

# The Impacts of Adoption of Genetically Engineered Crops on Yields, Pesticide Use and Economic Returns in the USA

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# Objective

To summarize the experience of the first 12 years of adoption of genetically engineered (GE) crops by U.S. farmers.



# Insect Resistant (Bt) Crops

- ◆ Bt crops carry the gene from the soil bacterium *Bacillus Thuringiensis*.
- ◆ Crops containing the Bt gene are able to produce proteins that are toxic when ingested by certain insects:
  - Bt corn protects against the European corn borer (and/or the corn rootworm).
  - Bt cotton protects against the tobacco budworm, the bollworm, and the pink bollworm.

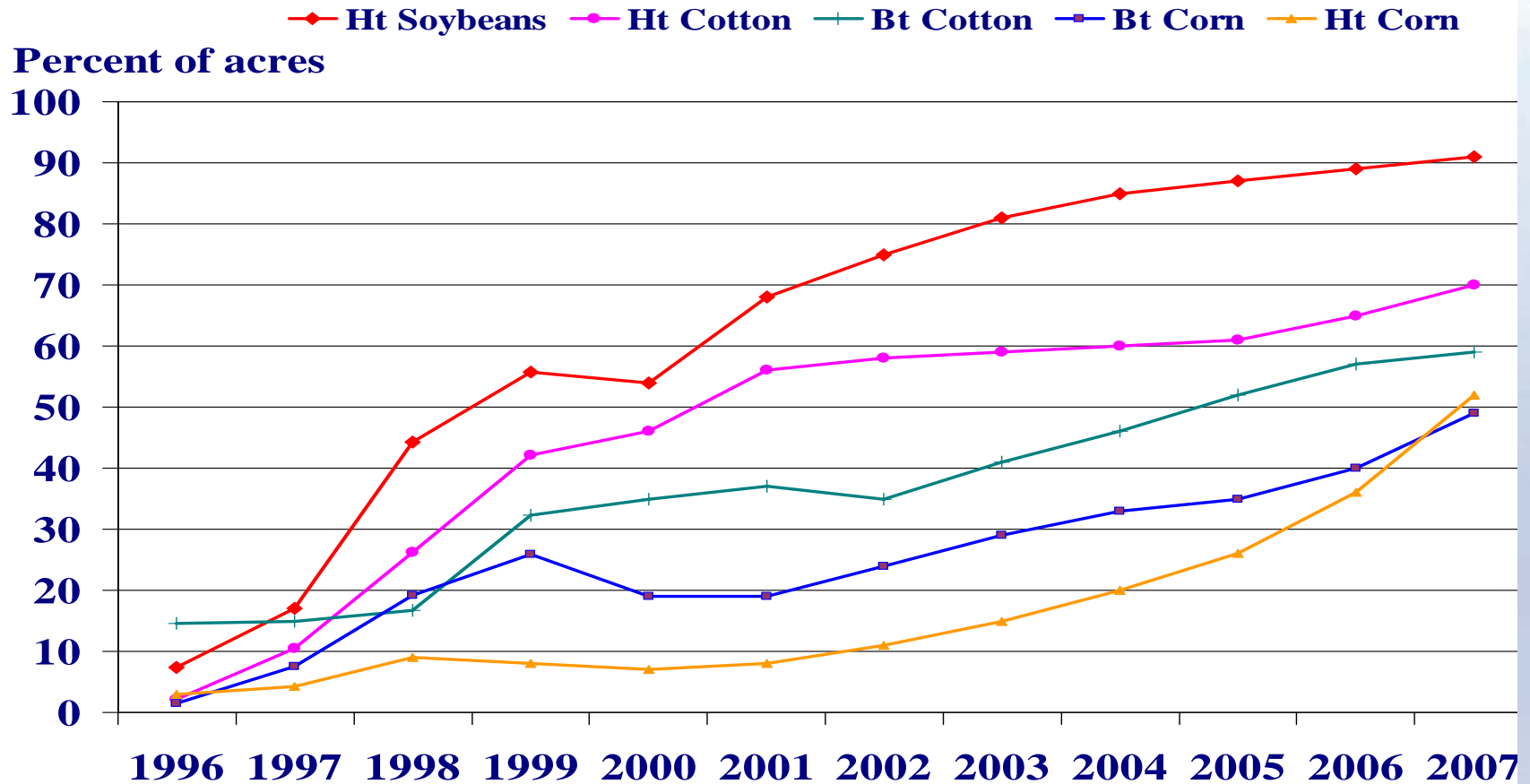


# Herbicide Tolerant (HT) Crops

- HT crops contain traits that allow them to survive certain herbicides that previously would have destroyed the crop along with the targeted weeds, allowing farmers to use more effective herbicides.



# Adoption of genetically engineered crops grows steadily in the U.S.

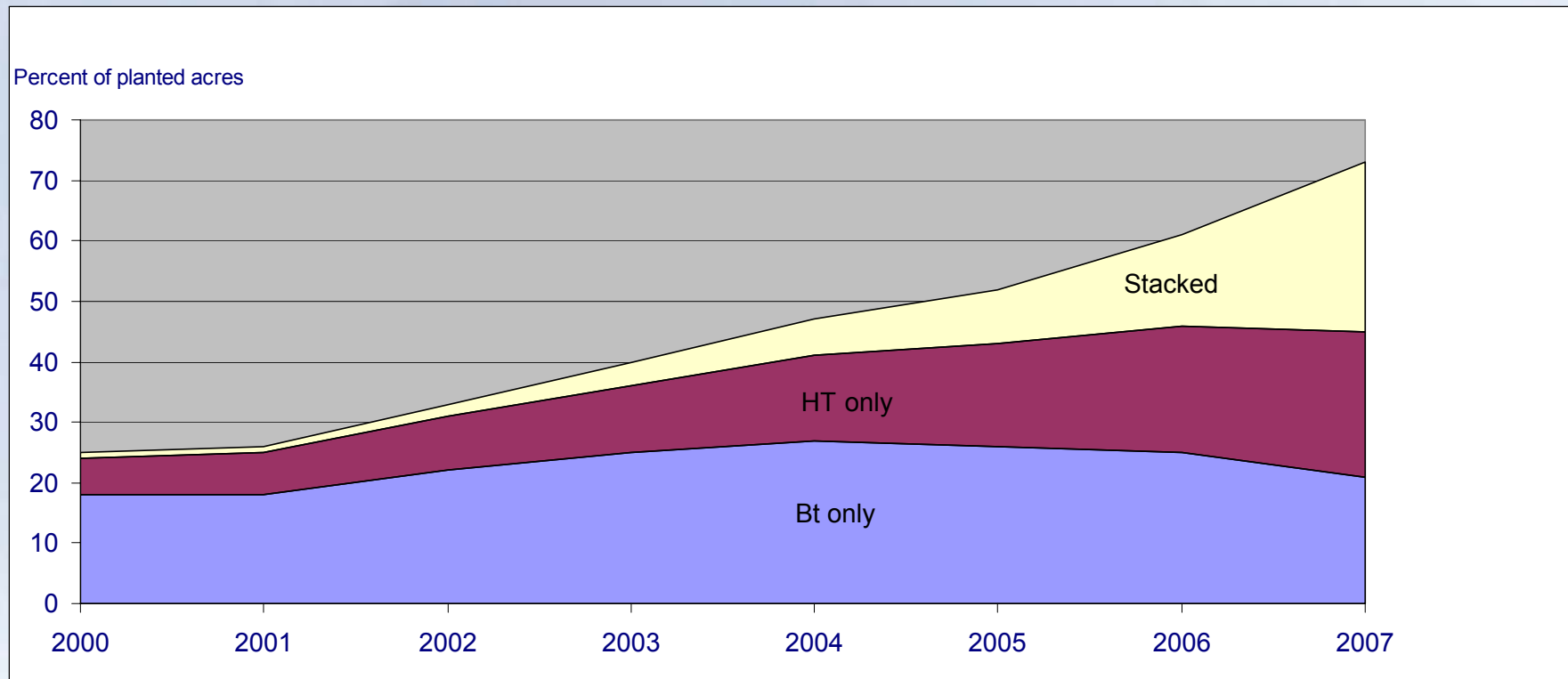


1. Data for each crop category include varieties with both HT and Bt (stacked) traits.
2. Bt to control corn rootworm introduced commercially in 2003.

Source: USDA/NASS data



# Adoption of GE Corn in the U.S.A.



Source: ERS, using NASS survey data



# Why are U.S. farmers adopting GE crops?

According to USDA surveys, the main reasons stated by U.S. farmers for adopting GE crops are:

1. To increase yields
2. To save management time and make other practices easier.
3. To decrease pesticide input costs.



# Farm Level Effects of Adoption





# Evaluating Adoption Impacts

- ◆ To examine the impacts of adoption on yields, pesticide use and returns we need to control for other factors like input and output prices, weather/infestation levels, farm size, managerial ability, and other production practices.
- ◆ To do this we use an econometric model.



# The Data Used for the Impact Studies

- ◆ U.S. farm-level data are obtained from the Agricultural Resource Management Survey (ARMS) developed and carried out by the USDA.
- ◆ ARMS is the major source of integrated information on production practices, acreage planted and harvested, resource use, and financial conditions among U.S. farms, as well as the characteristics of farm households.
- ◆ Most biotech studies are based on 1997-2001 survey data



# Yield and net returns and adoption of GE crops

	Yield	Net returns
HT cotton	↑	↑
Bt cotton	↑	↑
HT corn	Small↑	↑
Bt corn	↑	<b>Depends on infestation</b> <sup>1/</sup>
HT soybeans	Small↑	ns

Notes:

ns: Not significant

<sup>1/</sup> In low infestation years, some farms may have negative returns if Bt corn is used on fields where the value of protection against the pests is lower than the Bt seed premium. (This “over-adoption” may be due mainly to poor forecast of infestation levels).



# HT soybean adoption and net returns

- ◆ Despite the rapid adoption of HT soybeans by U.S. farmers, there was no significant difference between the net returns to using HT versus conventional soybeans.
- ◆ This result suggests that for some farmers other factors may be driving adoption, such as the simplicity and flexibility (less management time) of the HT program.



# Adoption of HT soybeans and off-farm income

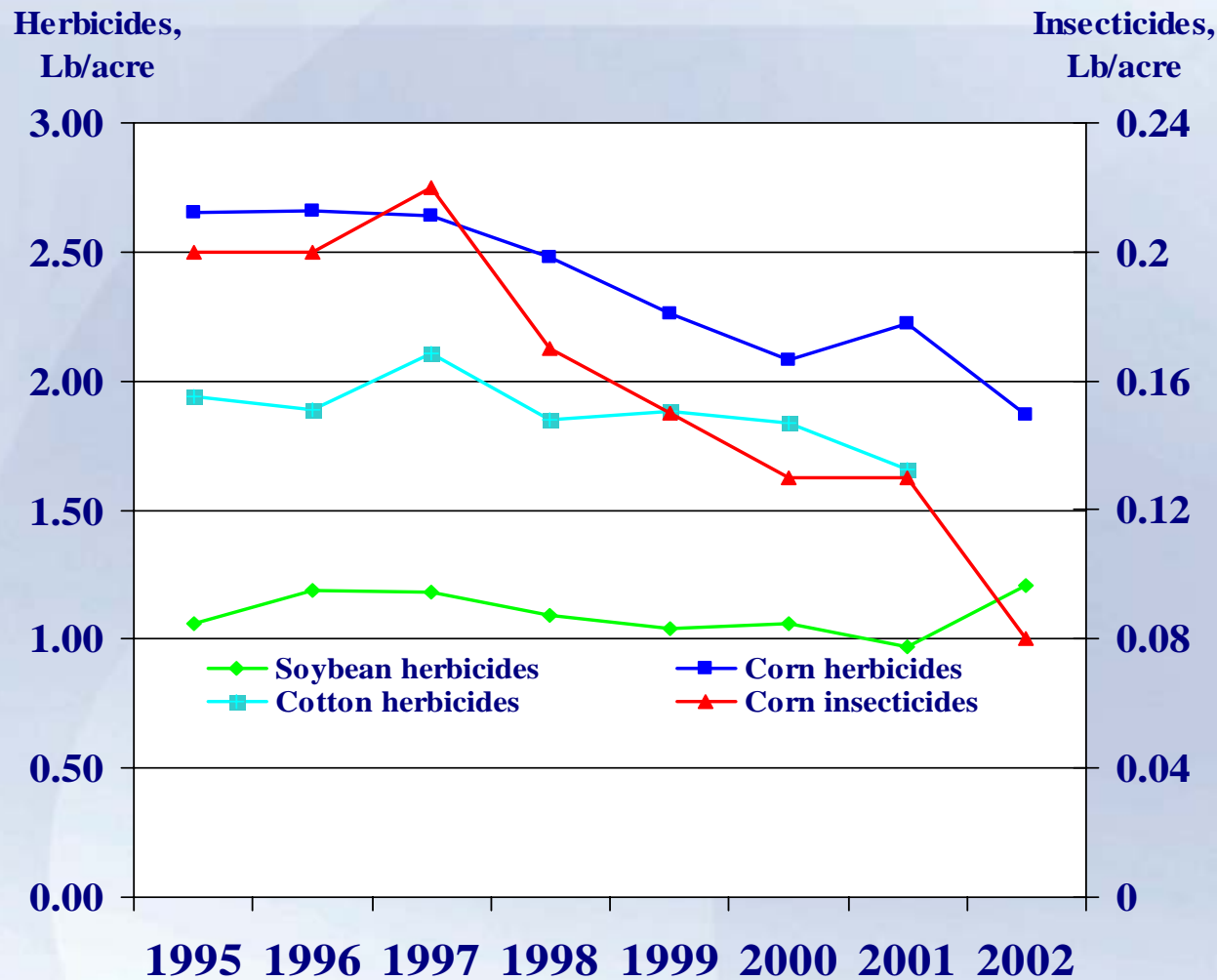
- ◆ An important alternative use of time is off-farm work by farmers and their spouses (off-farm income of U.S. farm households is now higher than net income earned from farming).
- ◆ Recent ERS research using 2000 U.S. data shows that adoption of HT soybeans is associated with a significantly higher off-farm household income as well as total farm household income.
- ◆ This result suggests that farmers who adopt HT soybeans save management time, allowing them to obtain a higher income from off-farm activities.



# Adoption and Pesticide Use



# Pesticide use per planted acre in major field crops



Source: USDA/NASS surveys



## Controlling for other factors, lower pesticide use was associated with adoption of GE crops:

- ◆ In terms of pesticide acre-treatments: reduction of 19.1 million, a 6.2 percent decrease (1997/98 data).
- ◆ In terms of total amount of pesticide active ingredients: reduction of about 2.5 million pounds.
- ◆ Adoption of HT soybeans allowed farmers to use more benign herbicides (glyphosate has lower toxicity (1/3) and persistence (1/2) than the herbicides that it replaces).





# Effect of GE Crops on Pesticide Use: Summary of Primary Studies

Number of studies	Data source	Effect on Pesticide Use
2	Experimental plots	Decrease
11	Surveys	10 Decrease 1 Small Increase



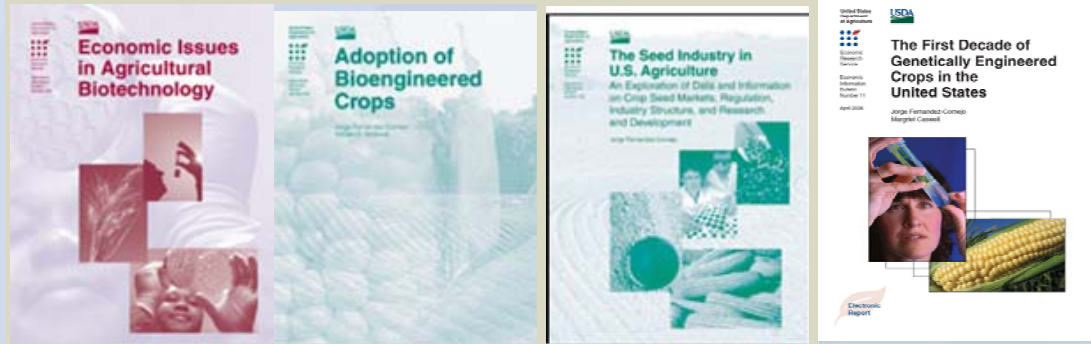
# Conclusions

- ◆ Adoption of GE crops in the U.S. has been rapid since these crops first became available to U.S. farmers in 1996. HT soybeans reached more than 90 percent adoption after 12 years.
- ◆ In general there were tangible benefits to farmers adopting GE crops, but not all are captured in traditional measures of profits.
- ◆ The adoption of GE crops is associated with a reduction in pesticide use. In addition, the pesticides used are more environmentally benign.



# Thank you!

For more information:



<http://www.ers.usda.gov/publications/aib762/>

<http://www.ers.usda.gov/publications/aib786/>

<http://www.ers.usda.gov/publications/aer810/>

<http://www.ers.usda.gov/publications/tb1906/tb1906.pdf>

<http://www.ers.usda.gov/publications/EIB11/>

Data:

1. ARMS: <http://www.ers.usda.gov/data/arms/>

2. Other adoption data: <http://www.ers.usda.gov/Data/BiotechCrops/>

