

## Highlights

This report presents information on nutrient and pest management practices, crop residue management, and other general crop management practices in use on U.S. farms.

Farmers are the primary decisionmakers on how they combine their production resources and management skills to produce food and fiber. Changes in farmer practices over time, but especially since the end of World War II, have greatly increased agricultural productivity. However, the public has expressed concerns about the possible undesirable effects of contemporary agricultural practices that rely heavily on commercial fertilizers and chemical pesticides. Partly as a response to these concerns, the U.S. Department of Agriculture (USDA) began collecting information from farmers on their chemical inputs and agricultural production practices in 1964. In 1990, through the President's Water Quality Initiative, the USDA expanded its data collection efforts. The information presented in this report is largely for the 1990's. Although the information cannot contribute to the science underlying the debate about the effects of agriculture on human health and environmental risk, it can provide information on the use of relevant inputs and production practices that are likely to abate, or to exacerbate, undesirable effects.

### **Nutrient Management**

In the 1996 National Water Quality Inventory, the U.S. Environmental Protection Agency reported that agriculture ranks first as the leading source of water quality problems for lakes and rivers and ranks fifth for contributing to the degradation of estuaries. More than 20 million tons of commercial fertilizer nutrients are used in the United States annually, and most of it is applied to agricultural land. Different nutrient management practices can affect both the quantity of commercial fertilizer needed for crop production and any potential movement of applied nutrients by leaching, runoff, or volatilization. The USDA survey findings about nutrient management practices are highlighted below:

- Three-fourths of the cropland acres represented by the surveys were treated with commercial fertilizers (the surveys represented approximately 60 percent of U.S. cropland used for crops). Nitrogen, the most widely used nutrient, was applied to 71 percent of the area and accounted for half of the total quantity of all primary nutrients applied. Phosphate was applied to 60 percent of the area and potash to 44 percent.
- Corn, with 99 percent of its planted area treated, accounted for 45 percent of the total area of the surveyed crops receiving fertilizer. The average application rate across all corn acres receiving nitrogen fertilizer was 132 pounds per acre. Vegetable crops and potatoes had the most intensive use of nitrogen fertilizer. Although average application rates for vegetables and potatoes often

exceeded 200 pounds per acre, the nitrogen applied to these crops accounted for only 1 percent of the total use of nitrogen.

- Nutrient application rates vary widely among fields planted to the same crop depending on yield expectations and growing conditions. For corn, the lowest 20 percent of the acreage (14 million acres) received nitrogen applications of 80 pounds or less per acre while the highest 20 percent received applications of more than 180 pounds per acre.
- Timing fertilizer applications to coincide with the crop's biological nutrient needs or to reduce potential nutrient losses from leaching, runoff, or volatilization can reduce seasonal application rates. About three-fourths of the nitrogen fertilizer was applied before or at planting time. About 28 percent of all nitrogen was applied in the fall, and most of that was for crops to be planted in the following spring. The fall applications reduce peak spring labor demands when weather can limit available working days, but fall-applied nitrogen has a greater potential for loss.
- Laboratory tests of soil samples can help farmers determine their need for commercial fertilizers. Soil tests were conducted for about one-fifth of the represented cropland. The practice was most common on land planted to fruits, vegetables, and cotton. About half of the corn acreage having soil tests included a test for nitrogen.
- Livestock manure is a source of plant nutrients, but its use is mostly limited to farms that have both crop and livestock enterprises. About 8 percent of the represented cropland, mostly planted to corn, had manure applied. The manure was analyzed for its nutrient content on about 10 percent of the area receiving manure.

### **Pest Management**

The use of pest-resistant crops as well as various kinds of cultural practices can reduce farmers' reliance on pesticides. About 900 million pounds of pesticides are used annually by U.S. agriculture to control weeds, insects, diseases, and other pests. Their use has raised concerns about their potential risk to human health and the possible environmental impacts on wildlife species and their habitats. The survey findings about pest management practices are highlighted below:

- Pest management on most cropland includes both cultural practices and the use of pesticides. At least some pesticides—herbicides, insecticides, fungicides, growth regulators, defoliants, or desiccants—were applied to 90 percent of the represented cropland.
- Corn, with 98 percent of the area treated with some pesticide, accounted for 39 percent of the total pounds of pes-

ticides applied to all surveyed commodities. All but 7 percent of the quantity applied to corn was for weed control.

- Cotton farmers were the largest users of insecticides. Representing only 7 percent of the surveyed commodity area, cotton accounted for 32 percent of the total pounds of insecticides.
- Fruits, vegetables, and potatoes accounted for 98 percent of all pesticides applied to control diseases (fungicides).
- Between 1990 and 1997, planted crop area and total pounds of pesticides applied remained relatively unchanged. However, the share of acres treated with pesticides increased as did the number of treatments applied per acre. The amount of pesticide applied with each treatment declined with the adoption of products applied at ultra-low rates, band treatments, and reduction in the application rates for some ingredients.
- The boll weevil and boll worm were the leading target pests for cotton insecticide treatments, while corn rootworm and corn borers were the leading target pests for corn insecticide treatments. Bt-transgenic corn and cotton seeds, crop rotations, and other pest management practices are used to reduce the reliance on pesticides to control these major pests.
- Pest-monitoring practices include field scouting, soil and plant tissue testing, traps baited with attractants, and field mapping for weeds. Nearly 80 percent of the surveyed crop acres were scouted; pheromone traps were used on nearly one-fourth of the cotton, fruit, and vegetable acres, and weed mapping was used on about one-fifth of the field crop acres. Soil and tissue testing for pests was used on about 4 percent of the surveyed crop acres. Pest monitoring was prevalent on crops receiving the most intensive treatments with insecticides and fungicides.
- Many insecticide application decisions are made by comparing the insect infestation level to a calculated threshold where the economic losses, if left untreated, are expected to exceed the cost of treatment (economic threshold). For nearly 45 percent of the surveyed crop acres receiving insecticides, a threshold concept was used to make the treatment decision. For most of the remaining acreage, treatment decisions were based on historic information or preventive schedules.
- Pest preventive practices, such as crop rotation, planting disease-resistant seeds/rootstocks, or adjusting planting dates to avoid certain pests, were widely applied. Over 80 percent of the row crop acreage (corn, soybeans, cotton, and potatoes) was in some type of crop rotation, and half of the represented acreage used resistant varieties/rootstocks and about 35 percent adjusted planting dates.

### **Crop Rotation**

Crop rotation is used to reduce soil erosion, increase soil productivity, break pest cycles, and reduce the development of pesticide-resistant pests. The survey findings about the use of crop rotations are highlighted below:

- Eighty-two percent of the represented acreage of major field crops (corn, soybeans, wheat, and cotton) was in a crop rotation. Cotton was the only field crop where the same crop was planted for at least 3 consecutive years (monoculture) on a large share of the acres. A monoculture system was used on 60 percent of the land planted to cotton.
- About three-fourths of the wheat acres were in a crop rotation. A wheat-fallow system is commonly used in the Northwestern growing regions. The monoculture system for growing wheat was most common in the Southern Plains.
- About 85 percent of the corn acreage was in a crop rotation. Until the recent development of resistant species, rotating corn with just about any other crop prevented damaging infestations by corn rootworm—the major target pest for corn insecticide treatments. Continuous corn production was most common in Nebraska and Kansas, States where corn rootworm treatments were most prevalent.
- Rotations that include hay, meadow, or pasture provide protection against soil erosion, and those that include a legume crop can reduce nitrogen fertilizer needs. Only about 3 percent of the surveyed crop area had a meadow or pasture crop in either of the preceding 2 years.

### **Crop Residue Management**

Crop residue management (CRM) systems use fewer and/or less intensive tillage operations, often combined with cover crops and other conservation practices, to provide sufficient residue cover to help protect soil from wind and water erosion. CRM is generally a cost-effective method of erosion control (requiring fewer resources than intensive structural measures such as terraces) that can be implemented in a timely manner to meet conservation requirements and environmental goals. Decreasing the intensity of tillage or reducing the number of operations with CRM can potentially result in cost savings to farmers through reduced fuel, labor, machinery, and time requirements. However, any potential cost savings may be offset somewhat by increases in chemical costs, depending on the herbicides selected for weed control and the fertilizers required to attain optimal yields. Surveys conducted by the Conservation Technology Information Center and USDA's surveys of field crops found that:

- Conservation tillage (no-till, ridge-till, and mulch-till) was used on almost 110 million acres in 1997, more than

37 percent of U.S. planted cropland area. Most of the growth in conservation tillage since 1990 came from expanded no-till and a concurrent decline in conventional tillage.

- Conservation tillage was used mainly on corn, soybeans, small grains, and sorghum in 1997. More than 47 percent of the total acreage planted to corn and soybeans was conservation-tilled. Expanded use of no-till has been significant on all major crops since 1990, but no-till use continues to be greater for corn and soybeans than for small grains or sorghum.

- Cultivation of row crops is primarily used to kill weeds and thereby reduce the need for herbicide treatments, but cultivations are also used to shape the surface for furrow irrigation or to maintain ridges in ridge-till systems. Nearly two-thirds of the corn area, 40 percent of the soybeans, and nearly all cotton received at least one cultivation. Fields receiving three or more cultivations used less herbicide for weed control than fields receiving fewer or no cultivations.