Fruit flies' genetic wealth has scientists abuzz

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Buzzing with excitement, the "fly people" swarmed into Chicago this week to hear the latest news about an unsung hero of science: the humble fruit fly.

The public may see the insect mainly as a kitchen pest, but to the 1,500 scientists attending the 50th annual Drosophila Research Conference, Drosophila melanogaster is one of the most important research animals in genetics, an encyclopedia of knowledge packed into a critter a tenth of an inch long.

By breeding fruit flies, early 20th century scientists figured out the location of genes controlling certain traits, creating the first crude genetic map. In 2000, Drosophila was the first multicellular organism to have its genome fully sequenced, providing a full blueprint of the organism.

With almost a century of fruit-fly research merging with new genetic technologies, the insect is now poised to broaden human knowledge of diseases from cancer to depression and provide a cost-effective and efficient system for testing promising therapies.

Despite the obvious differences between a fly and a human, the species share many genes and proteins, making the fruit fly ideal for unraveling biological mysteries.

"It's very, very hard for the average person or congressman to really believe that when we look at an insect it has anything to do with them," said Allan Spradling, an embryologist and Drosophila researcher at the Carnegie Institution of Washington. "But ... an organism that seems so foreign and different from us really taught us a lot about our own selves and our genome."

Politicians have been known to take potshots at fruit-fly research, most recently when Republican vice presidential candidate Sarah Palin cited it as an example of unnecessary earmarks at an October appearance. Though she was referring to a specific agricultural study taking place in Paris, Drosophila researchers were quick to defend their field, pointing out that many fly projects were aimed at one of Palin's favorite concerns, autism.

In truth, similar arguments on behalf of Drosophila could be made for virtually any human disease or behavior. Since 1910, when T.H. Morgan discovered a white-eyed mutant fly among his stock of wild-type red-eyed flies, scientists have been manipulating the flies' genes to learn how they work - or fail.

In the Chicago area, at least a dozen fruit-fly laboratories operate on university campuses, studying everything from sleep disorders to sexual orientation to evolution to gene therapy using the tiny insects.

Drosophila is so popular in part because researchers can breed and raise thousands of them very quickly and at a fraction of the cost of using rats or mice. A new generation of fruit flies can be created every 10 days, and females lay as many as 400 eggs during their lifetime.

In addition, exposing flies to radiation quickly creates random genetic mutations to study, and genetic tools can be used to flick genes on and off in fruit flies much more easily than in larger organisms.

"In spite of the hundreds of millions of years of evolution that have occurred between humans and Drosophila lineages, still 70 percent of the genes encoded in their genomes are similar," said University of Chicago geneticist Kevin White. "So we're able to use Drosophila ... to very rapidly do experiments and genetic manipulations that you just can't do in humans."

Last week, White and other researchers from the University of Chicago and Argonne National Laboratory published a paper in the journal Nature on a project that combined fruit-fly genetics with the latest in data-mining systems to find a new genetic marker of kidney cancer in humans.

Drawing upon nearly a century of work mapping Drosophila genes and the way their proteins interact, the team narrowed thousands of candidate genes down to a single protein, called SPOP, that is associated with faulty development of fly embryos. When the researchers tested human cancer cells for the presence of SPOP, they found it in 85 percent of renal cell carcinomas, a common form of kidney cancer.

The discovery could lead to tests that would identify kidney cancer at an early stage, improving treatment outcomes for patients, White said.

The lives of fruit flies may also hold insight into human behavior. Ravi Allada, a neurobiologist at Northwestern University, uses the insects to study circadian rhythms, the mechanisms that control sleep cycles in both flies and humans.

"The big picture is that if we understand more about which genes are important for our circadian rhythms or our sleep and understand how those genes work, it will give us a better understanding of diseases that may be the consequence of such systems going awry," Allarda said.

David Featherstone, a biologist at University of Illinois-Chicago, stumbled accidentally on a peculiar fly model of human behavior when studying glutamate, an excitatory neurotransmitter in fly and human brains. Disrupting a gene in one part of the brain created male flies, nicknamed genderblind, that attempted to mate with both females and other males.

The finding may be relevant not only to research on sexual orientation but also to studies of muscle disease and mental disorders such as schizophrenia and depression where signals between nerve cells are disrupted, Featherstone said.

"We're not just trying to figure out stuff to entertain people or fill textbooks with irrelevant minutia about how brain works," Featherstone said. "Ultimately we hope to understand the brain and gain the ability to engineer it."

Richard Carthew, a developmental biologist at Northwestern, is using Drosophila to study how RNA interference might be used to silence genes and nullify infectious viruses. Even after a century, the potential for fruit fly research to benefit human health is still growing, he said.

"It's a very traditional, long-standing lab animal, but it shows no signs of tiring. It has good legs," Carthew said. "There's really nothing comparable to it."
