Fruit flies help scientists sniff out new insect repellents

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By following the "nose" of fruit flies, Yale scientists are on the trail of new insect repellents that may reduce the spread of infectious disease and damage to agricultural crops. That's because they've learned for the first time how a group of genes used to differentiate smells is turned on and off, opening new possibilities for insect control. Just as in new drug development, researchers can target these or similar genes in other insects to create substances that make crops and people "invisible" to insect antennae.

Without the ability to smell correctly, the insects are far less likely to attack a person or plant, as is the case with mosquitoes whose ability to smell lactic acid is disrupted by the active ingredient in insect repellents, DEET. This finding is reported in the September 2010 issue of the journal *Genetics*.

According to Carson Miller, a researcher involved in the work from the Department of Molecular, Cellular and Developmental Biology at Yale University, "One of the fundamental questions in biology is, 'how does a cell choose which genes it should turn on and which genes it should turn off?' By studying this question in odor-sensitive neurons of fruit flies, we hope to learn how cells make these choices, as well as to develop more effective odor-based insect repellents."

The scientists studied four genes from a group of odor receptor genes in the fruit fly. These genes afford flies the ability to detect different scents. Pieces of DNA in front of these genes contained enough

information to tell the fly to turn on these genes in specific cells of the antenna. Miller made an artificial reporter gene that used the regulatory DNA in front of an Odor receptor gene to control a test gene that could be easily monitored for expression. An entire set of such reporter genes were created, each containing less of the regulatory DNA. The goal was to determine how short the regulatory region could be and yet still control the test gene normally. This helped Miller to identify where the important control elements lie in the regulatory DNA, and whether they serve to turn the gene on in cells where it is needed or to turn the gene off where it doesn't belong.

"The sense of smell is an Achilles heel for many insects," said Mark Johnston, Editor-in-Chief of the journal *GENETICS*, "and the more we learn about odor receptors the easier it will be to interfere with them to battle insect-borne disease and crop devastation. This study is a step forward in doing that by identifying the mechanism that results in the highly selective expression of 'smell genes'."

More information: Carson J. Miller and John R. Carlson. Regulation of odor receptor genes in trichoid sensilla of the Drosophila antenna. *Genetics* 2010 186:79-95. (http://www.genetics.org).

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