Global warming and insect pheromones

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Concentrations of carbon dioxide (CO_2) and ozone (O_3), two greenhouse gases associated with global climate change, have increased by more than 30% each since the mid 1800s. Gases can affect the nutrient content of plants and thus the damage inflicted by plant-feeding insects. For example, caterpillars may eat larger portions of plants grown in enriched CO_2 environments due to nutrient dilution in the plant tissues. Such plant-mediated "bottom-up" impacts of climate change on insect herbivores are better understood than are "top-down" effects, such as how greenhouse gases mediate interactions between insects and their enemies.

Now, Ed Mondor and his fellow entomologists at the University of Wisconsin (Madison, WI) are studying how these gases may influence top-down interactions and the corresponding health of agricultural and forest plants. "Pheromones regulate insect behaviors as diverse as alarm signaling and sexual communication", explains Mondor. "We need to know if increased levels of greenhouse gases alter pheromone communication, and how the production or reception of pheromones may change as climate change progresses."

Courtesy of M Tremblay

A colony of the sap-sucking aphid Chaitophorus stevensis *feeding on an aspen leaf.*

The team's research, conducted at the Aspen Free-Air CO_2 Enrichment (FACE) site in northern Wisconsin, investigated how elevated levels of CO_2 and O_3 modified pheromone-mediated alarm dispersal, a defensive behavior, in the aspen-feeding aphid, *Chaitophorus stevensis*. "Aphids frequently emit alarm pheromone only when attacked, therefore the signal is a reliable indicator of a predator", says Mondor. "Dispersal responses to this pheromone differ depending on atmospheric composition. When CO_2 was elevated, aphids did not disperse as readily. However, if O_3 was elevated, aphids exhibited an extreme dispersal response." The researchers think this exaggerated escape behavior may explain the larger aphid populations observed under enriched O_3 conditions.

In addition to the environmental disruption altered insect behaviors and demographics could cause, Mondor noted that the team's research may indicate a need to "take a second look at how pheromones are used for pest management".

"Pheromones are fundamental to insect survival", explains Mondor. "Understanding how pheromones and greenhouse gases interact will be vital for predicting how insect populations and the plants eat will fare in an environment radically altered by global climate change." ■