USING CHEMICAL ECOLOGY TO CONTROL PESTS & PROTECT POLLINATORS

Most agricultural systems in the Northeast rely on pesticides to ensure high yields and profits, but pesticides can pose risks to essential pollinators and environmental health. To reduce reliance on pesticides, scientists are exploring ways to harness natural plant defenses, such as emitting chemicals that slow insect feeding, inhibit infections, call beneficial insects to their aid, or warn other plants.

Researchers from 17+ land-grant universities are collaborating to better understand these chemically-mediated interactions, find ways to enhance natural plant defenses, and improve the economic and environmental sustainability of crop production.

The multistate approach has many benefits:

- Working on a multistate team helps researchers address overlapping pest issues in the region.
- Diverse expertise allows the team to tackle a variety of crops and pests.
- Ties between Cornell University and Pennsylvania State University have fostered funding for a facility to allow scientists from multiple states easy access to equipment and technical expertise needed for chemical ecology research. This enables efficient, reliable research.
- Collaborations with Extension and the Northeast IPM Center facilitate adoption of chemical ecology tools for sustainable pest control.

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RESEARCH HIGHLIGHTS

Researchers studied chemical cues that mediate interactions among plants, pests, and predators. For example, scientists:

- Found that different volatile organic compounds are emitted in response to abiotic stresses versus biotic stresses (Cornell University)
- Determined how biochemical changes in cranberries with false blossom disease influence pest behavior (Rutgers University)
- Showed how apple fruit chemistry changes in response to insect feeding (Virginia Tech)
- Showed that Asian longhorned beetle adults partition resources in response to high phenolic glycoside levels in poplar bark (Pennsylvania State University)
- Demonstrated that the chemicals emitted by corn plants when they are damaged by fall armyworm caterpillars can attract birds that feed on the caterpillars (University of Delaware)
- Identified the sagebrush cues that trigger resistance against chewing herbivores (University of California-Davis), compounds that affect beetle preference for squash (Cornell University), compounds in wild berries that attract fruit flies (Rutgers University), and rice compounds that attract stink bugs (Louisiana State University)

Scientists identified factors that influence chemically-mediated interactions among plants, pests, and predators. For example, they:

- Found that plant cue effectiveness is affected by the geographic proximity of the source of the cue (University of California-Davis)
- Studied how temperature and humidity influence chemical information transfer by plants (Cornell University)
- Found that landscape complexity and insecticide resistance affect Colorado potato beetle response to predators (Cornell University)
- Determined how domestication of lettuce, squash, sweet potato, blueberry, and apple impacted their chemical defenses and resistance to insect pests (Cornell University, North Carolina State University, University of California-Davis, Rutgers University, Virginia Tech)
- Showed that soil management practices like cover crops and organic amendments can affect plant defenses against insects by changing the soil's bacterial and fungal composition (University of California-Davis, Pennsylvania State University) and found that cucumber plants in soils with minimal silicon were not able to induce resistance in response to herbivore attacks (Cornell University)
- Showed that stink bugs may be more attracted to previously injured rice (Louisiana State University)

Researchers used chemical ecology to develop new pest control methods. For example, scientists:

- Developed traps that use visual and chemical stimuli to attract fruit flies and contain a toxin to kill the pests, keeping them from infesting blueberries (Rutgers University)
- Showed that methyl jasmonate seed treatments reduced populations of rice water weevil almost as effectively as insecticide applications (Louisiana State University)
- Explored using beneficial nematodes to prime chemical responses that make plants resistant to pests (Pennsylvania State University)

Researchers used chemical ecology to protect pollinators from pesticides and disease. For example, scientists:

- Determined whether common co-occurring exposures to pesticides result in synergistic toxicity in bees (Cornell University)
- Identified floral chemistry traits and microbial communities that affect the patterns or preferences of hummingbirds, honey bees, and carpenter bees (University of California-Davis)
- Discovered that exposure to pollen from sunflowers and a wide range of sunflower relatives helps reduce pathogen infection in bumble bees (University of Massachusetts)