Saving, diversifying honey bees: Researchers preparing bee semen bank

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Honey bee with parasite on back.

(Phys.org) —Washington State University researchers are preparing to use liquid nitrogen to create a frozen semen bank from select U.S. and European honey bee colonies.

At the same time, the researchers will use genetic cross-breeding methods to produce more diverse, resilient honey bee subspecies that could help thwart the nation's current colony collapse crisis.

Honey bees face a lot of challenges, said Steve Sheppard, professor of entomology at WSU. Invasive mites can sap a brood's strength and vector viruses. Pesticides can build up in the brood comb and gradually weaken the bees. And while the agricultural practice of monoculture provides a lot of food, it offers little of the nutritional variety that bees need.

Some of these threats may weaken or kill a hive on their own, but a combination of factors is thought to be the cause of colony collapse disorder, in which the worker bees abruptly disappear, and the entire local population is doomed.

Honey bee ban in 1922

Concerns over honey bee safety in the United States are not new. In 1922, shortly after tracheal mites were identified as the likely cause of bee kills on England's Isle of Wight, the United States restricted the importation of live honey bees.

"The ban was fairly effective," said Susan Cobey, a WSU research associate working with Sheppard. "It prevented tracheal mites from reaching our shores until 1984."

Varroa mite threat

Just a few years later a more serious threat, the Varroa mite, with the suitably ominous scientific name Varroa destructor, entered the United States. "The Varroa mite feeds on the developing bees, or brood, and also introduces bacteria and viruses that damage the health of the hive," Cobey said.

"Varroa mites will normally kill a colony within two years without intervention by a beekeeper," Sheppard explained. Intervention often comes in the form of chemical miticides, which are tolerated by bees in the short term, but cause harm over the long term as chemical residues accumulate in hives.

Creating smarter, stronger bees

Plant and animal breeders often seek to overcome challenges by finding resistant specimens to selectively breed, incorporating the resistance into the overall population. However, U.S. entomologists must also contend with a limited honey bee gene pool because of the import ban.

28 subspecies of honey bees

"Honey bees, Apis mellifera, have 28 recognized subspecies—in Europe, Africa, and Asia, the general vicinity of where honey bees are thought to have originated," said Sheppard. Evaluation of this extensive genetic diversity (such as for genes that may help honey bees adapt to differences in the New World) by U.S. bee breeders was effectively halted by this country's import restrictions.

Importing bees from Italy, Georgia, Alps

In an effort to find and utilize the needed genes, the USDA granted WSU a permit in 2008 to import honey bee semen for breeding purposes, subject to strict screening for viruses. To meet the various goals of beekeepers in different climate zones across the United States, Sheppard and his colleagues identified three subspecies for import.

Commercial beekeepers in southern states often want bees that reproduce quickly to provide maximum pollination of early-blooming crops like almonds. WSU plant breeders have been collecting semen from Italian honey bees for this trait. Beekeepers in colder climates want bees that are more reluctant to reproduce at the first warm spell in spring, as a cold snap could kill the vulnerable brood.

To find appropriate genetic stock, Sheppard and colleagues have been collecting semen from Carniolan bees of the eastern Alps and Caucasian bees from the mountains of Georgia (formerly part of the Soviet Union).

The semen is imported by special permit and tested for viruses. Queen bees inseminated with approved semen can then be released to queen bee producers.

Collecting and storing genetic material

The semen itself is fairly easy to collect, said Cobey. In general terms, if you apply a tiny amount of pressure to a mature drone's abdomen, it will push out the semen, which can be collected in a syringe equipped with a capillary tube.

Live semen will survive at room temperature for about 10-14 days, allowing Cobey to collect it and transport it back to her laboratory, where it can be frozen or injected into a selected queen bee's oviduct, to fertilize it.

The semen will be collected from the strongest and best stock in Europe, then injected into the strongest and best queen bee stock from the United States, thereby helping to strengthen and diversify U.S. bee colonies.

The question of how to store honey bee genetic material for years, as is already the practice with other animals of agricultural importance, has been solved with the help of Sheppard's graduate student Brandon Hopkins. Hopkins discovered that liquid nitrogen maintains the semen viability for decades, helping preserve imperiled subspecies in a honey bee genetic repository.

Provided by Washington State University

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