NOTE: Below are extracts collected and summarized by GMWatch from the new report on the impacts of GM crops on pesticide use in the U.S. since their introduction some 13 years ago. The report draws on U.S. Department of Agriculture data. Its author is Dr Charles Benbrook. Benbrook worked in Washington, D.C. on agricultural policy, science and regulatory issues from 1979 through 1997, including 7 years as the Executive Director of the Board on Agriculture of the National Academy of Sciences. He is now the Chief Scientist at the Organic Center .

Impacts of Genetically Engineered Crops on Pesticide Use: The First Thirteen Years
November 2009
by Charles Benbrook

Accessing the report
The full report - pdf (3.68 MBs, 69 pages)
Executive Summary - pdf (1.44 MBs, 15 pages)
Supplemental Tables - pdf

Extracts collected and summarized by GMWatch

On the report's purpose

This report explores the impact of the adoption of GM corn, soybean, and cotton on pesticide use in the United States, drawing principally on data from the US Department of Agriculture. The most striking finding is that GM crops have been responsible for an increase of 383 million pounds of herbicide use in the U.S. over the first 13 years of commercial use of GM crops (1996-2008).

This dramatic increase in the volume of herbicides applied swamps the decrease in insecticide use attributable to GM corn and cotton, making the overall chemical footprint of today's GM crops decidedly negative. The report identifies, and discusses in detail, the primary cause of the increase -- the emergence of herbicide-resistant weeds.

The steep rise in the pounds of herbicides applied with respect to most GM crop acres is not news to farmers. Weed control is now widely acknowledged as a serious management problem within GM cropping systems. Farmers and weed scientists across the heartland and cotton belt are now struggling to devise affordable and eff ective strategies to deal with the resistant weeds emerging in the wake of herbicide-tolerant crops.

But skyrocketing herbicide use is news to the public at large, which still harbors the illusion, fed by misleading industry claims and advertising, that biotechnology crops are reducing pesticide use.

In addition to toxic pollution from pesticides, agriculture faces the twin challenges of climate change and burgeoning world populations. The biotechnology industry's current advertising

campaigns promise to solve those problems, just as the industry once promised to reduce the chemical footprint of agriculture. Before we embrace GM crops as solution to these new challenges, we need a sober, data-driven appraisal of its track record on earlier pledges.

While the USDA continued to collect farm-level data on pesticide applications during most of the 13 years covered in this report, the Department has been essentially silent on the impacts of GM crops on pesticide use for almost a decade. This is why this report by Dr. Charles Benbrook was commissioned.

On the impacts of GM crops on pesticide use

GM crops have increased overall pesticide use by 318.4 million pounds over the first 13 years of commercial use, compared to the amount of pesticide likely to have been applied in the absence of HT (herbicide tolerant) and Bt seeds.

Bt corn and cotton have delivered consistent reductions in insecticide use totaling 64.2 million pounds over the 13 years. HT crops have increased herbicide use by a total of 382.6 million pounds over 13 years. HT soybeans increased herbicide use by 351 pounds (about 0.55 pound per acre), accounting for 92% of the total increase in herbicide use across the three HT crops.

Recently herbicide use on GM acres has veered sharply upward. Crop years 2007 and 2008 accounted for 46% of the increase in herbicide use over 13 years across the three HT crops (corn, soy and cotton). Herbicide use on HT crops rose a remarkable 31.4% from 2007 to 2008.

GM crops reduced overall pesticide use in the first three years of commercial introduction (1996-1998) by 1.2%, 2.3%, and 2.3% per year, but increased pesticide use by 20% in 2007 and by 27% in 2008.

Two major factors are driving the trend toward an increase in the pounds of herbicides used to control weeds on an acre planted to HT seeds, in comparison to conventional seeds:
*The emergence and rapid spread of weeds resistant to glyphosate, and
*Reductions in the application of herbicides applied on non-GM crop acres.

USDA NASS data show that since 1996, the glyphosate rate of application per crop year has tripled on cotton farms, doubled in the case of soybeans, and risen 39% on corn. The average annual increase in the pounds of glyphosate applied to cotton,
soybeans, and corn has been 18.2%, 9.8%, and 4.3%, respectively, since HT crops were introduced.

HT crops account for the lion’s share of total GM trait acreage - 72% over the first 13 years of commercial use and around three-quarters in most years. HT soybeans account for almost one-half of all GM trait acres. This is why HT soybeans are so important in terms of the overall impact of GM crops on the pounds of pesticides applied.

On the impact of Bt crops on pesticide use

The methodologies used by USDA to project pesticide use on conventional and GM-crop acres require a number of assumptions and projections, which may not be true.

1. One assumption is that Bt crop growers apply no chemical insecticides for the pests targeted by these traits, including cotton rootworm. But University of Illinois entomologists have documented spotty performance of Bt corn for Corn Root Worm control, especially under high population pressure, and reported that some growers have applied soil insecticides on Bt corn acres. So this assumption overstates the benefits of Bt technology regarding reducing insecticides.

2. Another assumption is that Bt corn planted for European Corn Borer and Southwestern Corn Borer can be credited with displacement of all the pounds of organophosphate or synthetic pyrethroid insecticides that would be applied to corn without the Bt trait. This assumption would overstate the benefits of the Bt technology regarding reducing insecticides, since a portion of most of these insecticides are applied by farmers for the control of other insects, including the Corn Root Worm.

3. A third assumption is that some portion of the acres planted to Bt corn displace insecticides. But before the commercial availability of Bt corn seed, some farmers were not treating their fields with insecticides. Historically, only around 35% of corn acres have been treated each year with an insecticide for control of the European Corn Borer, Southwestern Corn Borer, Corn Root Worm, and other insect pests. So this assumption overstates the benefits of Bt technology regarding reducing insecticides.

4. A fourth assumption is that the Bt toxins manufactured within the cells of Bt crops do not count as insecticides “applied” on Bt-crop acres. Opinions differ among experts on whether it is appropriate to count Bt toxins manufactured inside GM plants as equivalent to a Bt liquid insecticide sprayed on the outside of the plant.

One factor to bear in mind when considering this question is that liquid sprays expose pest populations to short-lived selection pressure, thereby reducing the risk of resistance. Bt liquid sprays are applied only when and as needed, consistent with the core principles of integrated pest management (IPM).

Bt plants, however, produce the toxin continuously during the growing season, not just when needed, and in nearly all plant tissues, not just where the toxins are needed to control attacking insects. In a year with low pest pressure, farmers can decide not to spray insecticides on a corn field, but they cannot stop Bt hybrids from manufacturing Bt toxins in nearly all plant cells.

On glyphosate-resistant weeds

Glyphosate-resistant (GR) weeds were practically unknown before the introduction of RR crops in 1996. Today, nine or more GR weeds collectively infest millions of acres of U.S. cropland. Thousands of fields harbor two or more resistant weeds. The South is most heavily impacted, though resistant weeds are rapidly emerging in the Midwest, and as far north as Minnesota,

Wisconsin, and Michigan. Farmers can respond to resistant weeds on acres planted to HT crops in five ways:
*Applying additional herbicide active ingredients,
*Increasing herbicide application rates,
*Making multiple applications of herbicides previously sprayed only once,
*Through greater reliance on tillage for weed control, and
*By manual weeding.
In the period covered by this report, the first three of the above five responses have been by far the most common, and each increases the pounds of herbicides applied on HT crop acres.

GR pigweed (Palmer amaranth) has spread dramatically across the South since the first resistant populations were confirmed in 2005, and already poses a major threat to U.S. cotton production. Some infestations are so severe that cotton farmers have been forced to abandon cropland, or resort to the preindustrial practice of “chopping cotton” (hoeing weeds by hand).

GR weeds are not only driving increases in the use of glyphosate, but also the increased use of more toxic herbicides, including paraquat and 2,4-D, one component of the Vietnam War defoliant, Agent Orange.

On how GR weed problems will impact health and the environment

Growing reliance on older, higher-risk herbicides for management of resistant weeds on HT crop acres is now inevitable in the foreseeable future and will markedly deepen the environmental and public health footprint of weed management on over 100 million acres of U.S. cropland. This footprint will both deepen and grow more diverse, encompassing heightened risk of birth defects and other reproductive problems, more severe impacts on aquatic ecosystems, and more frequent instances of herbicide-driven damage to nearby crops and plants.

On the road ahead for GM crops

Crop year 2009 will probably mark several tipping points for RR crops. The acres planted to HT soybeans fell 1% from the year before, and will likely fall by a few additional percentage points in 2010. Farmer demand for conventional soybeans is outstripping supply in several states, and universities and regional seed companies are working together to close the gap. Reasons given by farmers for turning away from the RR system include the cost and challenges inherent in dealing with GR weeds, the sharply increasing price of RR seeds, premium prices offered for non-GM soybeans, the poorer than expected and promised yield performance of RR 2 soybeans in 2009, and the ability of farmers to save and replant conventional seeds (a traditional practice made illegal with the purchase of HT/RR seeds).

In regions where farmers are combating resistant weeds, university experts are projecting increases of up to $80 per acre in costs associated with HT crops in 2010. This increase represents a remarkable 28% of soybean income per acre over operating costs.

The economic picture dramatically darkens for farmers combating resistant weeds under

average soybean yields (36 bushels) and market prices ($6.50 per bushel). Such average conditions would generate about $234 in gross income per acre. The estimated $80 increase in 2010 costs per acre of HT soybeans would then account for one-third of gross income per acre, and total cash operating costs would exceed $200 per acre, leaving just $34 to cover land, labor, management, debt, and all other fixed costs. Such a scenario leaves little or no room for profit at the farm level.

Monsanto and Syngenta are now offering to pay farmers rebates on the order of $12 per acre to spray herbicides that work through a mode of action different from glyphosate. Monsanto's program will even pay farmers to purchase herbicides sold by competitors, a sign of how seriously Monsanto now views the threat posed by resistance to its own product.

While corn, soybean, and cotton farmers view the spread of resistant weeds as a slow moving train wreck eroding their bottom line, the seed and pesticide industry sees new market opportunities and profit potential arising in the wake of resistant weeds. A large portion of industry R&D investments are going into the development of crops that will either withstand higher rates of glyphosate applications, or tolerate applications of additional herbicides, or both. In short, the industry's response is more of the same.

One major biotech company has applied for and received a patent covering HT crops that can be directly sprayed with herbicide products falling within seven or more different chemical families.