



# Biotech In focus



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## Challenges For Farmers: Pests Take Their Toll

Insects love food crops, just like we do. Planting a single crop on many acres and feeding it water and fertilizer is like setting a banquet table for insects (and the plant diseases that some insects spread).

Farms—large areas of good foods that are easy to feed on—are perfect places for insects to grow and, in many cases, escape from their natural enemies. To say that insects outnumber us is a big understatement: for each person on Earth, there are 200 million insects! If even a small fraction of them like what we eat, how can we keep ourselves fed?



**Controlling insect pests:** A pest's behavior is destructive to human needs or the environment. Early in the development of agriculture, farmers realized that they needed to reduce the numbers of insect pests feeding on their crops. The Chinese used ants to eat caterpillars on citrus centuries ago. Over time, growers noticed that some crop varieties were less attractive to insects. People started trying to kill insects with natural substances or catch and kill them in traps.



**Natural resistance to pests:** Many plants produce their own defenses. Some of these are chemicals—botanical insecticides—while others include characteristics (traits) that make plants harder to feed on, such as leaf hairs that aphids don't like. This made it possible to select insect-resistant crop varieties. Of course, breeding crops to make them tastier or more brightly colored sometimes leads to the loss of resistance traits. Nice big red tomatoes with smooth leaves attract lots of pests!

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# The "Green Revolution"

During the 1930s, man-made insecticides were thought to be our salvation. Once the insect-killing properties of organophosphates, organochlorines like DDT, and in later decades, pyrethroids, were discovered, these chemicals were used extensively and often without much care. Crop yields did increase for a time. But insects are great adapters and soon evolved resistance to many insecticides. People started to recognize the environmental and health risks of using those chemicals.

In 1962, Rachel Carson wrote *Silent Spring*. Her book examined the environmental impacts of synthetic insecticides. It had a profound effect on the way pests would be dealt with in the future.



## A New Generation



Recent developments in pesticide chemistry have produced many safer, more effective products for insect control. Some of these newer insecticides are biological products made by fungi or bacteria that kill insects; others are very specific chemicals that kill only the target pest.

## Cultural Practices

Where and when crops are planted, combinations of crops, how and when land is plowed (tillage); these and other farming decisions are called "cultural practices." Some of these methods make the crops less attractive to pests and can limit losses caused by pest damage.



## Biological Control



Insect pests are vulnerable to their natural enemies. Sometimes introducing a predator or parasite into an environment where an insect is causing damage can result in complete control of the pest! In 1894, an entomologist imported a ladybug from Australia to California (and later to Hawaii). This saved the U.S. citrus industry from cottony cushion scale, and helped other crops as well.



**Putting it all together:** As people came to realize that pests can't be eradicated, IPM (Integrated Pest Management) was developed. Rather than depending on one method, IPM mixes different approaches, including biological control, resistant crop varieties, cultural practices, physical controls (like trapping), and insecticides. Using IPM, our tomato farmers can use parasitic wasps, or they can spray an insecticide made from bacteria, which kills the worm but not the wasps. They can plant early in the season to avoid certain pests and use tomato varieties with hairy leaves to stave off aphids. Leafminer flies can be controlled with a growth regulator insecticide that kills only the flies.

But what if just one insect can kill a whole plant? What can the farmers do? Can plant breeders help? Can farmers and breeders find natural resistance? What if they can't?