Tomorrow's Table

Organic Farming, Genetics and the Future of Food Part 1

Yields can be comparable to conventional farms depending on the crop and location, but for some key crops such as rice, yields are often lower.

Some pests are difficult to control using organic methods

INSTITUTE ON THE
ENVIRONMENT

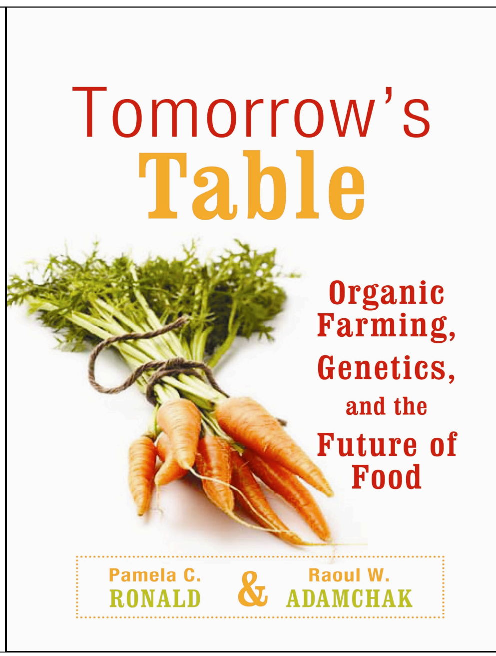
UNIVERSITY OF MINNESOTA
Driven to Discover℠

I would like to start with a short movie from the U of Minnesota,which i believe frames well one of the most important issues of our time

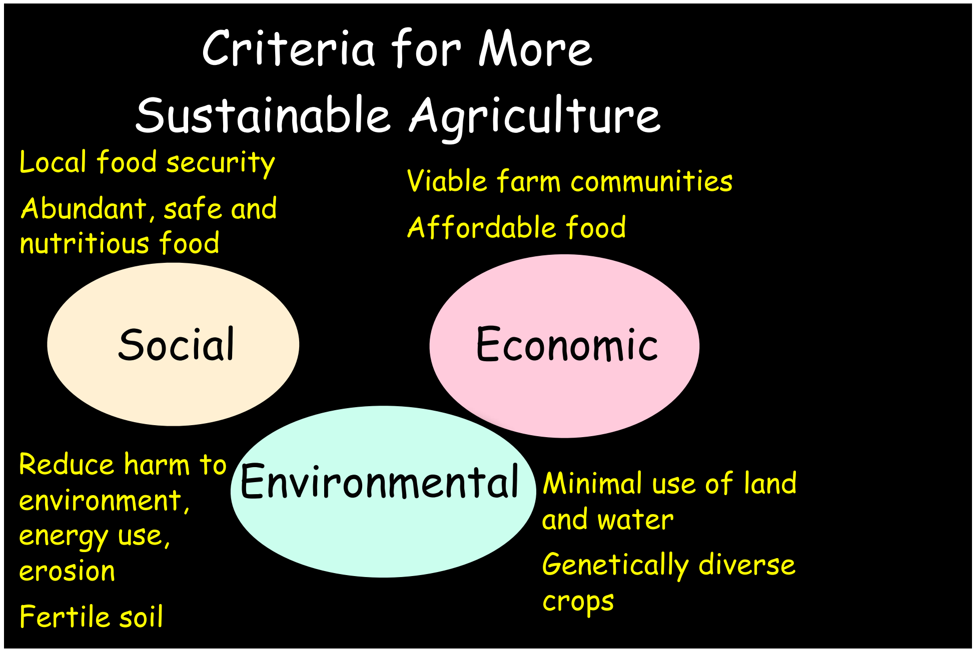
This is a question my husband Raoul Adamchak have discussed for over 15 years. He has grown organic crops for thirty years. Here he on the certified organic farm on teh UCDavis campus descriing organic production to his students.

YOu may think that geneticists and organic farmers represents polar opposits of the agricultural industry, Maybe you think that they dont even talk to each other. But we do and it is not difficutl because we both have the same goal: an ecologically based system of agriculture.

Over the years, many of our friends, family, and colleagues have asked us how GE will affect the environment and our food. Many \have asked us if



This book, written partly here at the Marconi center is our response to these questions. Our intention is to give readers a better understanding of what geneticists and organic farmers actually do and also to help readers distinguish between fact and fiction in the debate about crop genetic engineering.

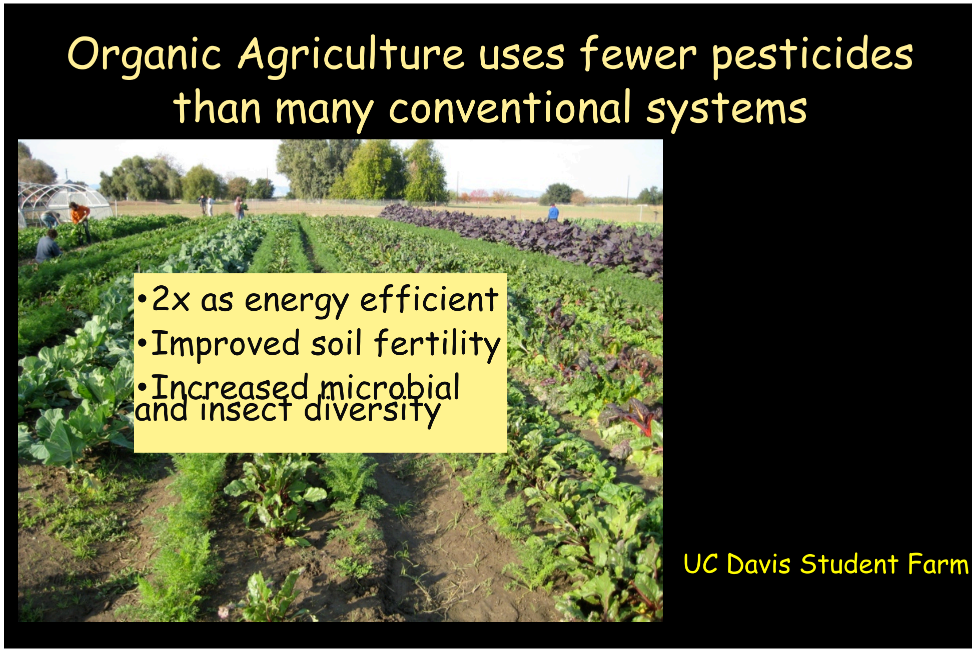


Our first step was to define...

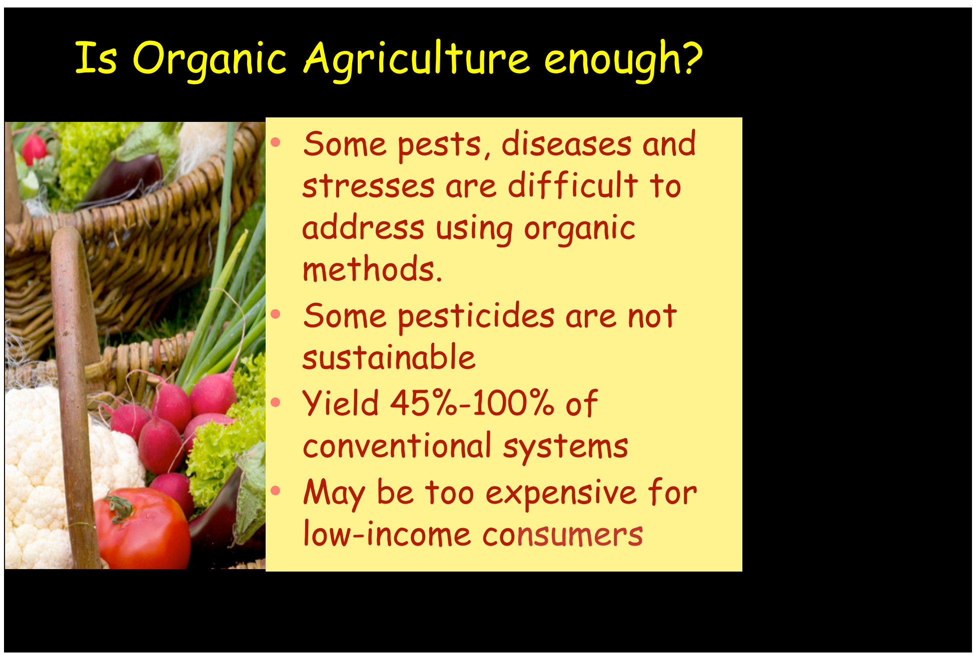
If farmers cannot make aliving, it is not sustainable
If people cannot afford the food it is not sustainable

Organic agriculture began as a response to the environmetal problems of conventional agriculture. In the US the USDA certifies farms as organic based on specific criteria.

Must have 3 years with no prohibited material and be inspected on an annual basis by a USDA accredited certifier to be certified organic



- Controls pests through crop rotation, support and enhancement of beneficial organisms, resistant varieties, and naturally



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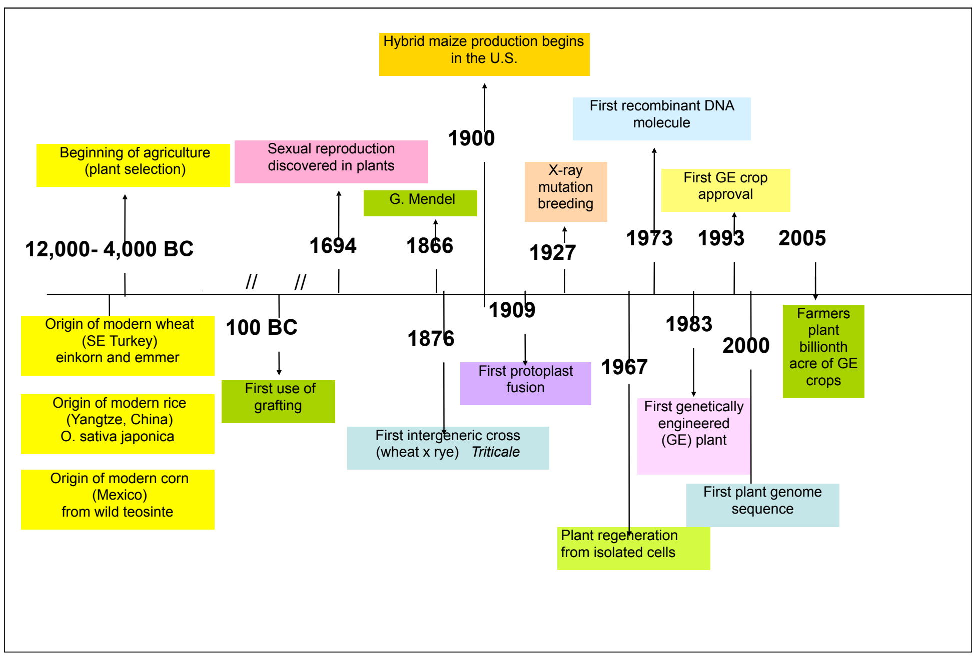
The Power of Improved Seed

Can modern genetic approaches contribute to sustainable agriculture?

so what can GE contidbute to sustianable ag in faxce of these large problems, which challenge us as much and are linked to climate chnage,



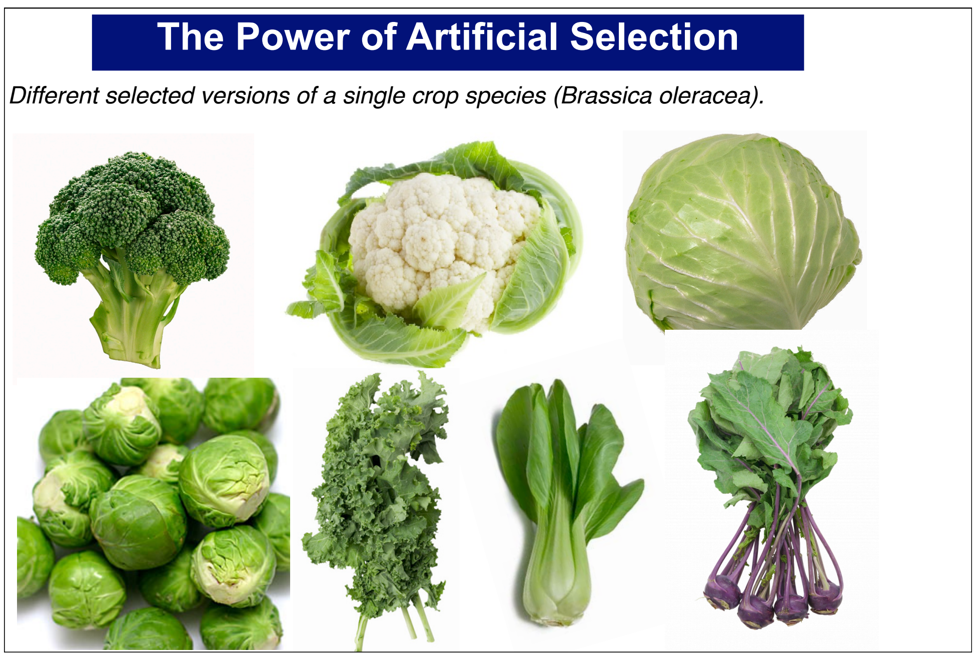
Teh seed contains the traits for yield favor nutirtions. All the information is contained int he seed. What seed you use has a huge impact in theyield you get and the durvival of the palnts in virous conditions. Our ancestors knew this.

This is a timelline...yoyu can see for the first 13,000 years improvements through prmivit pplant selection were slow.

Some people see GE as the natural progression of crop domesitcation, others see it as completely unnatural.
10K years ago
Einkorn Triticum monococcum (diploid)
Emmer T. turgidum (tetrapolid)

On the top: This is an ancient ancestor of modern-day corn, called Tripsacum. (Teosinte) It comes from a plant that doesn't look anything like a modern corn plant; it looks more like a type of grass, with long, thin blades. Also its seed structure, the primary source of nutrition from corn, is different in the way it is formed and what it contains. It is born on the end of one of its stalks, instead of on the body of the plant. Tripsacum produces 10 or 20 seeds per plant and the seeds of Tripsacum are much less nutritious. It requires a hammer in order to break the seed coat of the wild relative's grain to expose the nutritious kernel; something that most of our stomachs are not equipped to do.

On the bottom: This is an ear of modern corn; it contains the seeds that the plant produces in order to be able to insure a next generation. The modern hybrid corn will produce several ears each bearing in excess of 1000 seeds.

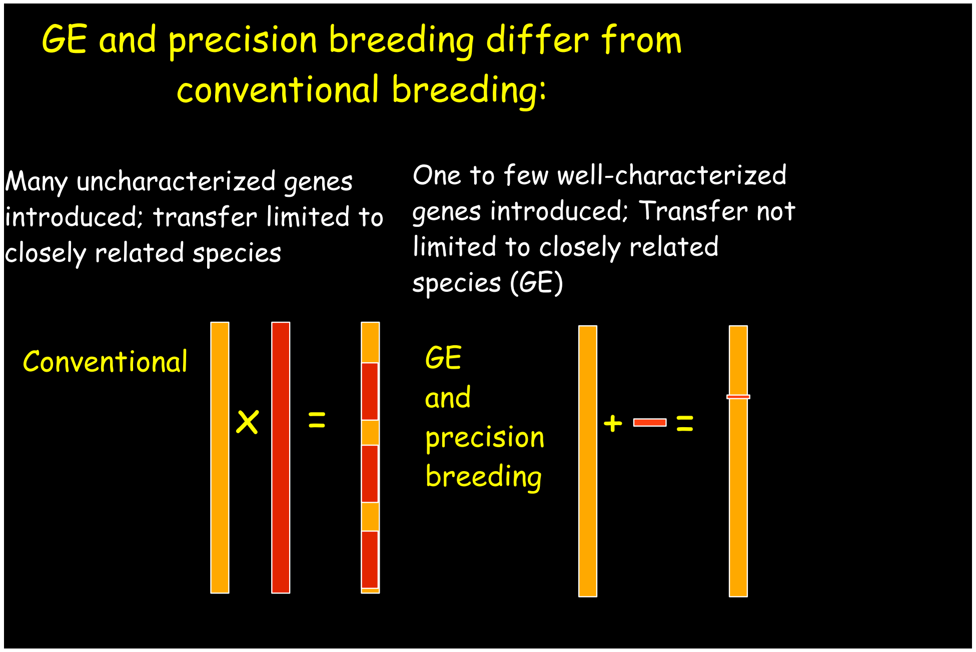


Much of this diversity produced within historic times in Europe.

It’s called a selective sweep.

These are all Brassica oleracea

Cauliflower is the newcomer at about 1200 AD and brussel sprout might have a similar time of origin. The others are known from Greek and Latin texts so much older. I found

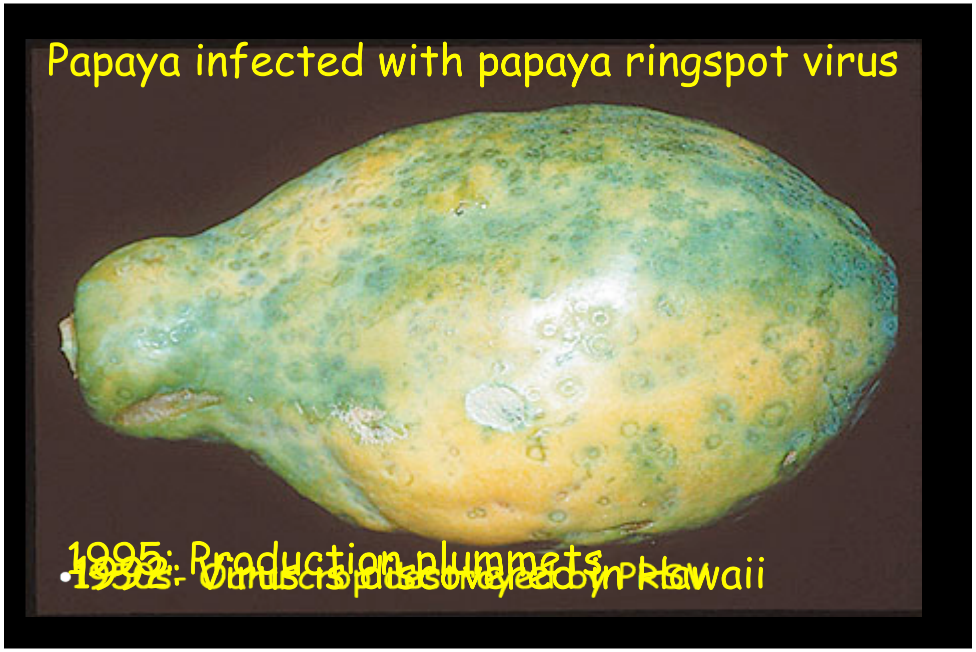


What is GE?
Pam: GE is a modern form of plant breeding that does not require pollination. It differs from conventional breeding in two basic ways:
Conventional plant breeding allows gene transfer only between closely related species.
With genetic engineering, genes from the same species or from any other species, can be introduced into a plant.

Plant breeding mixes large sets of genes of unknown function, whereas genetic engineering generally introduces only one to a few well- characterized genes at a time.
People have been domesticating crops for thousands

The science is clear. The current GE crops are safe to eat. The fact is that there is not a shred of any evidence of risk to human health from GM crops. Every academy of science, representing the views of the world's leading experts—the Indian, Chinese, Mexican, Brazilian, French and American academies as well as the Royal Society, which has published four separate reports on the issue—has confirmed this. Independent inquiries have found that the risk from GM crops is no greater than that from conventionally grown crops that do not have to undergo such testing.

The commercialized GE crops are safe to eat

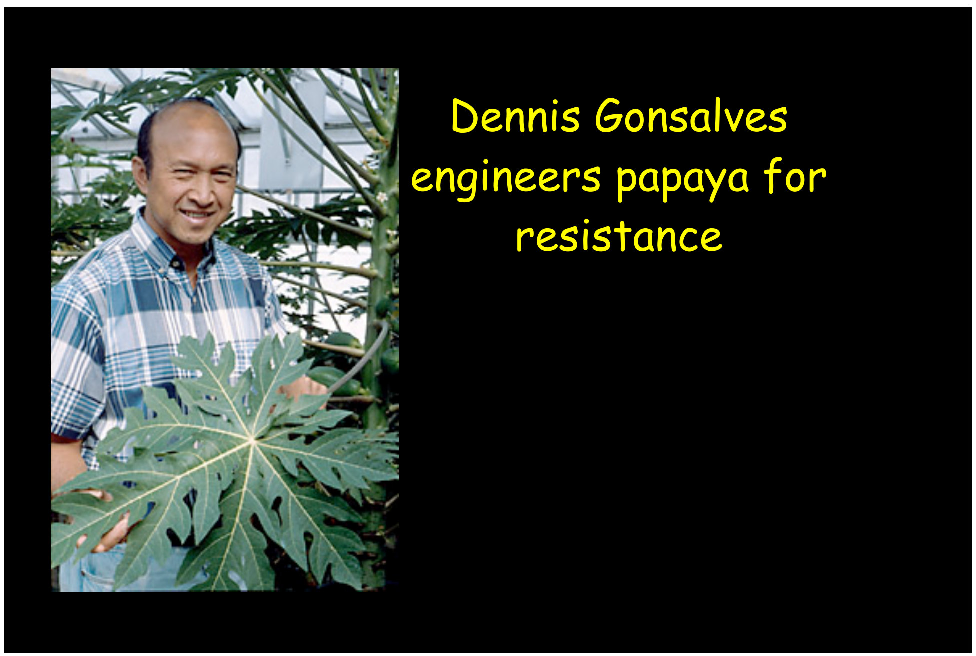


This is a papaya. Like humans, plants are also vulnerable to viral disease. THis pap infected with papaya ringspot virus.

You can see the ring spot symptoms on fruits. \

In the 1950's, the entire papaya production on the Island of Oahu was decimated by papaya ringspot virus. There was no way to control the disease so farmers were forced to abandon the island.

In 1992, the virus was discovered in the papaya orchards on the island of Hawaii (by 1995 the disease was widespread), creating a crisis for Hawaiian papaya farmers. By 1998 papaya production had dropped to 26 million pounds.



There is hero to the story . This is Dennis Gonsalves, in 1978, a native of Hawaii, and coworkers initiated research to develop
strategies to control the disease. Fortunately, geneticists were able to develop papayas resistant to the virus by using genetic engineering.

Gonsalves' group spliced a small snippet of DNA (made from viral RNA; called RNA interference; from a mild strain) into the papaya
genome. Similar to human vaccinations against polio or small pox, this treatment immunized the papaya plant against further infection.

Aerial view of transgenic field trial
in Puna that was started in October

Virus Resistant Papaya

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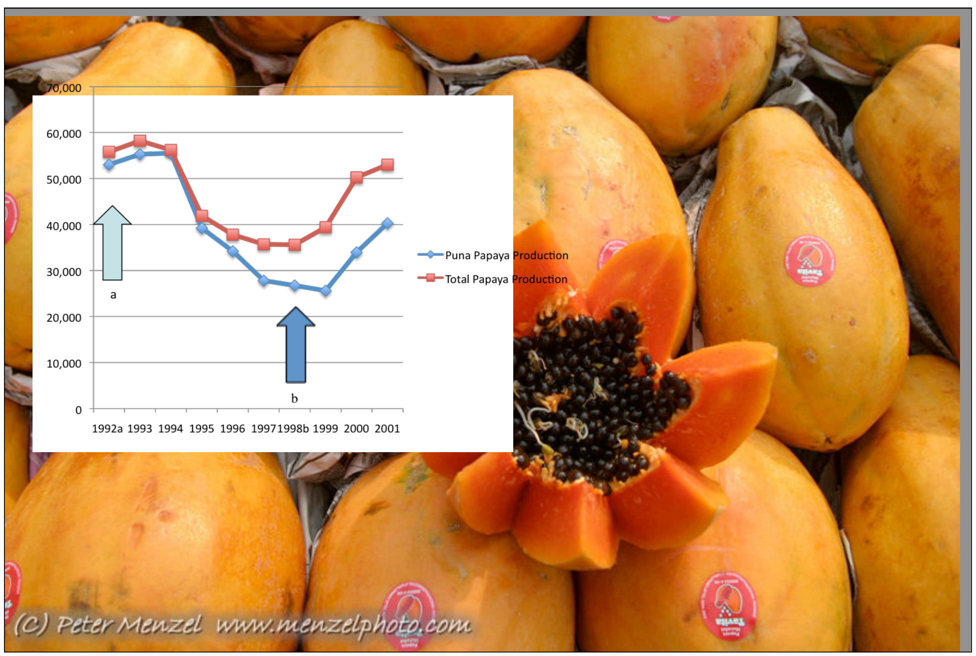

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Bt cotton carries a protein called Bt, a favorite insecticide of organic farmers

Bollworm egg hatching

Cotton uses approximately 25% of the world's insecticides to control this pests

The Environmental Protection Agency considers seven of the top 15 pesticides used on cotton in 2000 in the United States as "possible," or "known" human carcinogens

In the 1990s, varieties of cotton genetically engineered to protect itself against insects

In Arizona, Bt-cotton fields used half the insecticides; increased insect biodiversity

Tabashnik, 1993. Annual Review of Entomology 39:47.

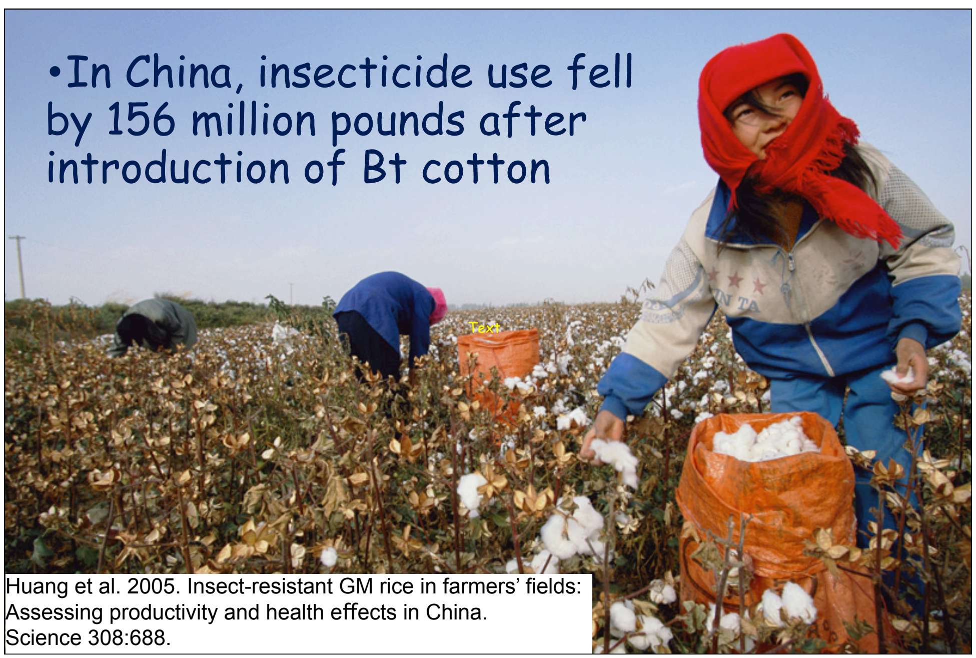
In Arizona, growers cut their insecticide use in half while maintaining the same yield as their neighbors. Insect biodiversity increased as measured by the diversity of beetles and ants in the field.example of arizona cotton?

This is f rom a vriginia tech magazine

With a goal to add value to the state's cotton crop, Professor of Biological Systems

Punjiben, cotton farmer, Gujarat, India(Photo from Fairtrade Foundation)
Beyond direct effects on cotton profits, a new technoology like Bt can have spillovers to othe rlocal markets (eg labor markets) and sectors. Qaim collected data in ne village in Indian sage of Maharashtra, capturing all market transcaction overs a period of 12 monts.

In India, yields increased 37 percent



China is the world's leading producer of cotton, with an output of 6.73 million tons per year. BEGINNING IN 1997, an important change swept over cotton farms in northern China. By adopting Bt cotton, growers found they could spray far less insecticide over their fields. Within four years they had reduced their annual use of the poisonous chemicals by 156 million pounds - almost as much as is used in the entire state of California each year. Cotton yields in the region climbed, and production costs fell. Strikingly, the number of

The global pipeline of GE crops

- Currently there are 30 commercialized GE crops cultivated worldwide.
- By 2015 there will be over 120 (including potato and rice)
- Half will come from national technology providers in Asia and Latin America designed for domestic markets

Source: Joint Research Centre of the European Commission, 2009

caused by *Xanthomonas campestris* pv. *musacearum*

First reported in Uganda in 2001.
The disease has also been reported in DR Congo,

The judicious incorporation of two important strands of agriculture—agricultural biotechnology and ecological farming—is key to helping feed the growing population in an ecologically balanced manner.

This idea is anathema to many people, especially the advocates who have helped build organic farming into a major industry in richer countries. As reflected by statements on their websites, it is clear that most organic farming trade organizations are deeply, viscerally opposed to genetically engineered crops and seeds. Virtually all endorse the National Organic Standards Board's recommendation that genetic engineering be prohibited in organic production.

But ultimately, this resistance hurts farmers, consumers, and the planet. Without the use of genetically engineered seed, the beneficial effects of organic farming - a thoughtful, ecologically minded approach to growing food - will likely remain small.

Despite tremendous growth in the last 15 years, organic farms still produce just a tiny fraction of our food; they account for less than 3 percent of all US agriculture and even less worldwide. In contrast, in the same period, the use of genetically engineered crops has increased to the point where they represent 50 to 90 percent of the acreage where they are available. These include insect-resistant varieties of cotton and corn; herbicide-tolerant soybean, corn, and

"A truly extraordinary variety of alternatives to the chemical control of insects is available. Some are already in use and have achieved brilliant success. Others are in the stage of laboratory testing. Still others are little more than ideas in the minds of imaginative scientists, waiting for the opportunity to put them to the test. All have this in common: they are biological solutions, based on understanding of the living organisms they seek to control, and of the whole fabric of life to which these organisms belong. Specialists representing various areas of the vast field of biology are contributing—entomologists, pathologists, geneticists, physiologists, biochemists, ecologists—all pouring their knowledge and their creative inspirations into the formation of a new science of biotic controls."

Rachel Carson, 1962

I would like to leave you with a quote from Rachel Carson, one of the most imporant environemntal activists of our time

READ

In pursuit of an ecologically based agriculture we need the best science and the best farming practices.

" we cannot reject the very thing that Rachel Carson, encouraged us to pursue—the new science of biotic controls.

Farms of the future must produce enough affordable food to feed all the people in a manner that relies less on herbicides