When ants attack: Researchers recreate chemicals that trigger aggression

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Argentine ants in their native habitat engage in inter-colony warfare, keeping their numbers in check. In introduced ranges, these ants are often genetically similar, allowing them to form supercolonies. Researchers have now isolated and synthesized chemicals used by Argentine ants to distinguish friend from foe. (Photo copyright © Alex Wild)

(PhysOrg.com) -- Experiments led by researchers at the University of California, Berkeley, have demonstrated that normally friendly ants can turn against each other by exploiting the chemical cues they use to distinguish colony-mates from rivals.

The new study, to be published Wednesday, Oct. 28, in the open-access journal *BMC Biology*, sheds light on the factors influencing the social behavior of the Argentine ant, *Linepithema humile*, and provides hope for a new tactic in controlling the spread of this invasive species.

The research was conducted on the highly invasive Argentine ant, but the researchers note that the findings are likely relevant to other types of

insects that rely upon chemical signals to identify each other.

"Almost all living organisms use chemical recognition cues to some degree, but it is particularly common among ants and other insects," said evolutionary biologist Neil Tsutsui, UC Berkeley associate professor of environmental science, policy and management and the study's principal investigator. "Surprisingly, it wasn't until this work that the specific chemicals used by Argentine ants to identify each other were isolated and tested."

Native to South America, the Argentine ant has taken hold in numerous countries worldwide, including Australia, Japan and the United States. In California, the ants are pervasive, pushing out native ant species and wreaking ecological havoc along the way. The Argentine ant has been blamed for exacerbating problems with some agricultural crops in the state, and for the decline of the coast horned lizard, which feeds exclusively upon the native ant species decimated by the invader.

In their native habitat, Argentine ants use their aggression to engage in inter-colony warfare with each other as they compete for resources, a behavioral trait that biologists credit for keeping the ants' numbers in check. Colonies tend to be small, typically measuring a few meters to a couple of hundred meters wide.

Argentine ants attack a much larger harvester ant. The Argentine ants, native to South America, have displaced native species of ants in California, threatening the coastal horned lizards that rely upon the native ants for food. (Photo copyright © Alex Wild)

Biologists say that part of what makes the Argentine ants such successful invaders is that outside their home turf in South America, the fighting among them largely stops, allowing Argentine ant colonies from different regions to band together into a formidable group. Previous research conducted by Tsutsui and others provided evidence that the reason behind this relatively peaceful co-existence is the ants' genetic similarity, suggesting that they are part of the same, vast family. This lack of diversity falls in line with the theory that the invasive ants descended from a few individuals introduced to the new region.

"The striking thing about these Argentine ants in introduced ranges is that - with few exceptions - they are essentially functioning as a single, geographically huge supercolony," said Tsutsui. "If you take ants from San Diego and put them next to those from San Francisco, they'll act like they've known each other all their lives. They are part of a massive supercolony that extends hundreds of miles, nearly the entire length of California."

The UC Berkeley researchers worked with study co-authors Robert Sulc and Kenneth Shea from UC Irvine to narrow down and synthesize seven chemical molecules that trigger aggressive behavior among the Argentine ants. They also used two "control" chemicals not linked to fighting behavior. The "enemy" compounds were similar in that they were all long chains of hydrocarbons with one to three methyl groups attached.

Researchers then coated individual worker ants from the same colony with the purified substance. The researchers matched each of the chemically disguised ants with 10 untreated ants, one by one for five minutes each, in a petri dish.

"The 'enemy' chemicals generated significantly greater instances of flared mandibles, biting and other attacking behavior than did the control chemicals," said study co-lead author Ellen van Wilgenburg, a post-doctoral researcher in Tsutsui's lab at UC Berkeley. "We also saw higher levels of aggression when we increased the concentration of the chemicals and when we combined some of the chemicals together."

Despite this finding, Tsutsui cautions that significant barriers must be overcome before a pest-control substance based upon these chemicals is ready for the market. "We are still in the process of understanding how these chemicals control social behaviors in ants," he said. "These are custom chemicals that are very costly to synthesize at this stage. We are still a long way off from having large enough quantities to deploy in the field, or even knowing if these chemicals can control populations in the field."

Source: University of California - Berkeley (news : web)

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