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News tips from a special issue of the International Journal of Plant Sciences

November 10, 2010

The November/December issue of the *International Journal of Plant Sciences* explores the current state of our knowledge of natural selection in plants.

"Plants were crucially important to Darwin's development of the theory of natural selection (six of his books were on plants)," writes Jeffrey Conner, a biologist at Michigan State University and guest editor of the issue. "Plants are still crucially important to the study of natural selection in the field."

The issue features reviews and original research articles that explore multiple aspects of this complex topic. A complete table of contents for the issue is available at http://www.journals.uchicago.edu/toc/ijps/current.

The Evolution of Self-Fertilization

The ability of some plants to self-fertilize has its advantages, especially in areas where there aren't many pollinating insects. But research by Susan Mazer from U.C. Santa Barbara and colleagues suggests that self-fertilization may not always be an evolutionary advantage in and of itself. Rather, it sometimes may evolve because it is linked to physiological traits that help plants deal with seasonal drought.

The researchers studied four closely related species of *Clarkia*, which belong to the Evening Primrose family. Two of the species are predominantly self-fertilizing (selfers); the other two are predominantly outcrossing, meaning they fertilize via pollen transfer from plant to plant. The research has found that the selfers have physiological traits (faster photosynthetic rates per area of leaf, for example) that appear to promote a more rapid life cycle. As a result, selfers produce flowers and begin the reproductive process weeks before their outcrossing counterparts, and before the onset of the late spring drought in the plants' native habitat.

In addition to avoiding the periods of most intense drought, the faster life cycle is associated with more rapid floral development and the production of smaller flowers. In those smaller flowers, the male and female sex parts are closer together, increasing the chance that pollen will be transferred to the flower's own stigma — self-fertilization. These results suggest that in the case of *Clarkia*, self-fertilization may have evolved partly as a "side-effect" of natural selection for a drought-avoiding life cycle.

Susan Mazer, Leah Dudley, Alisa Hove, Simon K. Emms, and Amy Verhoeven, "Physiological performance within and between Clarkia sister taxa with contrasting mating systems: do selfers avoid water-stress by flowering early?"

How Pollinators Sculpt Flowers

For the past 10 years, José María Gómez and Francisco Perfectti of the University of Granada have used complex geometric analysis to study how insect pollinators influence the evolution of flower shape.

Through a series of experiments, the researchers found that different pollinators have preferences for distinct variations in flower shape in *E. mediohispanicum*, a wild herb common in mountainous regions of Spain. For example, large bees preferred flowers with narrow petals; small bees had a preference for wider flowers; bee flies had a preference for rounded flowers. In the wild, flower shapes in different populations of *E. mediohispanicum* were found to differ significantly according to which type of pollinators were more common in the area. The result is a “geographic mosaic of selection on different [flower] shapes,” the researchers write.

Why would insects prefer specific flower shapes? Gómez and Perfectti’s research indicates that, in *E. mediohispanicum*, flower shape is an honest signal of a pollinator’s reward. Flowers with shapes preferred by pollinators tend to have higher output of nectar and pollen. The research provides valuable insight into the evolution of a complex trait in flowering plants — a topic Darwin once described as an “abominable mystery.”

José María Gómez and Francisco Perfectti, “Evolution of complex traits: the case of *Erysimum corolla* shape.”

Natural Selection on Not-so-natural Plants

Research by Andrew Stephenson and his colleagues at Penn State shows that while a genetically modified squash plant may be resistant to common virus transmitted by aphids, it’s no match for bacteria transmitted by beetles.

Stephenson’s ongoing research program examines what happens when modified genes, known as transgenes, escape into fields of wild squash. Stephenson is investigating a particular transgene that gives squash plants extra resistance to a virus that commonly infects both wild and cultivated squash. Scientists have long worried that if transgenes like this one escape into the wild, plants with the gene may grow unchecked and wreak havoc on ecosystems.

Stephenson’s field experiments, which have been going on for four years now, show that the transgene does help plants resist the target virus. When aphids that carry the virus arrive in experimental fields in the spring, wild plants without the transgene tend to become infected while transgenic plants stay healthy. Good health, however, makes the transgenic squash look tasty to beetles. Beetles preferentially attack transgenic squash, infecting many with devastating bacteria. The beetle attack neutralizes nearly all of the fitness advantage the transgenic squash may have enjoyed by being resistant to viral infection. So in this case, natural selection kept the genetically modified plants in check.

Miruna Sasu, Matthew Ferrari, and Andrew Stephenson, “Costs and Benefits of a Virus Resistant Transgene During Introgression into a Wild Gourd.”