Shedding light on pollen movement

Black light is used to analyze crime scenes, detect leaks in machinery, and identify counterfeit money and art forgeries. For researchers at Michigan State University (MSU), it's also a handy tool to study gene flow in restored prairies.

A key component of gene flow is the distance in which pollen moves, says Jenna Walters, an MSU undergraduate student. "If pollen only travels short distances or in small populations of plants, then in-breeding can happen," she explains. "The resulting seeds aren't as viable when they're dispersed and may not germinate or grow well. For healthy, flourishing prairies to continue, gene flow needs to take place at longer distances."

Yet not much is known about the scale at which insect pollination happens in prairie flowers, particularly in landscapes with scattered fragments of prairies. To help fill this knowledge gap, Walters conducted a series of experiments at Big Rock Valley (BRV), the Edward Lowe Foundation's 2,000-acre headquarters property in southwest Michigan.

Jenna Walters and Samantha Stefaniak apply fluorescent powder to gray-headed cornflowers in a prairie strip at Big Rock Valley.

Ideal test site

The foundation has established more than 175 acres of prairie at BRV, including four long strips (approximately 80 feet wide and averaging 2,650 feet long) in the interior of a wheat field to enhance soil. These strips were ideal for Walters' project, because they enabled her to see how far insects might transport pollen within a single unit — and if they traveled across the wheat field to a prairie unit located 440 feet away.

Walters and MSU field technician Samantha Stefaniak applied fluorescent powder to different species of prairie forbs during their peak blooming periods. Later at night, about 10 hours after they had applied the powder, the researchers returned to the site. Using black lights, they searched for glowing powder outside their marked source area, noting both the number of incidences and distances insects transported pollen.

Other researchers have studied pollen's impact on genetic diversity by sampling plant DNA, analyzing the plant's parents and then inferring pollen movement. "That's a robust technique, but it's intensive and expensive," says Lars Brudvig, associate professor of plant biology at MSU and Walters' adviser. "Jenna's approach is to survey the pollen movement itself, which is much quicker and easier — and less expensive."

Suprising results

In separate trials Walters looked at pollen movement in three different species. For sand coreopsis (Coreopsis lanceolata) and gray-headed coneflower (Ratibida pinnata), she found considerable movement within the prairie strip, but none across habitats. Yet pollen from false sunflower (Heliopsis helianthoides) did show up in the prairie strip located across the wheat field west of the test zone. The three species also demonstrated varying frequencies of movement with 40 incidences for the sand coreopsis, 50 for the false sunflower, and a whopping 276 for the gray-headed coneflower.

"In summary, the patterns of pollen dispersal aren't as simple as we originally thought — and there seems to be variations in terms of species of flowers," Walter says. "It's good to keep in mind to analyze and prioritize what seeds are being sown into a prairie field and how they interact with each other."

"A prairie starts with all the genetic diversity it's ever going to have, unless it can exchange with another prairie unit," says Brudvig. "As we learn more about natural pollen movement we can help land managers maintain genetic diversity by knowing what distance they should plant fields to ensure sufficient gene flow or when to add seeds periodically to bolster genetic diversity."