulent, so a realistic test would be to simply wash the intact leaves with a modest amount of water to see if any allelopathic chemicals naturally wash out of the plant. Hibbs and Shumaker's (1987) experiment was also unrealistic because plants were grown in perlite, an inert potting medium. In nature, allelopathic chemicals are often inactivated by binding to soil particles or degraded by soil microbes (Taiz & Zeiger 1991).

There is no doubt that substances from plants can inhibit the growth of other plants in lab experiments. However, there is little solid evidence that allelopathy is an important factor in natural competition between plant species (Taiz & Zeiger 1991). In allelopathic experiments it is often difficult to rule our effects of plant competition for water, mineral nutrients, light, and soil oxygen. A further complication is that adding undecomposed plant materials to soil can stunt plant growth due to immobilization of nitrogen by the soil microbes that degrade the plant material.

Any teaching of allelopathy should make students aware of the experimental difficulties and misconceptions. Allelopathy is an excellent case study of two common pitfalls in science:

1. The danger of inferring a cause-and-effect relationship from a correlation between two factors
2. The danger of extrapolating from artificial lab experiments to a natural ecosystem.

David R. Hershey
Biology/Horticulture Department
Prince George's Community College
301 Largo Road
Largo, MD 20772-2199

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