Mighty Mites
Ubiquitous, Inconspicuous, Harmful, Helpful

Mites have successfully colonized nearly every known habitat on Earth. They thrive in polar and alpine extremes, tropical lowlands, and desert barrens, surface and mineral soils to depths of 32 feet, cold and hot surface springs, and subterranean waters with temperatures as high as 50˚C. They live in freshwater streams, ponds, lakes, and seawater—even at ocean depths of 15,000 feet.

Mites are among the oldest of all terrestrial animals, with fossils known from the early Devonian period—nearly 400 million years ago.

Mites are also incredibly diverse, second only to insects in the number of species known to live on Earth. Yet the 48,200 species described by scientists may make up only 10 percent of the total number of mite species that exist; the remaining 90 percent has yet to be studied.

Research on mites, as on many other arthropods, is hampered by their minute size. Most species are too small to be seen without a microscope. Some are only about as large as a good-sized bacterium. Indeed, the human follicle mite is so small it can raise an entire mite family on one human hair follicle. And honey bee tracheal mites live and breed within a bee's tiny respiratory tubes.

But some mites are easily seen. For example, red velvet mites, which can be up to 0.4 inches long—among the giants of the Acari—can be seen hunting on the ground or on tree trunks. And although water mites are rarely more than a few millimeters long, their bright colors and rapid movement often bring them to our attention. Unfortunately, these larger species are but a small fraction of the total.

In this issue of *Agricultural Research*, ARS researchers discuss new technologies that apply computerization and digital imaging to help cope with these problems of size. Through flash-freezing of specimens and use of a low-temperature scanning electron microscope, scientists have obtained images of mites caught in the act of feeding. This nondestructive technique also allows detailed examination of tiny structures such as mouthparts and hairs, or setae. These methods are shedding invaluable light for the first time on how mites sense and interact with their environment.

This knowledge is important because mites can be both destructive and beneficial. For example, many species cause serious damage to plants by feeding on them or transmitting diseases. Mites also affect people and animals by causing allergies, spreading diseases, acting as parasites on their bodies, and contaminating dried food products.

At the same time, many groups of mites are our best hope for controlling other mite pests. These tiny predators feed voraciously on other mites and control their populations naturally.

Agricultural Research Service scientists have a long and distinguished history of providing research and service on mites. Since the late 1800s, ARS' Systematic Entomology Laboratory (SEL), in Beltsville, Maryland, and its predecessors have been home to several well-known mite researchers, including E.W. Baker, renowned as one of the fathers of modern acarology.

Today, SEL researchers apply new technologies to help solve problems caused by mites. The laboratory also helps maintain and improve the National Collection of Insects and Mites in conjunction with the Smithsonian Institution in Washington, D.C. This unique and priceless collection of over 30 million specimens took nearly 120 years to assemble. It is absolutely critical to our ability to understand mite diversity and relationships, make predictions about possible new pests, and archive records of past efforts.

The mite systematists in SEL and other ARS researchers have focused on mite species that have invaded the United States from other countries. Of the more than 1,900 species of plant-feeding mites now known to exist in the United States, scientists believe that as many as 200 species have invaded this country from other parts of the world. Escaping the predators, parasites, and diseases of their native lands, these invaders run rampant in this country. Accurate identification, classification, and information on their distribution are absolutely vital to controlling these emergent pests.

Armed with new technologies, acarologists are finding a whole host of new characters that will trigger some profound changes in how we view mites and how we understand their relationships—harmful or helpful—with their plant and animal hosts. These advances herald a new age for acarology and provide easier, faster, and more efficient ways to control and use mites to benefit humans.

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