INTERNATIONAL COTTON ADVISORY COMMITTEE
1629 K Street NW, Suite 702, Washington DC 20006 USA
Telephone +1-202-463-6660 • Fax +1-202-463-6950 • email secretariat@icac.org

August 2010

Report From the
Expert Panel on Social, Environmental and Economic Performance of Cotton Production (SEEP)

FACTORS INFLUENCING THE USE OF PESTICIDES IN COTTON IN THE U.S.

1. Factors Impacting Insecticide Usage in the U.S.

Although the amount of insecticide use has varied from year to year, the usage on cotton has been on the decrease in the U.S. since the early 1990s. The number of insecticide applications has decreased by almost 50% (Figure 1) with corresponding decreases in amounts of active ingredient applied (Figure 2). Factors having the greatest influence on the decline in the amount of insecticide used are:

(1) The early adoption (beginning in the 1960s) and continued use of integrated pest management (IPM) strategies;

(2) The successful elimination of the boll weevil as a pest on over 87% (USDA-APHIS 2007) of total U.S. cotton area through an area-wide management program known as the Boll Weevil Eradication Program (BWEP);

(3) The reduction in pink bollworm populations as a result of the Pink Bollworm Eradication Program (many of the early participating areas now report a 99% reduction in seasonal moth captures with no use of insecticides to control pink bollworm since 2006); and

(4) The introduction of transgenic varieties known as Bt cottons with insecticidal activity against tobacco budworm, cotton bollworm, pink bollworm, and other lepidopteran pests.

Figure 1. Average number of insecticide applications per hectare on cotton: 1986-2008. (National Cotton Council 2009a)

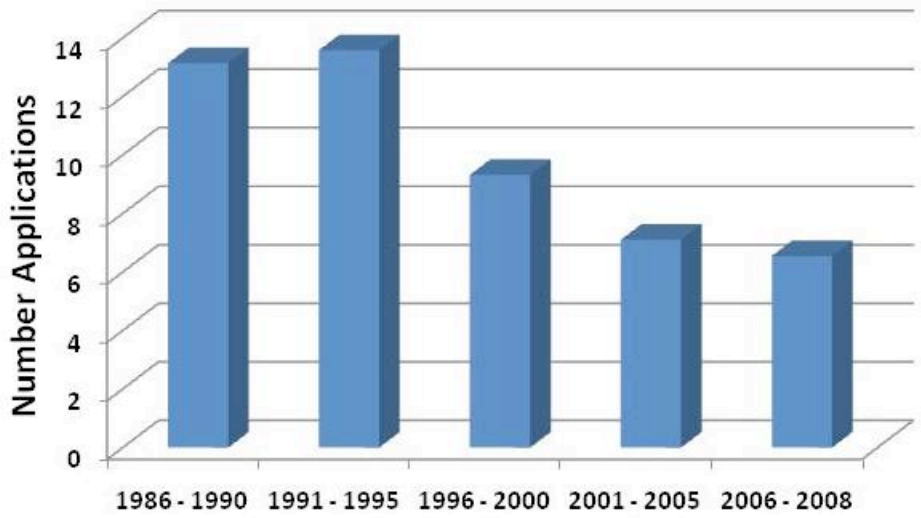
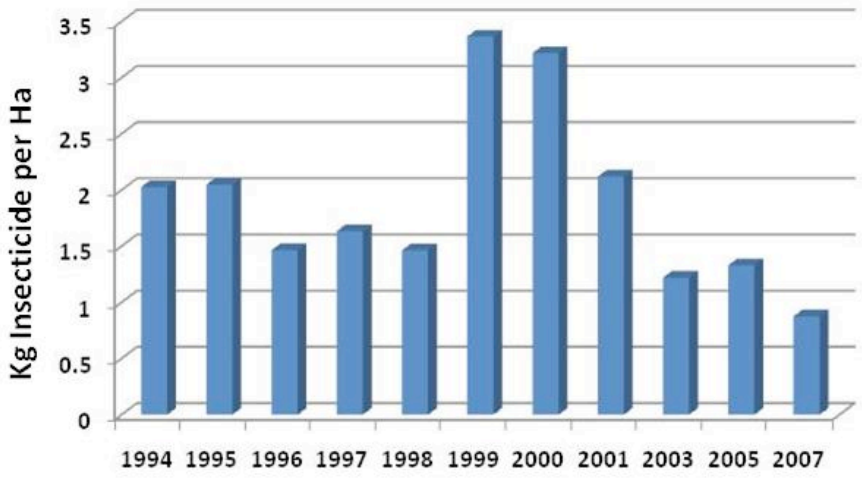


Figure 2. Average number of kilograms of insecticide (includes nematacides) applied per planted hectare in the U.S. 1994-2007 (USDA-NASS 1994-2007)



1.1 Integrated Pest Management

The use of IPM strategies in cotton has a long history in the U.S. Cotton producers were earlier adopters of the technologies and are further along the IPM continuum than producers of other major crops in the U.S. For example, in 1996, scouting practices for insects were used on 88% of planted acres, and for weeds, 72% (Fernandez-Cornejo & Jans 1999). In 2007, scouting practices for both weeds and insects were in place on > 90% of the farms that produced cotton and on > 90% of the planted cotton acres (USDA-NASS 1994-2008).

The cooperative extension programs in the 17 cotton producing states are to be credited with the successful implementation and adoption of IPM in the U.S. These programs produce recommendations for scouting, treatment thresholds, insecticides, pest avoidance and suppression tactics, etc., to help growers and consultants to implement IPM.

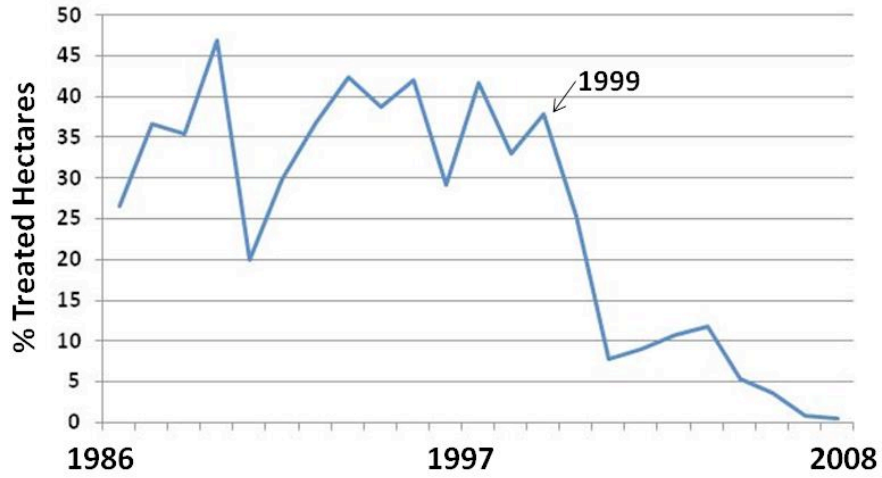
1.2 The Boll Weevil Eradication Program

The boll weevil (*Anthonomus grandis*) is a native of Mexico and Central America. It was first introduced into the U.S. near Brownsville, Texas, in about 1892. By 1922, the pest had spread into most of the cotton growing areas of the U.S. Since then, it has cost U.S. cotton producers more than $15 billion from yield losses and costs to control the insect pest (National Cotton Council 2009b).

Late in the 1970s, the Boll Weevil Eradication Program (BWEP) was launched in southern Virginia and northern North Carolina. Today all cotton area in the U.S. is involved in the program along with parts of northern Mexico with cotton acreage along the U.S. border. As the program has progressed towards completion, an increasing number of hectares are weevil-free, and the number of hectares requiring pesticide application for control of the pest has dramatically decreased (Figure 3).

It must be noted that in certain years BWEP has had a negative impact on the yearly use of pesticides on cotton in the U.S. Different cotton growing regions have joined BWEP in different years. Typically, heavy applications of insecticides are required in the first year of the program, followed by years when applications are made based on monitoring data. A large increase in the number of cotton-producing regions joining the program began in 1993, and in 1999-2000 high insecticide use coincided with more than 800,000 hectares in Texas coming into the program (Figure 3).

Figure 3. Estimated proportion of cotton area treated for control of boll weevil: 1986-2008. (National Cotton Council, 2009a)



1.3 The Pink Bollworm Eradication Program

The pink bollworm (*P. gossypiella*) was first detected in Texas in 1917 and presumably entered the U.S. from northeast Mexico. The pest gradually expanded westward into New Mexico, Arizona, and California. A sterile pink bollworm moth-release program was initiated in the San Joaquin Valley of California in 1970 to protect the valley against establishment of the pest. The National Cotton Council estimated the pink bollworm was costing western cotton producers $32 million annually in control costs and yield losses (National Cotton Council 2009c). In 2001, a Pink Bollworm Eradication Program was initiated. The program began in El Paso, Texas, and New Mexico with later expansion into Arizona and southern California. Northern areas of Mexico bordering the U.S. are now part of the program. USDA-APHIS provides coordination assistance for this Bi-National Eradication Program.

1.4 Biotech Cotton

Biotech cotton varieties carrying the gene for the Bt toxin were introduced in the U.S. in 1996. In 2009, more than 60% of cotton area was planted to Bt varieties (Figure 4). As the adoption of these varieties increased, there was a steady decline in the number of insecticide applications used for tobacco budworm (*Heliothis virescens*), cotton bollworm (*Helicoverpa zea)*, and pink bollworm (*P. gossypiella*) (Figure 5).

Figure 4. Adoption rate for Bt transgenic cotton varieties: 1996-2009 (USDA-ERS 2009; Fernandez-Cornejo and McBride 2002)

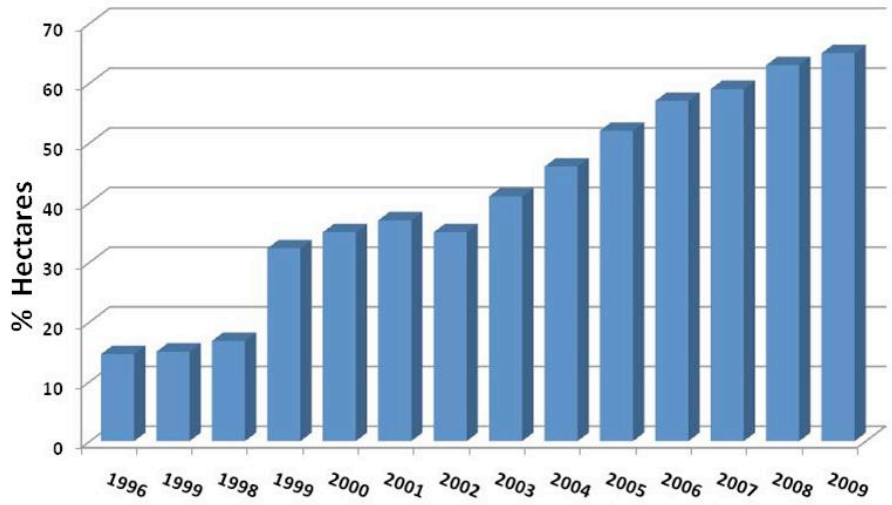
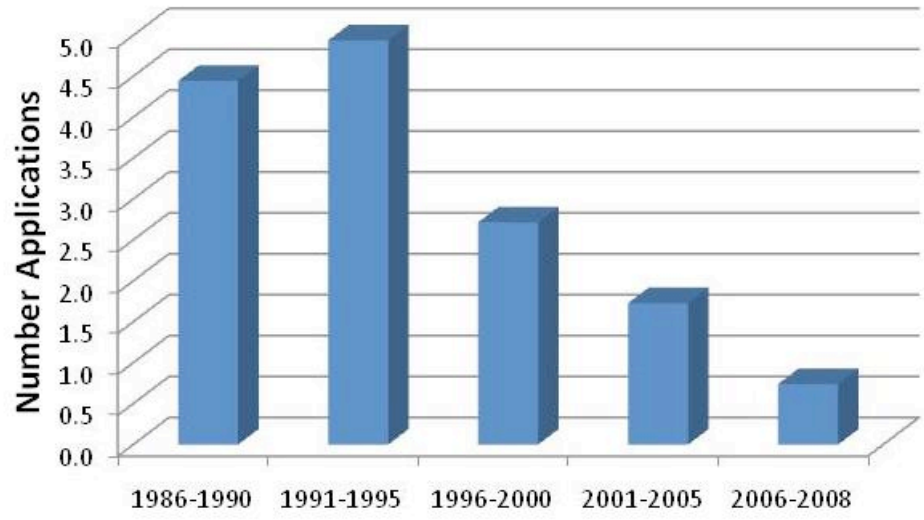


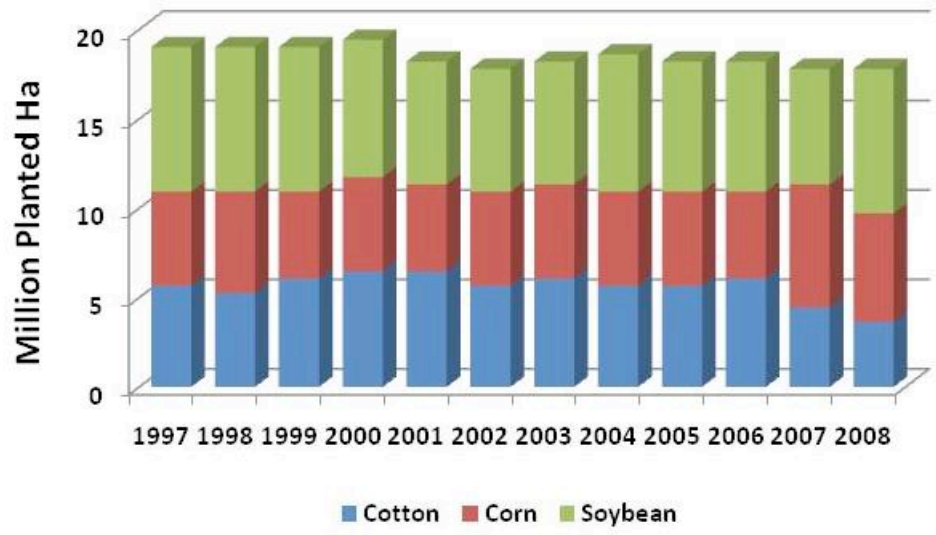
Figure 5. Average number of insecticide applications per hectare for control of tobacco budworm, cotton bollworm, and pink bollworm in U.S. cotton: 1986-2008 (National Cotton Council 2009a)



1.5 Other factors

Other factors that have contributed to the decline in the amount of pesticides used in cotton include the broad adoption of seed treatments and the successful use of insect growth regulators (IGRs) against the whitefly in the southwest. There has also been a decline in cotton area (Figure 6) brought about by market pressure from other commodities, primarily wheat, corn, and soybean. Cotton area has declined from a high of 6.8 million planted hectares in 1995 to 6.1 million hectares in 2006, and in 2009, there were only 3.6 million hectares planted in the U.S. Much of this decline in hectares was in production regions with high insect and weed pressure.

Figure 6. Planted hectares for corn, soybean, and cotton in the U.S: 1997-2008 (USDA-NASS 1975-2009)



2 Spectrum of Pesticides Used

In the U.S. there is a broad spectrum of pesticides available for use on cotton. Federal registration status and risk mitigation measures are among the factors that influence the active ingredients available to growers.

2.1 Pesticide Registration Framework

All pesticides sold or distributed in the U.S. must be registered by the Environmental Protection Agency (EPA), based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides the framework for EPA to regulate pesticides and requires that registered pesticides be reviewed on a regular basis to ensure that older pesticide products meet modern standards. FIFRA also requires EPA and state agencies to establish worker protection programs and provide training to workers and certification for applicators.

Passed in 1996, the Food Quality Protection Act (FQPA) amended FIFRA, setting more stringent standards for pesticide use in food crops. Cotton is regulated as a food crop in the U.S. Under FQPA, EPA must assure “reasonable certainty” that no harm will result from all combined sources of exposure to pesticides or combined effects of similar acting pesticides. Mitigation measures are imposed on products in order to reduce potential harm. One must remember, Risk = Exposure X Hazard. Identification of proper mitigation measures to reduce exposure provides safe use of a product with hazardous properties. There are many mitigation possibilities. For example, closed system mixing/loading of pesticides can mitigate concerns that workers would be exposed to harmful materials. In other instances, some products (e.g. dicrotophos) have had restrictions imposed that limit the amount of material that may be used per application and/or the total amount that may be applied per year, while others (e.g. endosulfan) are further restricted to where they can be used. Endosulfan is registered for use on cotton in Arizona, New Mexico, Texas and California, only.

Since 1990 registration of 13 pesticides noted in the Study has been cancelled and they can no longer be used legally on cotton in the U.S. (Table 1).

Table 1. Changes since 1990 in the registration status of 13 active ingredients used on cotton. Source: USEPA.

Pesticide	Regulatory Update
azinophos-methyl	Registration on cotton cancelled September 11, 2009
carbofuran	Last registrations cancelled December 31, 2009; Used in cotton only under Pesticide Emergency Exemption (Section 18 of FIFRA)
diazinon	Registration on cotton cancelled May 2, 2001
disulfoton	Last registrations cancelled September 23, 2009
ethoprophos	Registration on cotton cancelled prior to 1997
fonofos	Last registrations cancelled November 2,1998. Use allowed until November 30, 1999
lindane	Last registrations cancelled August 2, 2006
metamidophos	Last registrations cancelled September 23, 2009
mevinphos	Last registrations cancelled July 1, 1994. Use allowed until November 30, 1995
parathion (ethyl)	Last registrations cancelled December 31, 2002. Use allowed until October 31, 2003
parathion (methyl)	Last 2 registrations to be cancelled May 28, 2010; Others cancelled 2002-2003
phosmet	Registration on cotton cancelled December 10, 2007
phosphamidon	Last registrations cancelled May 30, 1990. Use allowed until supplies depleted.
sulprofos	Last registrations cancelled April 1997

2.2 Risk Mitigation

There are legal requirements that must be met in the U.S. before pesticides can be used in an agricultural setting. EPA requires identification of risk mitigation measures as a component of the registration process. These measures appear on the product label and are legally binding. Examples include:

- closed systems for mixing/loading
- type of protective clothing
- user training
- method of application
- practices to minimize surface runoff
- application distance from drinking water or surface water
- environmental conditions under which the product can be applied
- measures to protect honey bees
- measures to reduce potential for spray drift

Those pesticides that are considered to have a relatively high degree of potential human and/or environmental hazard even when used according to the label directions are designated as Restricted Use Pesticides. These pesticides are available for purchase and use only by certified pesticide applicators or persons under their direct supervision. Some states adhere to EPA's federal listing for determining the pesticide active ingredients that are classified as "restricted," while others may determine that additional active ingredients should be added due to local conditions, generally related to environmental concerns.

In addition to the requirements that are on the label, the Worker Protection Standard for Agricultural Workers (WPS), enacted in 1992, provides further mitigation of risk associated with the use of a pesticide. The WPS is a federal regulation designed to protect farm workers and pesticide handlers from occupational exposures to agricultural pesticides. It contains requirements for:

- pesticide safety training
- notification of pesticide applications
- use of personal protective equipment
- restricted entry intervals following pesticide application
- access to decontamination supplies
- directions for access to emergency medical assistance, if needed

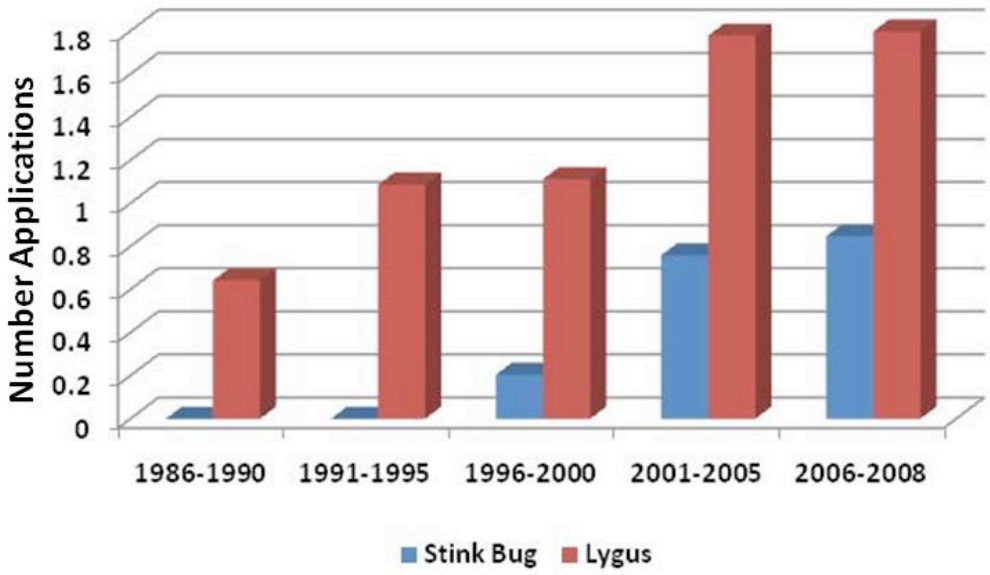
All agricultural employers, owners, and managers, as well as labor contractors, are required to comply with the WPS.

3 Conclusions

There has been a downward trend in the amounts of insecticides applied to cotton in the U.S. in the last 15 years. A number of factors have contributed to this decline, including IPM, the BWEP, and biotech cotton. The reduction in amounts of insecticide used has led to a change in the status of several pests that attack cotton. This has been especially apparent in the mid-south and southeastern states where there has been both a high adoption of biotech cotton varieties and where the BWEP has reached completion. In the past, insecticides applied for control of tobacco budworm, cotton bollworm and the boll weevil had inadvertently kept populations of the tarnished plant bug (*Lygus lineoaris*) and the stink bug complex (green stink bug, *Acrosternum hilare;* southern green stink bug, *Nezara viridula*; and brown stink bug, *Euschistus servus*) at relatively low levels. But in a low insecticide environment, these pests have become major late season economic pests, and the number of applications of insecticide for their control has increased (Figure 7). However, the overall average number of applications made and amounts of insecticide used have continued to decline in spite of the change in the pest complex.

Farmers have a relatively wide spectrum of pesticides available for their use to manage the cotton crop, some of which are in the WHO Class I category (see section 2.2). In the U.S., cotton is considered a food crop and pesticides used on cotton are regulated accordingly by federal and state governments. In addition, the U.S. cotton production system is highly mechanized; a combination of closed mixing systems, personal protective equipment and enclosed cabs for application equipment, all significantly limit worker exposure. Also in place are stringent laws backed up by strict enforcement to ensure the safety of the cotton product, safety of the workers, and safety of the environment.

Figure 7. Average number of insecticide applications per hectare for control of Lygus and stink bugs in U.S. cotton: 1986 – 2008. (National Cotton Council 2009a).



References

Carpenter, J., & Gianessi, L. (2001). *Agricultural biotechnology: Updated benefits estimates*. Washington, DC: Case National Center for Food and Agricultural Policy. http://www.ncfap.org/documents/updatedbenefits.pdf

Fernandez-Cornejo, J, and S. Jans. 1999. Pest Management in U.S. Agriculture. (Agricultural Handbook No. 717).
http://www.ers.usda.gov/publications/ah717/ah717.pdf

Fernandez-Cornejo, J. and W. D. Mc Bride. 2002. Adoption of Bioengineered Crops. (Agricultural Economic Report No. 810). http://www.ers.usda.gov/publications/aer810/aer810.pdf

Frisvold, George B., Jeanne M. Reeves and Russell Tronstad. 2006. Bt Cotton Adoption in The United States and China: International Trade and Welfare Effects. http://www.agbioforum.org/v9n2/v9n2a01-frisvold.pdf

Gianessi, L.P., Silvers, C.S., Sankula, S., & Carpenter, J.E. (2002). *Plant biotechnology: Current and potential impact for improving pest management in U.S. agriculture, an analysis of 40 case studies*. Washington, DC: National Center for Food and Agricultural Policy. http://www.ncfap.org/documents/CottonIR1.pdf and http://www.ncfap.org/documents/CottonIR2.pdf

James, C. (2007). *Global Stataus of Commercialized Biotech/GM Crops: 2007.* (ISAAA briefs no. 37). Ithaca, NY: International Service for the Acquisition of Agri-biotech Applications.

Marra, M.C. (2001). The farm level impacts of transgenic crops: A critical review of the evidence. In P.G. Pardey (Ed.), *The future of food: Biotechnology markets in an international setting* (pp. 155-184). Baltimore: Johns Hopkins Press and International Food Policy Research Institute.

National Cotton Council. 2009a. Beltwide Cotton Conference Proceedings. 1987-2009. Cotton Insect Losses Reports.

National Cotton Council. 2009b. Boll Weevil Eradication Program. http://www.cotton.org/tech/pest/bollweevil/

National Cotton Council. 2009c. Pink Bollworm Eradication.
http://www.cotton.org/tech/pest/bollworm/index.cfm

USDA-APHIS. 2007. Boll Weevil Eradication Fact Sheet.
http://www.aphis.usda.gov/publications/plant_health/content/printable_version/faq_boll_weevil_07.pdf

USDA-ERS. 2009. Adoption of Genetically Engineered Crops in the U.S.
http://www.ers.usda.gov/data/biotechcrops/

USDA-NASS. 1994 - 2008. Agricultural Chemical Usage: Field Crops Summary.
http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1560