Insecticides based on RNA technology could poised to be a low impact way to control plant pests

A novel insecticide targets a specific gene in a pest, killing only that bug species on crops and avoiding collateral damage to beneficial insects caused by today's pesticides.

Though the technology is still in its infancy, a Cornell study published online in Pest Management Science describes how the RNA-based insecticide can be effective for at least 28 days when sprayed on a leaf, a finding that dispels previous concerns that the genetic material would quickly degrade in rain and sunlight.

The proof-of-principle study aimed to answer whether an RNA-insecticide spray would be stable enough to use in agriculture. The researchers matched double-stranded (ds) RNA to an actin gene in Colorado Potato Beetle, a leading potato pest that inflicts $100 million per year in costs to North American farmers and also damages tomato and other plants. Actin genes produce actin proteins that are essential for many cellular functions and prevalent in eukaryotic cells, and were used in this study to test how stable the ds RNA would be in the field.

Once applied on leaves, the ds actin-RNA insecticide was highly effective on potato beetles that ate the leaves.


Colorado potato beetle. Credit: USDA ARS

“The major problem with conventional insecticides is they affect non-target organisms,” said Jeff Scott, a Cornell entomology professor and a co-author of the study along with Keri San Miguel, the manager in Scott’s lab. “This is an insecticide that is based on a specific gene. Thus, you might be able to kill only that specific insect, and that would be a phenomenal breakthrough in pest control.”

RNA, ribonucleic acid, is present in all living cells. Mainly, it acts as a messenger carrying instructions from DNA for controlling the synthesis of proteins. For the last two decades researchers have employed a process called RNA interference, where double-stranded RNA is tailored to match a gene’s sequence, such that once injected into a cell it hunts out and destroys the transcripts of a specific gene. Geneticists have used the technique to silence specific genes, examine what functions are lost and hence learn that gene’s purpose. The idea for crop protection was born out of this technology.

As part of the study, Scott and San Miguel put a film of ds RNA on plate glass and exposed it to ultraviolet light, which is found in the sun’s rays and breaks down many materials. They discovered that under such direct exposure, half the RNA degraded within an hour. More study is needed to understand why, once sprayed and dried on a potato leaf, the ds RNA lasts 28 days or longer, but Scott speculated the spray may be protected by shade from tiny hairs on the leaf, or perhaps it soaks into the leaf.

The researchers also experimented on whether the ds RNA moved around the plant. They found that when a leaf is cut and the stalk is placed in solution with RNA insecticide, and potato beetles ate that leaf, mortality occurred but it wasn’t as high. Also, they found that when one leaf was treated with spray, the RNA did not transfer internally to other leaves.

Before such an insecticide is ready for market, it needs more work, Scott said. For example, the cost of making RNA insecticide is currently much higher than conventional insecticides. Also, for the insecticide to work, insects need to eat the leaf, which means the spray will not affect insects that don’t eat leaves, such as houseflies, or those that suck sap, such as aphids. Also, some insects are simply unaffected, perhaps due to gut enzymes that break down the ds RNA.

“The technology is really at its infancy,” said Scott. “It may take some tweaking but its potential to be specific is going to be hard to beat.”

Read the original post here.