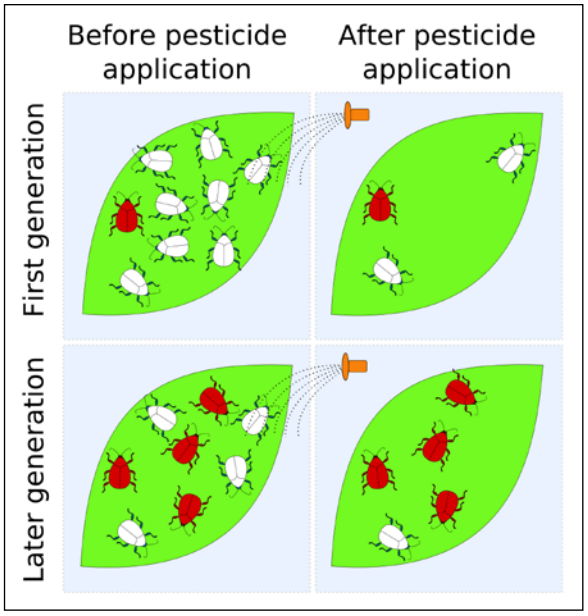
Pesticide Resistance

Pesticide resistance, the ability of an organism to withstand a poison, is a predictable consequence of repeated pesticide use. The Insect Resistance Action Committee, a pesticide industry working group, defines resistance as "a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species." Resistant organisms are simply following the rules of evolution; the best-adapted individuals survive and pass their resistance on to their offspring.

In many cases, pesticide resistance has resulted in more frequent spraying as farmers and residential pest control operators scramble to destroy the resilient organisms, followed by increasing resistance and escalating crop losses. This cycle is often called the pesticide treadmill as users spray more with increasingly potent chemicals and still lose ground.



Resistance on the Rise

Pesticide resistance is increasing in occurrence. In the 1940s, farmers in the U.S. lost seven percent of their crops to pests, while since the 1980s, the percentage lost has increased to 13 percent, even though more pesticides are being used. According to Michigan State University Extension, over 500 species of insects have developed a resistance to a pesticide. Others estimate it is even higher.

Genetically engineered (GE) crops have been responsible for an increase of 383 million pounds of herbicide use in the U.S. over the first 13 years of commercial use. The primary cause of the increase is the emergence of herbicide-resistant weeds. As a result, biotech companies are now working on crops resistant to more potent herbicides.

Development of Resistance

Organisms can develop resistance by: 1) developing a means of detoxifying the pesticide; 2) altering the target site (part of the body's metabolism affected by the pesticide) to reduce its sensitivity or the pesticide's ability to bind; or 3) decreasing pesticide penetration.

A single resistance mechanism can convey resistance to two or more pesticides that have similar modes of action, called cross-resistance. While multiple resistance is the ability to cope with pesticides of different modes of action.

How quickly pesticide resistance develops depends on: the frequency of use, the mechanisms of resistance, the genetics of the resistance mechanism, the size of the gene pool and how quickly the organisms reproduce. For example, plants have been slower to develop resistance because they have only a few generations each year and a large bank of unexposed plants in the form of seeds in the soil.

Bed Bugs: Why they are not going away

The U.S. has been relatively bed bug free for the past 60 years. In the 1940's bed bugs were controlled with toxic chemicals such as DDT. Since then, newer classes of insecticides like synthetic pyrethroids have been employed to keep bed bug populations down. Meanwhile, bed bugs have slowly been developing resistance mechanisms and have become resistant to most, if not all, insecticides on the market. On average, insecticides labeled for bed bug control can take over 150 hours to kill a bed bug, compared to seconds or minutes in previous years. An Ohio State study, "Transcriptomics of the Bed Bug," published January 2011 in the journal *PLoS One* confirms bed bug resistance to pyrethroid insecticides and highlights the need to adopt non-chemical methods for controlling bed bugs and other insect pests. According to researchers, bed bugs have developed multiple mechanisms to evade chemical attack.

- **Reduced cuticular penetration:** for some bed bugs, insecticides are unable to penetrate the exoskeleton (cuticle), thereby rendering the pest insusceptible to chemical attack.
- **Enhanced enzymatic activity:** if the insecticide is able to penetrate the cuticle, some resistant bugs can quickly detoxify the chemical agent and eliminate it from their bodies due to heighted enzymatic action.
- **Target site insensitivity:** mutations at the target site for the chemical render the pests unaffected by the insecticide.