

CERIAS

The Center for Education and Research in Information Assurance and Security

PURDUE
UNIVERSITY

The Evolution of Agricultural Pest Control and Food Security

Lisa Liu, Larry Bledsoe

Food security is one of the critical issues in homeland security. Just as the infrastructure, electric grid, or Internet, it is the primary responsibility of homeland security authorities to protect the food we grow from any eventuality that will hurt the consumer, be it a direct act of contamination or an unintended side effect of a production practice. This research deals with the latter in a long-term historical aspect, demonstrating that protective measures must be undertaken now to prevent considerable damage to food supply later.

Time Line

Pre-1940's: The Conventional Approach

Prior to the 1940's, Insecticides had been developed however were not commonly used. The main methods for controlling agricultural pests included crop rotation, companion planting, and cultivation methods.

Mid-1940's: Organochlorine / Cyclodiene Insecticides

Organochlorine and Cyclodienes were introduced with the onset of World War II; these insecticides were highly effective: powerful in controlling pests as well as persistent in the environment.

However, in 1962 the biologist and conservationist Rachel Carson noticed the link between these Insecticides and vanishing of the birds. She wrote the book "Silent Spring" which brought attention to the issue. Additionally, insects eventually developed resistance.

A well known Organochlorine was **DDT**; widely blamed for the endangerment of bald eagles. Bald Eagles consumed fish that consumed worms that consumed agricultural runoff with DDT. The concentration of DDT in the birds proved fatal to Eagle offspring.

1980's: Organophosphate Insecticides

Organophosphate insecticides were an improvement to insecticides used in the previous era. They were still powerful, however much less ecologically pervasive. This meant that crops could grow with high yield without as much damage to the environment.

However, organophosphate insecticides dramatically increased the rate in which insects evolve resistance. Agricultural pests quickly became immune to these pesticides.

2000's: The Beginning of Transgenic Crops

Genetically modified corn, also known as "GMO corn" is a type of corn that had been genetically modified to contain and express genes that were previously seen in another species.

Many GMO corn species contain a gene encoding an endotoxin produced by the bacterial species *Bacillus thuringiensis* (bt). BT corn allowed farmers to become more independent of pesticide usage as bt is highly effective against Corn Root Worm larvae.

However, GMO crops also have their problems. GMO crops as well as companies that produce GMO crops [Monsanto] are met with media outrage. GMO crops cause a discrepancy of usage between scientists and farmers. GMO crops are also prey to insect resistance.

This year, there has been a corn field in Iowa with confirmed Corn Root Worm resistance to GMO crops. Resistance has begun to spread.



My Research:

I worked with a team to conduct research for agro companies such as Pioneer, Monsanto, Cygenta, and Bayer conducting studies that compared efficacy and yield results of various treatments of pesticides, GMO/refuge (non transgenic corn) ratios, and Corn Root Worm beetle emergence data.

The Importance of Agricultural Pest Research in Relation to Food Security

Currently, a discrepancy exists between farmers, scientists, and agro companies on exactly how much refuge (non-GMO) corn should be planted amongst transgenic (GMO) corn in order to slow down insect resistance.

Scientists are stating that 50% refuge and 50% transgenic should be mandatory in order to slow resistance. Agrocompanies are pushing for 5% refuge, and 95% transgenic -- and they must. Farmers across America work hard to survive and they expect high yield when they pay for costly designer seed. Farmers see results with a high transgenic percentage and would not be willing to pay for seed with 50% refuge corn.

So, what might happen if scientists win with a 50% refuge ratio?

Farmers might begin to purchase cheap transgenic seed from unethical sources-- sources that claim to offer high quality transgenic seed for low cost but in actuality, offer questionable quality seed obtained as a result of manufacturing shortcuts.

This could be catastrophic in several ways:

- Farmers could purchase inferior quality seeds leading to production deficits; therefore skyrocketing the cost of food and the cost of living.
- Farmers could purchase transgenic seed that has a high probability of enhancing insect resistance.
- Farmers could purchase seed that contains cheap ingredients that are environmentally damaging: such as seeds coated with organochlorine/cyclodienes to mimic the results of transgenic yield.

What can be done?

Homeland Security supported research on:

- The optimal refuge/transgenic ratio
- Several types of transgenics seeking the optimal pricing solution for farmers, scientists, and agrocompanies
- An alternative crop protecting method