

Find the full report at www.ers.usda.gov/publications/eib-economic-information-bulletin/eib-124.aspx

Pesticide Use in U.S. Agriculture: 21 Selected Crops, 1960-2008

Jorge Fernandez-Cornejo, Richard Nehring, Craig Osteen, Seth Wechsler, Andrew Martin, and Alex Vialou

What Is the Issue?

Pesticides—including herbicides, insecticides, and fungicides—have contributed to substantial increases in crop yields over the past five decades. Properly applied, pesticides contribute to higher yields and improved product quality by controlling weeds, insects, nematodes, and plant pathogens. In addition, herbicides reduce the amount of labor, machinery, and fuel used for mechanical weed control. However, because pesticides may possess toxic properties, their use often prompts concern about human health and environmental consequences. The examination of pesticide use trends is critical for informed pesticide policy debate and science-based decisions. This report analyzes pesticide use trends using a new pesticide database compiled from USDA and proprietary data, focusing on 21 crops.

What Did the Study Find?

Total pesticide use, as well as the specific active ingredients used (for example, with novel target sites of action or improved toxicological profiles), has changed considerably over the past five decades.

Pesticide use on the 21 crops analyzed in this report rose rapidly from 196 million pounds of active ingredient (a.i.) in 1960 to 632 million pounds in 1981, largely because of the increased share of planted acres treated with herbicides to control weeds. In addition, the total planted acreage of corn, wheat, and, in particular, soybeans increased from the early 1960s to early 1980s, which further increased herbicide use. Most acres planted with major crops (particularly corn and soybeans) were already being treated with herbicides by 1980, so total pesticide use has since trended slightly downward driven by other factors, to 516 million pounds in 2008 (the most recent year for which we have enough complete data).

The rapid adoption of herbicides was mainly driven by relative price declines that helped reduce the cost of herbicides relative to other pest control practices and encouraged substitution of herbicides for labor, fuel, and machinery use in mechanical weed control. The fluctuations in pesticide use over 1982-2008 were driven by several factors, including changes in planted acreage, crop and input prices, weather, pesticide regulations, and the introduction of new pesticides and genetically engineered (GE) seed. Changes in the acreages of corn, cotton, soybeans, potatoes, and wheat contributed to fluctuations in pesticide use from 1981 to 2008, with many high and low years in herbicide and pesticide use coinciding with high and low years in total acreage of these crops.

The pesticide types applied by U.S. farmers for the 21 crops analyzed changed considerably from 1960 to 2008. *Insecticides* accounted for 58 percent of pounds applied in 1960, but only 6 percent in 2008. On the other hand, *herbicides* accounted for 18 percent of the pounds applied in 1960 but 76 percent by 2008. The growth of herbicide use is also illustrated by the percent of acres treated.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

Approximately 5-10 percent of corn, wheat, and cotton acres were treated with herbicides in 1952. By 1980, herbicide use had reached 90-99 percent of U.S. corn, cotton, and soybean acres planted. Notably, the four most heavily used active ingredients in 2008 (glyphosate, atrazine, acetochlor, and metolachlor) were all herbicides. *Fungicides'* share of pesticide use has remained at 7 percent or less since 1971, down from 11-13 percent in the early 1960s. *Other pesticides*—which include soil fumigants, desiccants, harvest aids, and plant growth regulators—generally accounted for 5-11 percent of total pesticide use from 1960 to 1992, increased to 17 percent of use in 2002, and then declined to 13 percent in 2008.

Total **pesticide expenditures** in U.S. agriculture reached close to \$12 billion in 2008, a 5-fold increase in real terms (adjusted for inflation) since 1960, but well below the \$15.4-billion peak reached in 1998.

In 2008, corn, soybeans, cotton, wheat, and potatoes accounted for about 80 percent of the pesticide quantity (measured in pounds of a.i.) applied to the 21 crops examined. *Corn* has been the top pesticide-using crop in the United States since 1972 and received about 39 percent of the pesticides in 2008 (mostly herbicides). While corn is a major component of livestock feed, expansion of ethanol production for fuel use has boosted corn acres in recent years. The increase in corn acreage led to an increase in pesticide use and change in the active ingredients used. The change in active ingredients also reflects increased glyphosate use associated with the adoption of HT crops.

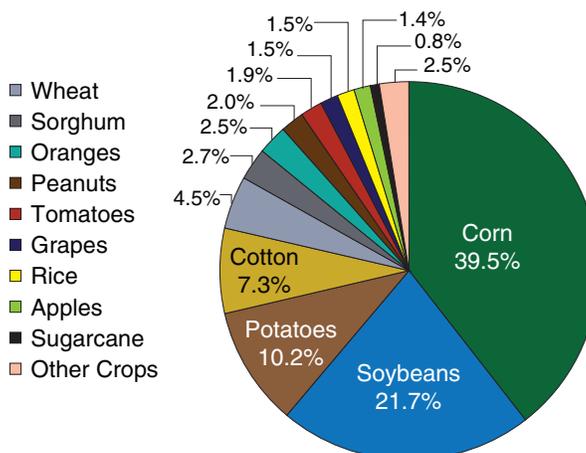
Soybean production had the next largest share in 2008 (22 percent), almost all of which were herbicides. *Potatoes'* share rose significantly in the 1990s and reached about 10 percent by 2008. Other pesticides, including soil fumigants and desiccants, constituted a large portion of the pesticides applied to potatoes in 2008. *Cotton* accounted for just over 7 percent of the pesticides, mostly insecticides, in 2008, a major reduction from its 40-percent share in the early 1960s. The quantity applied to cotton trended downward since 1972 due to the replacement of DDT and other older insecticides with more effective products, eradication of the boll weevil, and adoption of Bt cotton. *Wheat* accounted for less than 5 percent of the pesticides, mostly herbicides, in 2008.

How Was the Study Conducted?

The study analyzes a new pesticide database that was compiled from pesticide use surveys carried out by USDA's National Agricultural Statistics Service (NASS) and Economic Research Service (ERS), supplemented by proprietary data provided by a market research company to the U.S. Environmental Protection Agency (EPA), and shared with ERS under an agreement between the two agencies.

The data were collected for 1960-2008 and focus on 21 crops: apples, barley, corn, cotton, grapefruit, grapes, lemons, lettuce, peaches, peanuts, pears, pecans, potatoes, oranges, rice, sorghum, soybeans, sugarcane, sweet corn, tomatoes, and wheat. These crops account for roughly 72 percent of total conventional pesticide use in U.S. agriculture. This report discusses "conventional" pesticides defined by the EPA as substances developed and produced primarily or only for use as pesticides and excludes sulfur, petroleum distillate, sulfuric acid, and hydrated lime. In addition to data described above, the study used pesticide expenditure data covering all U.S. agriculture drawn from ERS publications.

Pesticide use by crop, 21 selected crops, 2008, percent total pounds of active ingredient applied



Note: "Other Crops" include: lettuce, pears, sweet corn, barley, peaches, grapefruit, pecans, and lemons.

Sources: Economic Research Service with USDA and proprietary data. See Appendix 2.