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Bees Learning Smell of Bombs With Backing From Pentagon

By ANDREW C. REVKIN

Scientists working for the Pentagon have trained ordinary honeybees to ignore flowers and home in on minute traces of explosives, a preliminary step toward creating a buzzing, swarming detection system that could be used to find truck bombs, land mines and other hidden explosives.

The research, under way for three years, initially focused on using bees to help clear minefields. But the effort has broadened, the scientists say. In two tests last summer, before the terrorist attacks on Sept. 11, trained bees picked out a truck tainted with traces of explosives.

The work is in its early stages, and bees, like bomb-sniffing dogs, have limitations. They do not work at night or in storms or cold weather, and it is hard to imagine deploying a swarm to sniff luggage in an airport. But they also have extraordinary attributes, including extreme sensitivity to scant molecular trails and the ability to cover every nook around the colony as they weave about in search of food.

Pentagon officials acknowledge that the idea of bomb-sniffing bees has a public relations problem, a "giggle factor," as one official put it. But that official and scientists working on the project insist the idea shows great potential.

"It appears that bees are at least as sensitive or more sensitive to odors than dogs," said Dr. Alan S. Rudolph, program manager for the Defense Sciences Office of the Defense Advanced Research Projects Agency, which is overseeing the experimentation.

The Air Force Research Laboratory at Brooks Air Force Base, in Texas, has just completed an analysis of a round of tests of bees' bomb-sniffing ability and confirmed that they found the explosive chemical more than 99 percent of the time, project scientists said.

In coming weeks, the team plans the first field tests of a new radio transmitter, the size of a grain of salt, that could allow individual bees to be tracked as they follow diffuse trails of bomb ingredients to a source. Such a system would help if bees were used to search a wide area for hidden explosives.

But such sophisticated technology would not be necessary at, say, a truck stop, where the clustering of alerted bees would be apparent.

Scientists involved in the project said bees were also being considered for sniffing out illicit drugs, which release more volatile chemicals into the air and are easier to trace

than explosives.

For many years, biologists, notably a group at the University of Montana, have been training bees to prefer different scents, using sugar as a reward. After one bee learns the new cue, it somehow transfers that knowledge to others. Within hours, an entire hive, and sometimes adjacent hives, switch to searching for the new scent.

Scientists have found that it takes less than two hours to use sugar-water rewards to condition a hive of honeybees to eschew flowers and instead hunt for 2,4-dinitrotoluene, or DNT, a residue in TNT and other explosives, in concentrations as tiny as a few thousandths of a part per trillion.

In tests of 12 trained bee colonies last summer at the Southwest Research Institute in San Antonio, one to two bees an hour were seen flying around uncontaminated controls, while "we were getting 1,200 bees an hour on the targets," said Philip J. Rodacy, a chemist in the explosives technology group at Sandia National Laboratories in Albuquerque. Sandia, the Southwest institute and the University of Montana are among many institutions contributing to the research.

One idea is to place a hive of trained bees near important security checkpoints to guard against potential terrorists, Dr. Rudolph of the defense research agency said. But he added that much more work had to be done before that could happen.

"It's not straightforward to move from watching bees hovering around a box to watching trucks parking in a weigh station for a minute," he said. "This is not a capability until we know how predictable it is."

The work is a facet of a much broader effort overseen by Dr. Rudolph to exploit the chemical sensitivity and mobility of bees, as well as moths and other insects, so they can scour broad areas for a whiff of a chemical. Over all, the Pentagon has spent \$25 million since 1998 on researching what it calls controlled biological systems, traits of animals that might be turned into war-fighting technologies.

Scientists are also exploring whether moplike insect hairs can be used to screen the air for releases of biological or chemical weapons. Early tests have shown that bees are an efficient sampling mechanism for airborne bacterial spores, including those of a close cousin of the anthrax bacteria, said Dr. Jerry J. Bromenshenk, an entomologist at the University of Montana.

He and other researchers there have developed "smart hives" that monitor the comings and goings of the insects and, with equipment developed at the Oak Ridge National Laboratory in Tennessee, sip the air as bees return, to test for explosives.