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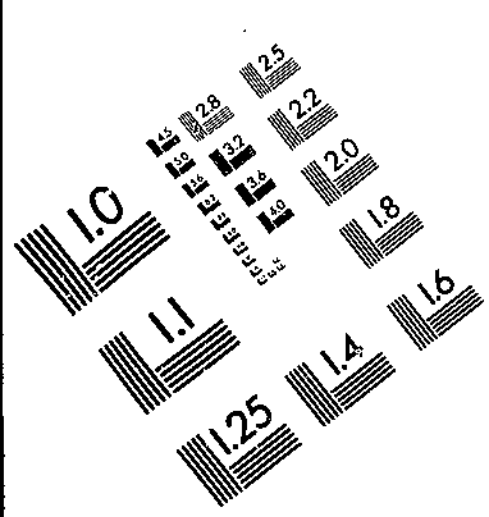

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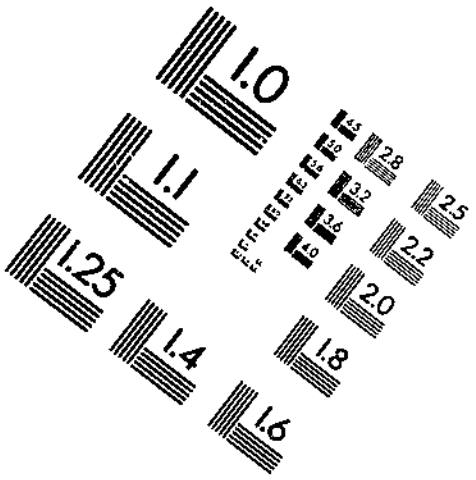

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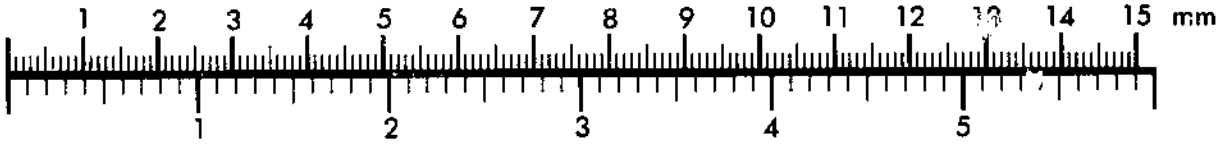

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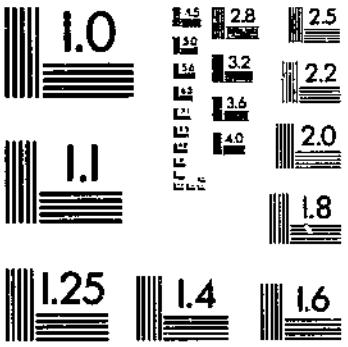

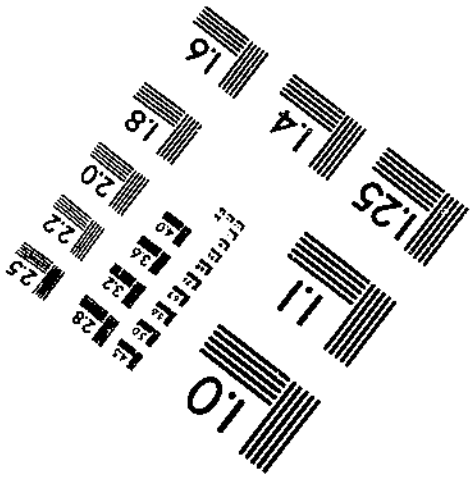

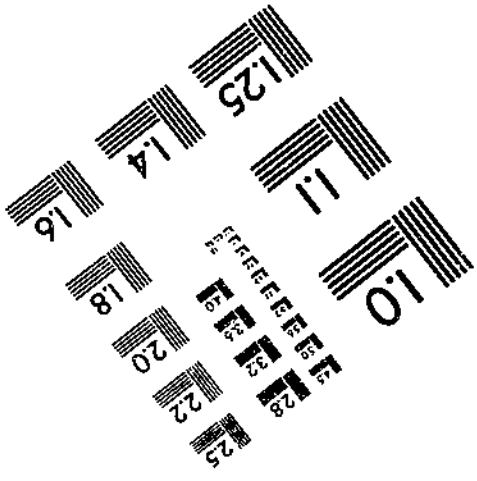

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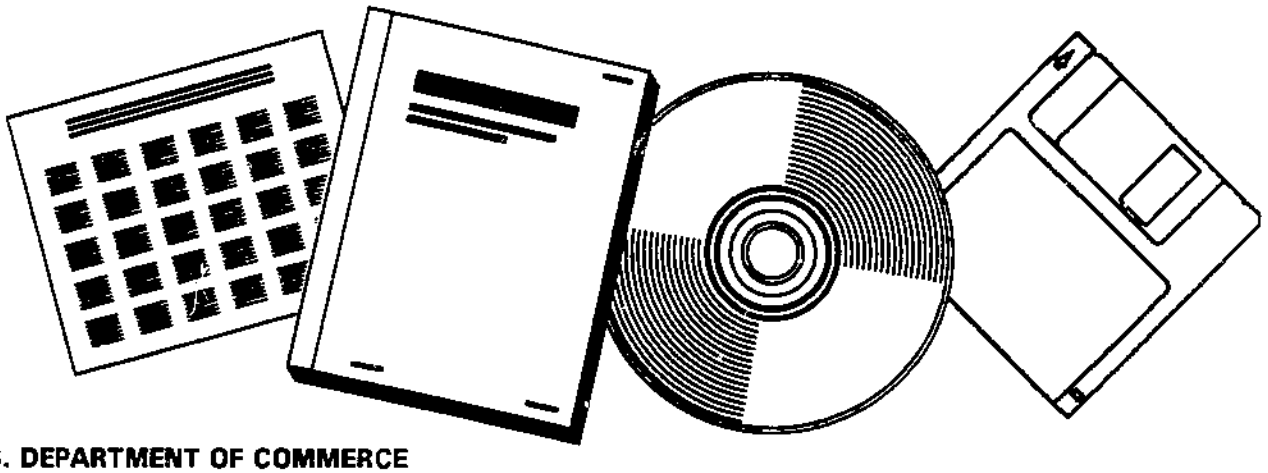

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Crop Residue Management and Tillage System Trends

Len Bull and Carmen Sandretto

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Crop Residue Management and Tillage System Trends. By Len Bull and Carmen Sandretto, Natural Resources and Environment Division, Economic Research Service, U.S. Department of Agriculture. Statistical Bulletin No. 930.

Abstract

Conservation tillage was used on more than 99 million acres in 1994, about 35 percent of U.S. planted crop area. Five years earlier, the total conservation-tilled acreage was 72 million. Besides conserving soil, crop residue management practices also cut production costs on many farms. Advantages of crop residue management systems over conventional systems include fuel and labor savings, lower machinery investments, and long-term benefits to soil structure and fertility.

Keywords: Crop residue management, conservation tillage, no-till, mulch-till, production costs, fuel and labor savings, and machinery investments.

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Summary

Conservation tillage was used on more than 99 million acres in 1994, about 35 percent of U.S. planted crop area. Five years earlier, the total conservation-tilled acreage was 72 million. Besides conserving soil, crop residue management practices also cut production costs on many farms.

Advantages of crop residue management systems over conventional systems include fuel and labor savings, lower machinery investments, and long-term benefits to soil structure and fertility.

New or retrofitted machinery may be needed for crop residue management, but fewer trips over a field and reduced fuel and labor requirements can mean immediate cost savings. Farmers apply conservation tillage mostly at their own expense. Just 600,000 acres were cost-shared in 1993 under the Agricultural Conservation Program, USDA's major cost-sharing program.

Crop residue management systems include no-till, ridge-till, mulch-till, reduced-till, and other conservation practices that provide sufficient residue cover to help protect the soil surface from wind and water erosion.

The Corn Belt and Northern Plains regions had the most planted cropland in 1994 and accounted for nearly 61 percent of total conservation-tilled acres. Conservation tillage was used mainly on corn, soybeans, and small grains in 1994. More than 45 percent of corn and soybean acreage was conservation-tilled. The share of corn and soybean acreage planted with no-till has more than tripled since 1989.

Where fields were double-cropped in 1994, conservation tillage was used on more than 66 percent of soybean acreage, 53 percent of corn acreage, and 50 percent of sorghum acreage. The benefits of no-till with double-cropping include timeliness in getting the second crop planted and limiting potential moisture losses from the seedbed germination zone.

USDA's annual Cropping Practices Surveys, since 1988, show a decline in use of moldboard plows for all surveyed crops, a decline in all conventional tillage systems for corn and soybeans, and an increase in use of conservation tillage. Less than 10 percent of the surveyed area in major producing States used a moldboard plow in 1994, down from 20 percent in 1988.

Crop Residue Management and Tillage System Trends

Len Bull
Carmen Sandretto*

Introduction

USDA aims to mitigate environmental problems while maintaining agricultural profitability and competitiveness. The 1985 Food Security Act implemented new programs to conserve soil resources. The 1990 Food, Agriculture, Conservation, and Trade Act further strengthened the Federal role of protecting soil and water resources. USDA farm conservation plans, developed to meet Farm Act requirements, frequently specify the use of crop residue management systems to reduce soil loss and protect water resources from agricultural contaminants (see box, "Crop Residue Management and Cropping Practices Surveys").

National and Regional Use of Crop Residue Management

Crop residue management systems include conservation tillage practices such as no-till, ridge-till, and mulch-till and other conservation practices that provide sufficient residue cover to help protect the soil surface from the erosive effects of wind and water. According to the annual Crop Residue Management Survey, farmers practiced conservation tillage on over 99 million acres in 1994, up from 72 million acres in 1989 (table 1). Conservation tillage now accounts for 35 percent of U.S. planted crop acreage (fig. 1). Increased use of no-till and ridge-till practices will likely continue as farmers use crop residue management to implement their conservation compliance plans (see box, "Tillage Systems").

Besides providing soil conserving benefits, crop residue management practices are adopted on some farms for their cost effectiveness. Fuel and labor savings, lower machinery investments, and long-term benefits to soil structure and fertility are commonly cited advantages of crop residue management systems over conventional systems. While new or retrofitted machinery may be required to adopt crop residue management systems, fewer trips over the field and reduced fuel and labor requirements can result in immediate cost savings. Machinery costs usually decline in the long run because a smaller machinery complement is needed. Farmers apply conservation tillage mostly at their own expense; only 600,000 acres were cost-shared in 1993 under the Agricultural Conservation Program, USDA's major cost-sharing program.

The Corn Belt and Northern Plains had the most planted cropland in 1994 and accounted for nearly 61 percent of total conservation tillage acres (fig. 2). These regions, plus the Lake States, Mountain Region, and Southern Plains, have substantial acreage with 15- to 30-percent residue cover. With improved crop residue management, much of the 15- to 30-percent residue cover area has the potential to qualify for conservation tillage status.

U.S. crop area planted with no-till increased by more than 2.7 times since 1989 to nearly 39 million acres in 1994. Since 1989, no-till's share of conservation tillage acreage has increased while the share with mulch-till has declined (fig. 3). No-till's share of conservation tilled area is greater in the six eastern regions than elsewhere (fig. 4). The aftereffects of the 1993 Midwest floods resulted in a slight decline in 1994 for the share of acres planted with conservation tillage, mostly mulch-till, in the Corn Belt and Lake States (fig. 5). Over the period 1991-94, the share with no-till showed an increase for nearly all regions (fig. 5).

Increased use of high-residue types of tillage has resulted in no-till and ridge-till accounting for almost 43 percent (more than 42 million acres in 1994) of U.S. acreage with conservation tillage. This share demonstrates a shift away from clean tillage (less than

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Tillage Systems

Crop Residue Management (CRM)—A conservation practice that usually involves a reduction in the number of passes over the field with tillage implements and/or in the intensity of tillage operations, including the elimination of plowing (inversion of the surface layer of soil). This practice is designed to leave sufficient residue on the soil surface to reduce wind and/or water erosion.

CRM—A year-round system that includes all field operations that affect the amount of residue, its orientation to the soil surface and prevailing wind and rainfall patterns, and the evenness of residue distribution throughout the period requiring protection. CRM may include the use of cover crops where sufficient quantities of other residue are not available to reduce the vulnerability of the soil to erosion during critical periods.

Conservation Tillage—Any tillage and planting system that maintains at least 30 percent of the soil surface covered by residue after planting to reduce soil erosion by water, or where soil erosion by wind is the primary concern, that maintains at least 1,000 pounds per acre of flat, small-grain-residue equivalent on the surface during the critical wind erosion period. Two key factors influencing crop residue are (1) the previous crop, which establishes the initial residue amount and determines its fragility, and (2) the type of tillage operations before and including planting.

Conservation Tillage Systems (as defined in both the Crop Residue Management Survey and the Cropping Practices Survey)

Mulch-till—The soil is disturbed before planting. Tillage tools, such as chisels, field cultivators, disks, sweeps, or blades, are used. The Cropping Practices Survey assumes that any system with 30 percent or more residue after planting that is not a no-till or ridge-till system is a mulch-till system.

Ridge-till—The soil is left undisturbed from harvest to planting except for nutrient injection. Planting is completed in a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges.

No-till—The soil is left undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners, disk openers, inrow chisels, or rototillers.

Conventional Tillage Systems (as defined in the Cropping Practices Survey)

Conventional tillage with moldboard plow (Conv/w mbd plow)—Any tillage system that includes the use of a moldboard plow.

Conventional tillage without moldboard plow (Conv/wo mbd plow)—Any tillage system that has less than 30 percent remaining residue and does not use a moldboard plow.

Other Tillage Systems (as defined in the Crop Residue Management Survey)

Reduced-till (15-30-percent residue)—Tillage types that leave 15-30-percent residue cover after planting, or 500-1,000 pounds per acre of small-grain-residue equivalent throughout the critical wind erosion period.

Conventional-till (less than 15-percent residue)—Tillage types that leave less than 15-percent residue cover after planting, or less than 500 pounds per acre of small-grain-residue equivalent through the critical wind erosion period.

15-percent residue) (table 1). High-residue types of tillage can leave as much as 70 percent of the soil surface covered with crop residues.

Tillage Systems Use On Major Crops

Conservation tillage was used mainly on corn, soybeans, and small grains in 1994. Over 45 percent of the total acreage planted to corn and soybeans was conservation-tilled. The increased use of no-till with major crops since 1989 is particularly evident for corn and soybeans (fig. 6). The acreage of full-season soybeans planted with no-till in four Corn Belt States illustrates the pace of no-till adoption (fig. 7). Where double-cropping was used, over 66 percent of soybean acreage, 53 percent of corn acreage, and 50 percent of sorghum acreage was produced using conservation tillage systems. The widespread use of no-till with double-cropping captures several benefits, such as timeliness in getting the second crop planted and limiting potential moisture losses from the seedbed germination zone. These benefits allow greater flexibility in cropping sequence or rotation (CTIC).

The 1988-94 Cropping Practices Surveys (see box, "Crop Residue Management and Cropping Practices Surveys") provide additional detail on residue levels and tillage systems for major crops and producing States (Bull). These annual surveys show a decline in the use of the moldboard plow for all surveyed crops, a decline in other conventional tillage for corn and soybeans, and an increase for conservation tillage types (see box, "Tillage Systems"). Less than 10 percent of the surveyed area in major producing States used a moldboard plow in 1994, down from 20 percent in 1988.

Winter Wheat

Survey results show that, except for 1994, a steady decline in moldboard plow use has been reported in winter wheat production since 1988 (table 2). The survey showed corresponding increases in conventional tillage without the plow and in no-till. The 1994 crop was planted in some States just after the heavy rains and floods of 1993. Siltation from flooding and the impact of the heavy rains may have contributed to the increased use of the moldboard plow in Kansas, Missouri, Nebraska, Colorado, Idaho, Oklahoma, Montana, and Ohio in 1994.

Oregon reported the heaviest reliance on the moldboard plow (27 percent) among major States harvesting winter wheat in 1994 (table 3), down from 36 percent in 1993 and 43 percent in 1992. According to Extension personnel, some western producers believe that the risk of disease is intensified when large amounts of wheat residue are left on the soil surface. Many of these States follow a wheat-fallow or a wheat-wheat-fallow rotation. Colorado and South Dakota reported that mulch-till was used on nearly 25 percent of winter wheat acreage. Illinois, Missouri, and Ohio reported over 22 percent no-till on winter wheat acreage. These States often plant winter wheat after fragile-residue soybeans. For example, in 1991, Missouri reported that 47 percent of the harvested winter wheat acreage was planted after soybeans, Illinois 67 percent, and Ohio 85 percent (USDA/ERS).

Illinois, Missouri, Ohio, and South Dakota had the highest estimated residue remaining after planting (over 25 percent) because of extensive use of mulch-till and no-till methods. Oklahoma and Oregon had the lowest (13 and 14 percent) because of greater use of conventional tillage methods.

Except when the no-till system is used, wheat acreage normally requires more trips over the field than most other field crops because much of the wheat produced in the Great Plains and Western States is produced after a fallow period (USDA/ERS). All implement trips over the field made during the fallow year were included in determining residue levels. The typical fallow procedure starts in the fall with chisel plowing and other noninversion tillage operations instead of a single pass with the moldboard plow. The acreage in these States, therefore, may require more trips over the field with conventional tillage without the moldboard plow than with the plow.

Corn

Tillage systems used for corn production in the 10 major producing States in the period 1988-94 indicate a trend toward the use of conservation tillage systems (table 4). In the surveyed States, a moldboard plow was used on 8 percent of the corn acreage in 1994, down from 20 percent in 1988. No-till systems were used on 17 percent of the acreage, a steady increase from 5 percent in 1989. Ridge-till systems, mainly in Nebraska and Minnesota, increased to 3 percent of the total acreage.

The trend toward the use of higher residue tillage systems is reflected in a corresponding increase in the average percentage of soil surface covered with residue. At the same time, decreases are reported in the number of hours per acre and the number of times over the field for tillage operations.

The implementation of conservation plans, developed in response to conservation compliance requirements, contributed to the increased acreage using conservation tillage systems. Another factor may be adoption of cost-saving technology. "Early-adopters" of these conservation systems are now suggesting advantages other than erosion reduction. These include direct cost benefits, such as fuel and labor savings, lower machinery investment, no yield reductions, and long-term benefits, such as better soil structure and fertility. Machinery designed specifically for conservation tillage has also become more readily available.

Illinois, Indiana, Missouri, Nebraska, and Ohio all had greater than 20 percent of corn acreage under no-till, likely reflecting implementation of conservation plans (table 5). Ohio has traditionally had a high proportion of no-till acreage because of the emphasis placed on such systems by its agricultural agencies. Nebraska had the highest average residue level, due to the prevalence of nonmoldboard-plow tillage systems and extensive continuous corn production, much of which was irrigated. Nebraska and Ohio have consistently been among the highest users of no-till in corn production.

Wisconsin had the highest use of the moldboard plow—36 percent—to accommodate the corn/alfalfa rotations needed to support dairy farming. Use was down from 64 percent in 1989.

Soybeans

Soybean production also indicates a trend toward conservation tillage systems (tables 6 and 7). The 14 major soybean-producing States were divided into northern and southern areas. In 1993 and 1994, six of the seven southern area States were not surveyed (table 7). The northern area steadily increased usage of no-till systems from 3 percent of the acreage in 1988 to 26 percent in 1994. At the same time, mulch-till increased from 14 to 26 percent and use of the moldboard plow has dropped from 28 to 9 percent. The southern area increased no-till system use from 7 percent of the acreage in 1988 to 14 percent in 1992. In the northern area, Indiana (46 percent) and Ohio (39 percent) were the greatest users of no-till systems in 1994 (table 8). This is an increase from 10 percent in 1990. Similar results are shown in figure 7.

Soybean acreage produced with ridge-till systems increased to 1 percent of the total acreage in 1992 and has remained at that level. Ridge-till is used mainly in Nebraska and Minnesota.

The northern area reported that 9 percent of its acreage in 1994 was farmed with a moldboard plow compared with 28 percent in 1988.

Cotton

Nearly all cotton is produced using conventional tillage methods in the six major cotton States (table 10). However, use of the moldboard plow has decreased to about a third of the 1988 level.

Use of the moldboard plow was minimal (1 percent or less) in Arkansas, Louisiana, and Mississippi (table 11). While the plow was used most extensively in Arizona (64 percent of the acreage) and Texas (14 percent), its use in these States is also decreasing. Arizona, California, and parts of Texas have State "plow-down" laws requiring producers to dispose of harvested cotton plants to eliminate the overwinter food source for bollworms and boll weevils. Some producers have misinterpreted these laws to mean that the previous crop must be plowed with a moldboard plow. California producers mainly use multiple passes with a heavy disk. In some areas of Texas, the moldboard plow is also used to bring up subsoil clay to cover the soil surface with clods, which helps control wind erosion.

The large number of tillage trips across the field (averaging 6.2) leaves very little residue, even without use of the moldboard plow. Some cotton-producing States are researching mulch-till and no-till systems and the "stale seedbed" system, which uses cover crops or weeds to cover the field from harvest to planting.

Spring and Durum Wheat

The surveys show some variation over time in the types of tillage systems used in the production of spring and durum wheat, with recent growth in the use of no-till systems (tables 12 and 13). This variation may be partly due to weather-soil relationships in the areas producing these crops.

Much of the wheat grown in the Great Plains and the Western States is produced after a fallow period. Implement passes made during the fallow year were included in determining residue levels, hours per acre, and trips over the field. Normal fallow procedure in these States starts with chisel plowing and other noninversion tillage operations in the fall instead of a pass with the moldboard plow. For these States, therefore, the tables reflect more trips over the field under conventional tillage without the moldboard plow (table 14). Durum wheat acreage in North Dakota also shows this pattern because much of the durum wheat is planted after a fallow period.

Minnesota results indicate greater use of the moldboard plow in spring wheat tillage operations in 1994 (16 percent) because most spring wheat in Minnesota is produced on heavy clay soils in the Red River Valley.

References

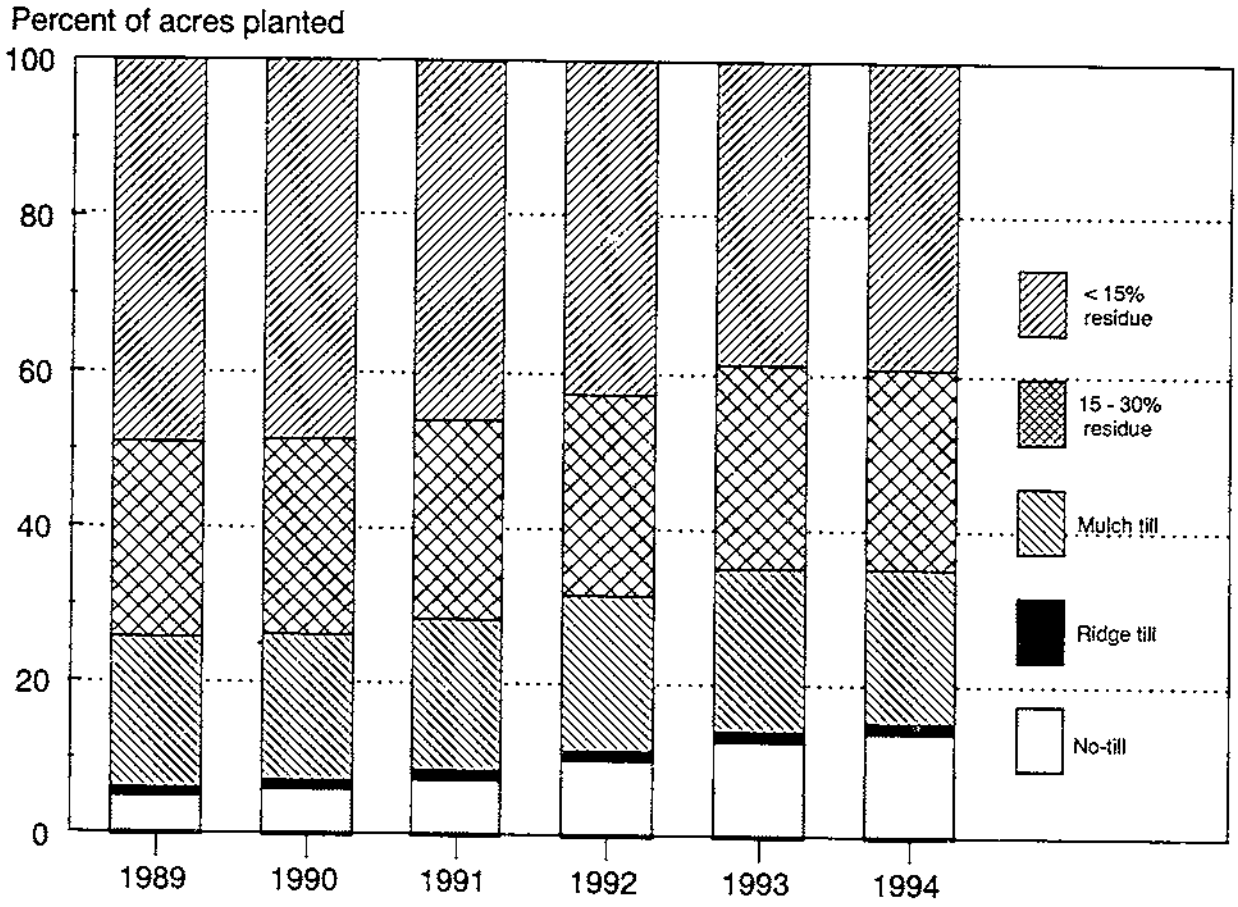
Bull, Len. *Residue and Tillage Systems for Field Crops.* U.S. Dept. Agr., Econ. Res. Serv. Staff Report No. AGES 9310. July 1993.

Comments by the Field Specialist at the quarterly meeting of the Conservation Technology Information Center, October 1994.

U.S. Department of Agriculture, Economic Research Service. *Agricultural Resources: Situation and Outlook Report.* AR-28. Oct. 1992, pp 7-12.

Figure 1

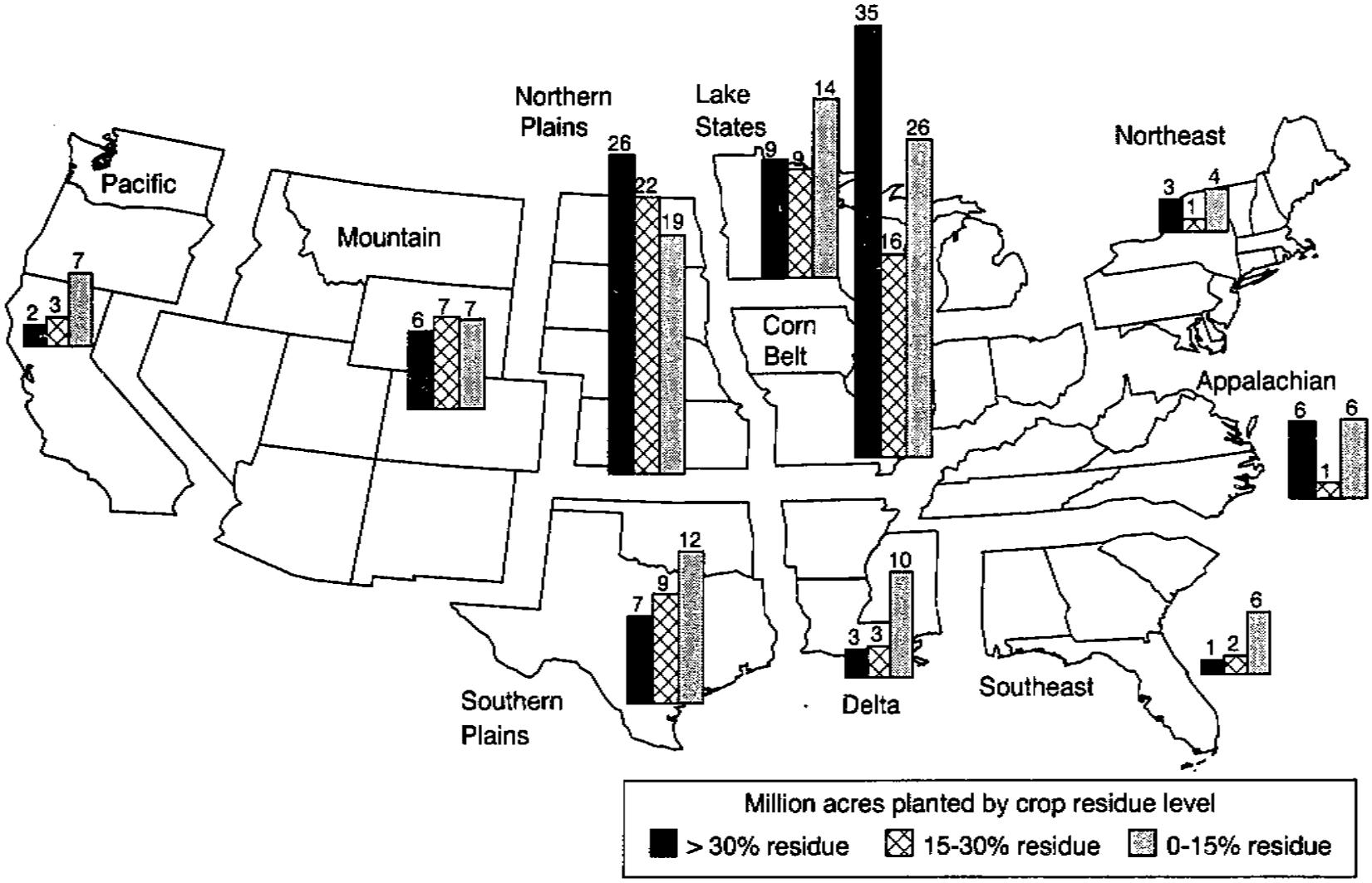
National use of crop residue management, 1989-94



Source: Prepared by ERS from National Crop Residue Management Survey data, CTIC.

Figure 2

Crop residue levels on planted acreage by region, 1994



Source: Prepared by ERS from National Crop Residue Management Survey data, CTIC.

Figure 3

Acres planted with conservation tillage by practice, 1989-94

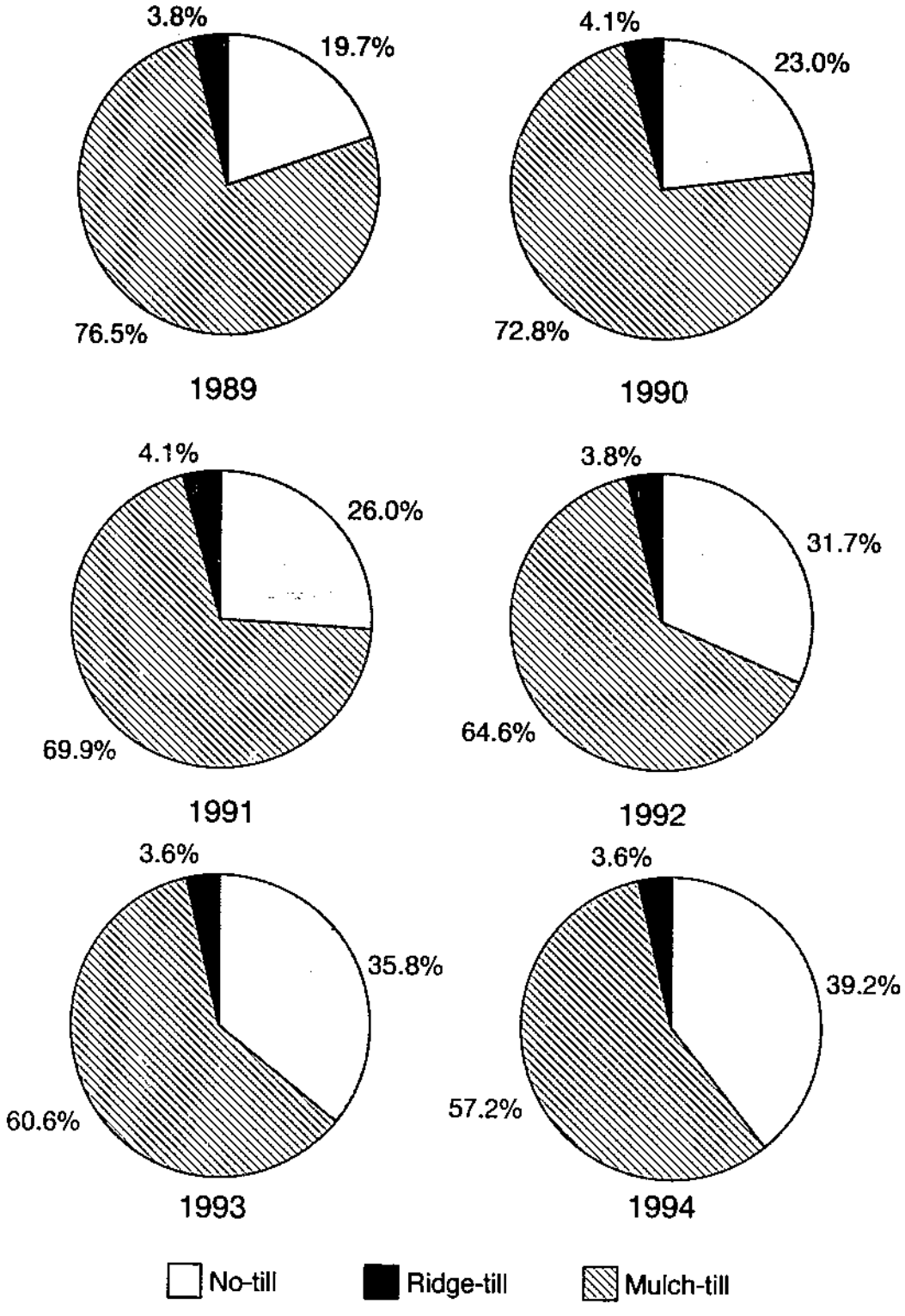


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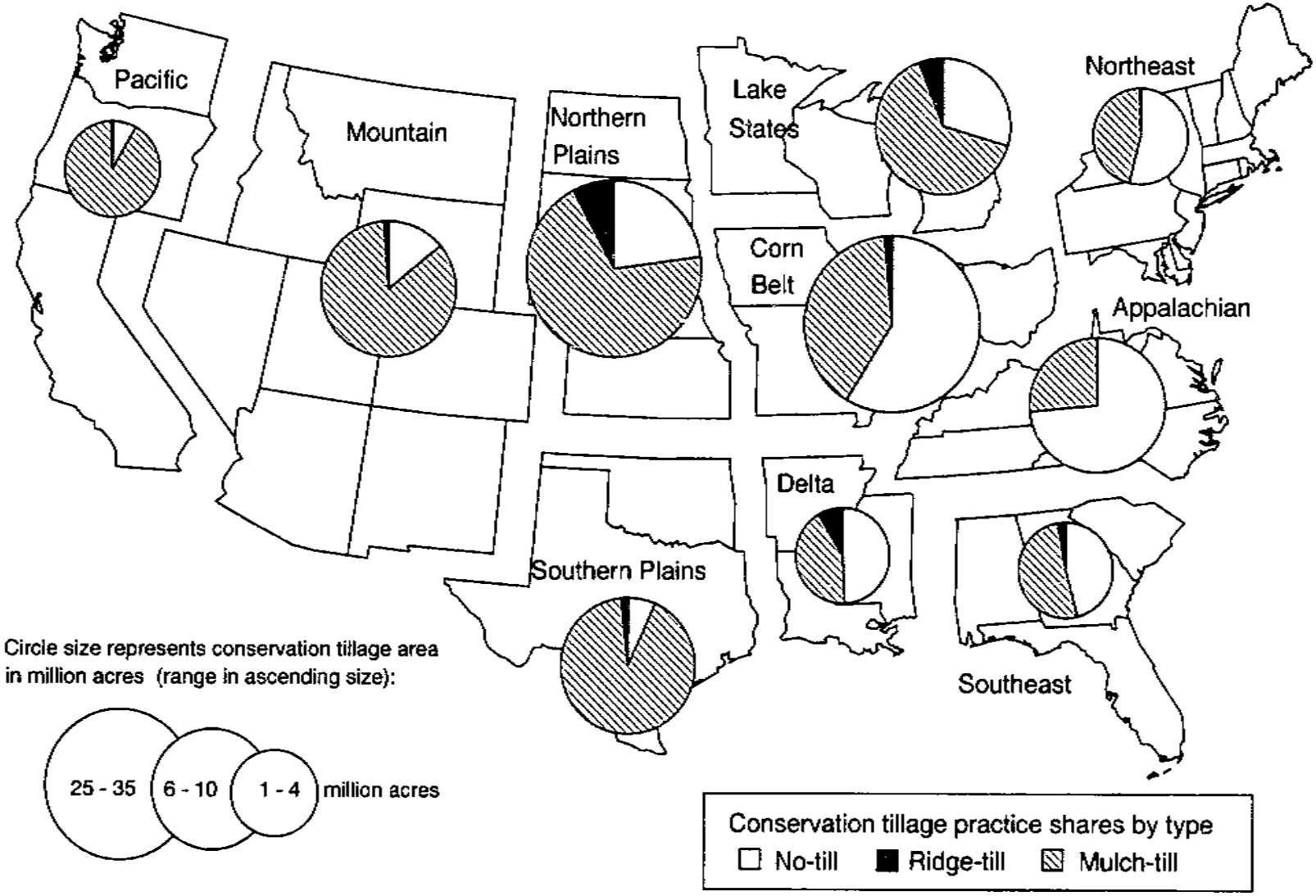
Figure 4

Applied conservation tillage practices, 1994



Source: Prepared by ERS from National Crop Residue Management Survey data, CTIC.

Figure 5

Percentage of acres planted with conservation tillage by region and tillage practice, 1991-94

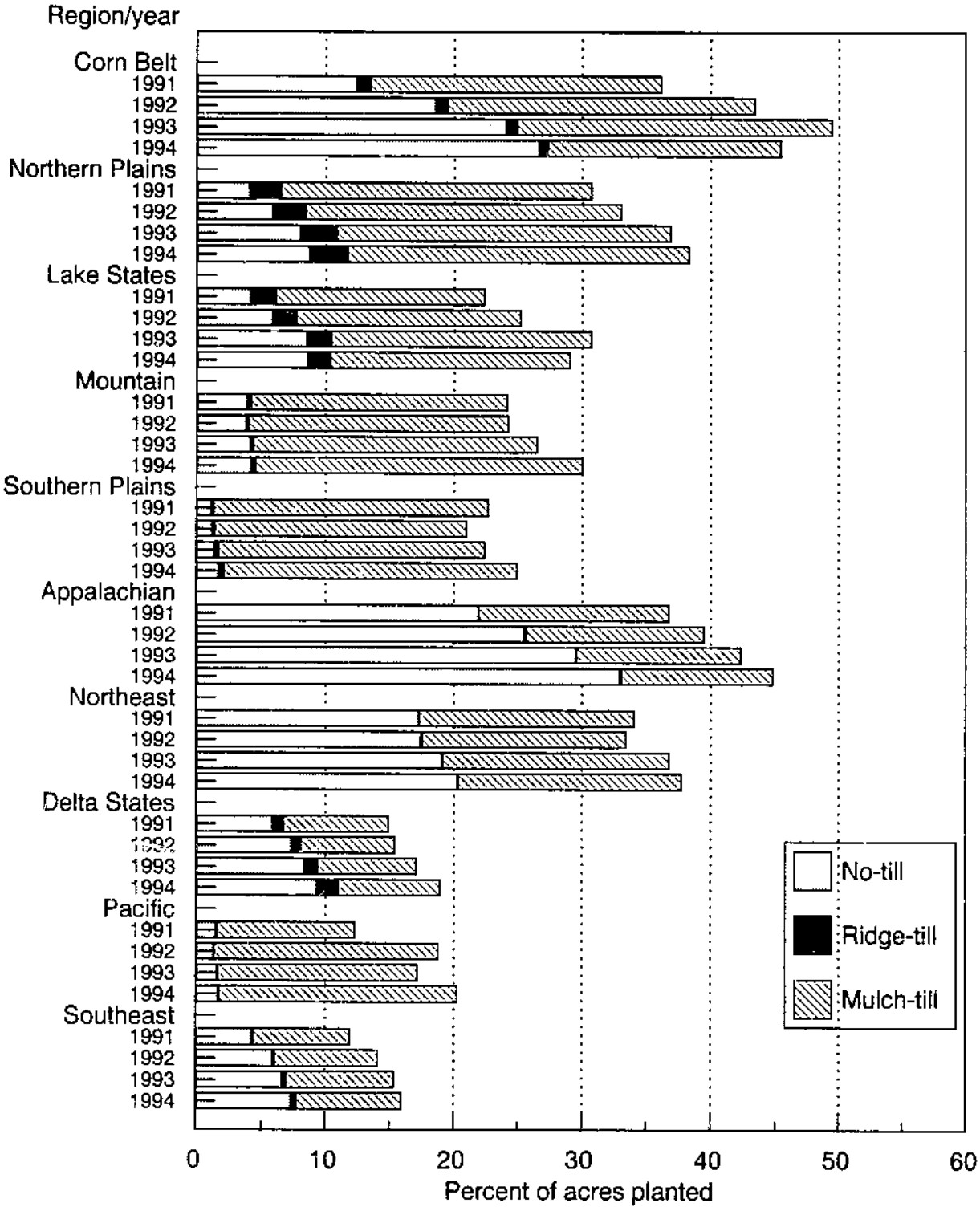


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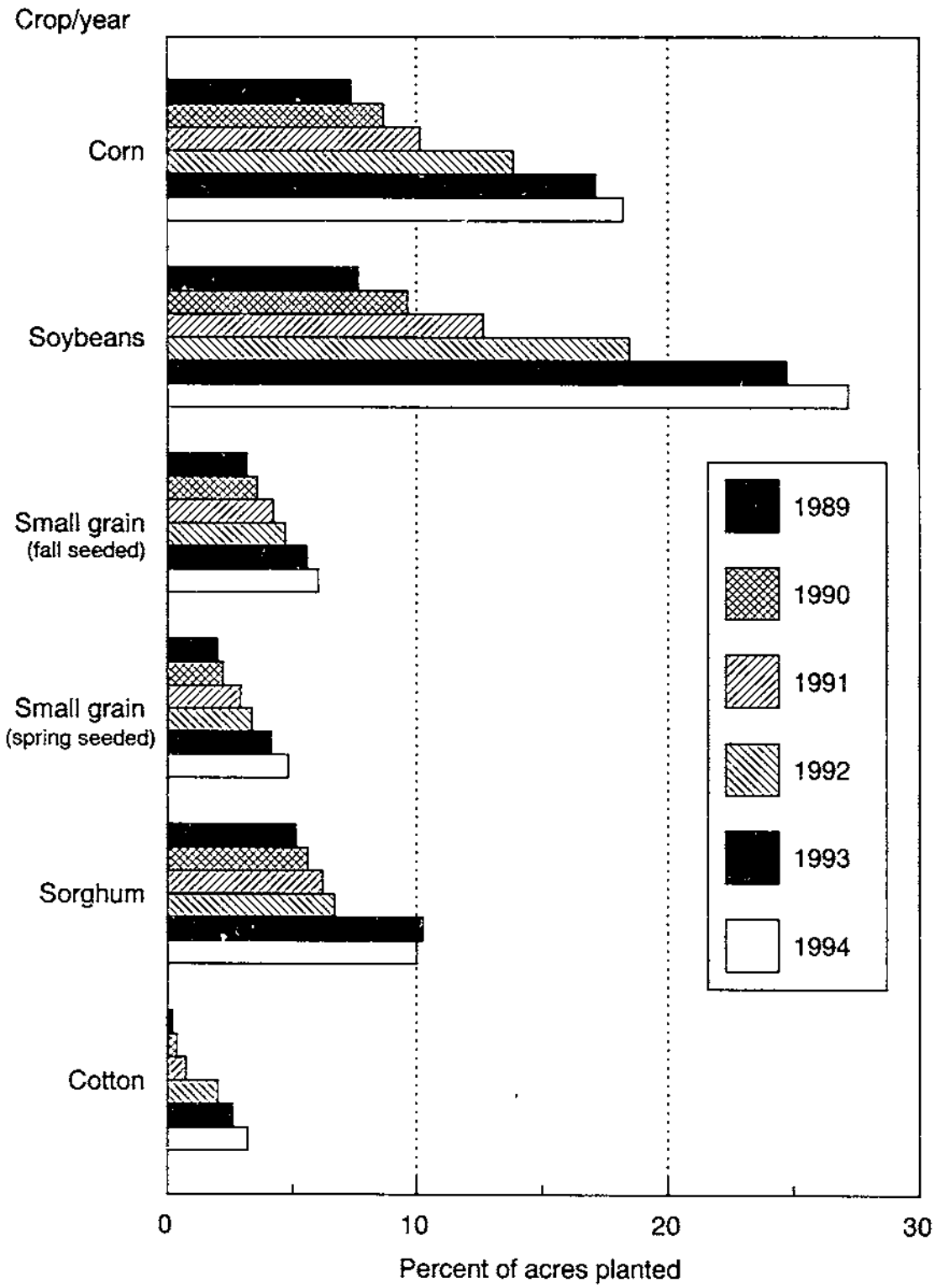
Figure 6

Share of acreage planted with no-till, 1989-94



Source: Prepared by ERS from National Crop Residue Management Survey data, CTIC.

Figure 7

Percent of acres planted with no-till by State, full season soybeans, 1989-94

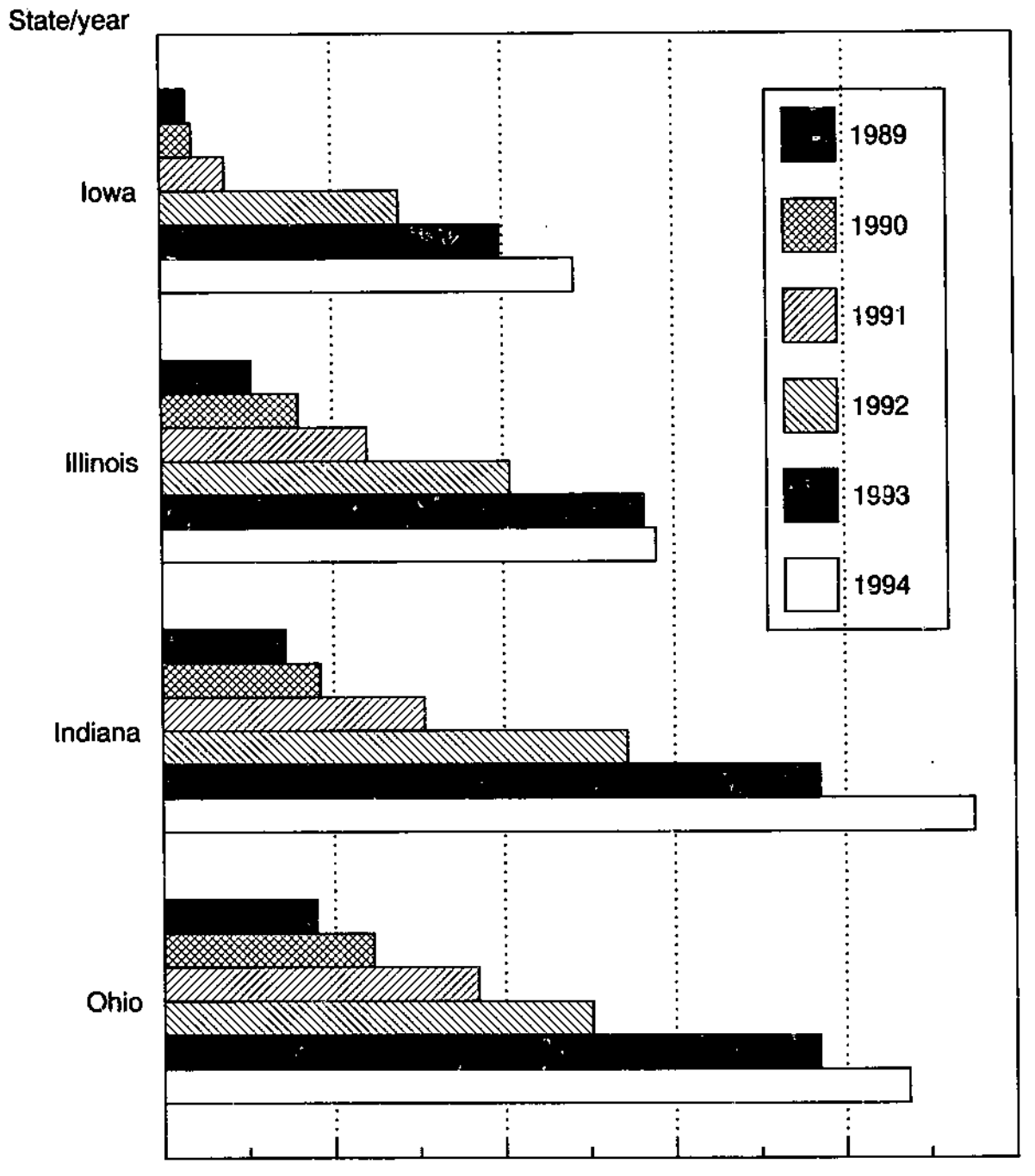


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Table 1—National use of crop residue management practices, 1989-94

Item	1989	1990	1991	1992	1993	1994
			Million acres			
Total area planted (CTIC)[1]	279.6	280.9	281.2	282.9	278.1	283.9
Area planted with:						
No-till	14.1	16.9	20.6	28.1	34.8	39.0
Ridge-till	2.7	3.0	3.2	3.4	3.5	3.6
Mulch-till	54.9	53.3	55.3	57.3	58.9	56.8
Total conservation tillage[1]	71.7	73.2	79.1	88.7	97.1	99.3
Other tillage types:						
15-30% residue	70.6	71.0	72.3	73.4	73.2	73.1
<15% residue	137.3	136.7	129.8	120.8	107.9	111.4
Total other tillage types[1]	207.9	207.7	202.1	194.2	181.0	184.6
			Percent[2]			
Percentage of area with:						
No-till	5.1	6.0	7.3	9.9	12.5	13.7
Ridge-till	1.0	1.1	1.1	1.2	1.2	1.3
Mulch-till	19.6	19.0	19.7	20.2	21.2	20.0
Total conservation tillage	25.6	26.1	28.1	31.4	34.9	35.0
Other tillage types:						
15-30% residue	25.3	25.3	25.7	25.9	26.3	25.8
<15% residue	49.1	48.7	46.1	42.7	38.8	39.3
Total other tillage types	74.4	73.9	71.9	68.6	65.1	65.0

[1] Estimates of tillage practice use derived by ERS from the National Surveys of Conservation Tillage Practices from the Conservation Technology Information Center (CTIC), National Association of Conservation Districts. [2] May not add to 100 due to rounding.

Table 2—Tillage systems used in winter wheat production, 1988-94

Category [1]	1988	1989	1990	1991	1992	1993	1994
				Thousands			
Harvested acres [2]	32,830	34,710	40,200	34,180	36,990	37,210	34,590
				Percent of acres [3]			
Tillage system: [4]							
Conventional with moldboard plow	15	16	12	12	11	8	8
Conventional without moldboard plow	67	68	69	72	68	76	75
Mulch-till	16	15	17	13	18	14	12
No-till	1	1	3	3	3	4	5
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	2	2	2	2	2	2	2
Conventional without moldboard plow	14	14	14	14	14	13	14
Mulch-till	38	35	38	38	38	39	38
No-till	61	66	53	57	58	54	57
Average [5]	17	17	18	17	19	18	18
				Number			
Hours per acre:							
Conventional with moldboard plow	0.7	0.7	0.7	0.7	0.6	0.7	0.7
Conventional without moldboard plow	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Mulch-till	0.4	0.4	0.3	0.4	0.4	0.3	0.3
No-till	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Average [5]	0.5	0.5	0.5	0.5	0.5	0.4	0.5
Times over field:							
Conventional with moldboard plow	5.3	5.3	5.3	5.6	5.3	5.6	5.4
Conventional without moldboard plow	5.0	4.8	5.0	5.0	4.9	5.0	5.0
Mulch-till	4.5	4.1	4.0	4.2	4.2	4.1	4.3
No-till	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Average [5]	4.9	4.7	4.7	4.9	4.7	4.7	4.8

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
[1] Arkansas and Indiana not included in 1993 or 1994. [2] Preliminary. [3] May not add to 100 due to rounding. [4] See box, "Tillage Systems."
[5] Weighted average based on acreage.

Table 3—Tillage systems used in winter wheat production for major producing States, 1994

Category	CO	ID	IL	KS	MO	MT	NE	OH	OK	OR	SD	TX	WA	Area[1]
							Thousands							
Harvested acres[2]	2,600	800	900	11,400	1,100	1,850	2,000	1,200	5,300	870	1,350	3,000	2,300	34,670
							Percent of acres[3]							
Highly erodible land	67	55	29	27	32	67	39	15	24	40	23	22	49	34
Tillage system:[4]														
Conventional with moldboard plow	4	14	nr	9	3	4	8	7	17	27	nr	1	5	8
Conventional without moldboard plow	71	63	69	76	62	76	80	55	78	63	65	86	78	75
Mulch-till	24	19	9	14	6	13	6	3	5	10	25	12	14	12
No-till	2	5	22	1	28	7	7	35	nr	nr	10	2	3	5
							Percent of soil surface covered							
Residue remaining after planting:														
Conventional with moldboard plow	2	2	nr	2	2	1	2	1	2	2	nr	2	3	2
Conventional without moldboard plow	17	9	17	13	13	14	13	13	13	16	15	12	17	14
Mulch-till	38	39	42	38	35	39	34	32	35	37	40	39	41	38
No-till	28	53	54	62	54	71	63	52	nr	nr	70	72	34	57
Average[5]	21	16	27	16	25	21	17	27	12	14	27	17	20	18
							Number							
Hours per acre:														
Conventional with moldboard plow	0.5	0.4	nr	0.6	0.8	0.7	0.8	3.2	0.7	0.7	nr	0.5	0.7	0.7
Conventional without moldboard plow	0.4	0.4	0.3	0.5	0.4	0.4	0.5	0.4	0.6	0.5	0.4	0.5	0.5	0.5
Mulch-till	0.2	0.4	0.2	0.4	0.3	0.2	0.5	0.2	0.4	0.4	0.2	0.4	0.4	0.3
No-till	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	nr	nr	0.1	0.1	0.1	0.1
Average[5]	0.4	0.4	0.2	0.5	0.3	0.3	0.5	0.5	0.6	0.6	0.3	0.5	0.5	0.5
Times over field:														
Conventional with moldboard plow	7.0	4.9	nr	5.2	4.0	4.8	6.6	5.3	5.3	5.8	nr	4.0	4.5	5.4
Conventional without moldboard plow	5.2	3.6	2.6	5.4	3.0	4.8	5.4	2.7	5.0	5.7	4.1	4.8	6.0	5.0
Mulch-till	4.0	3.4	2.0	4.9	2.8	2.5	4.6	2.0	5.0	4.7	3.5	4.3	4.9	4.3
No-till	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	nr	nr	0.9	1.0	0.7	1.0
Average[5]	5.0	3.6	2.2	5.3	2.5	4.3	5.1	2.3	5.1	5.6	3.6	4.7	5.7	4.8

Source: USDA, ERS, Cropping Practices Survey, 1994.
id = Insufficient data. nr = None reported. [1] Arkansas and Indiana not included in 1993 or 1994. [2] Preliminary. [3] May not add to 100 due to rounding. [4] See box, "Tillage Systems." [5] Weighted average based on acreage.

Table 4—Tillage systems used in corn production, 1988-94

Category	1988	1989	1990	1991	1992	1993	1994
				Thousands			
Planted acres[1]	53,200	57,900	58,800	60,350	62,850	57,350	62,500
				Percent of acres[2]			
Tillage system:[3]							
Conventional with moldboard plow	20	19	17	15	12	9	8
Conventional without moldboard plow	60	59	57	55	49	49	49
Mulch-till	14	17	18	20	25	24	23
Ridge-till	*	*	*	*	2	3	3
No-till	7	5	9	10	12	15	17
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	2	2	2	2	2	2	2
Conventional without moldboard plow	16	16	16	17	17	17	17
Mulch-till	38	38	38	38	38	38	39
Ridge-till	*	*	*	*	45	51	45
No-till	60	64	64	65	65	66	66
Average[4]	19	19	22	24	27	29	30
				Number			
Hours per acre:							
Conventional with moldboard plow	0.8	0.7	0.7	0.8	0.6	0.7	0.7
Conventional without moldboard plow	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Mulch-till	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Ridge-till	*	*	*	*	0.2	0.2	0.2
No-till	0.1	0.2	0.2	0.2	0.1	0.1	0.1
Average[4]	0.5	0.5	0.4	0.4	0.3	0.3	0.3
Times over field:							
Conventional with moldboard plow	4.0	4.1	3.8	3.9	3.6	3.8	3.7
Conventional without moldboard plow	3.5	3.5	3.4	3.4	3.1	3.1	3.0
Mulch-till	2.6	2.7	2.6	2.6	2.4	2.3	2.3
Ridge-till	*	*	*	*	1.5	1.7	1.5
No-till	1.0	1.3	1.1	1.2	1.1	1.0	1.1
Average[4]	3.3	3.4	3.1	3.1	2.7	2.6	2.6

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
* Included in no-till for these years. [1] Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 5—Tillage systems used in corn production for major producing States, 1994

Category	IL	IN	IA	MI	MN	MO	NE	OH	SD	WI	Area
						Thousands					
Planted acres[1]	11,600	6,100	13,000	2,550	7,000	2,400	8,600	3,700	3,800	3,750	62,500
						Percent of acres[2]					
Tillage system:3/											
Conventional with moldboard plow	4	7	3	18	20	2	2	12	6	36	8
Conventional without moldboard plow	55	51	47	49	62	57	35	47	52	40	49
Mulch-till	20	17	35	18	15	18	25	14	30	17	23
Ridge-till	*	*	1	*	2	1	13	nr	1	1	3
No-till	21	26	15	14	1	21	25	26	11	7	17
						Percent of soil surface covered					
Residue remaining after planting:											
Conventional with moldboard plow	2	3	3	2	2	2	2	2	3	2	2
Conventional without moldboard plow	17	16	18	14	15	14	18	15	17	17	17
Mulch-till	38	40	37	39	37	41	40	40	39	40	39
Ridge-till	id	id	26	id	34	26	50	nr	26	41	45
No-till	65	64	64	63	66	66	70	66	74	73	66
Average[4]	31	31	31	24	17	30	40	30	29	19	30
						Number					
Hours per acre:											
Conventional with moldboard plow	0.6	0.5	0.7	0.6	0.7	0.9	0.7	1.1	0.5	0.8	0.7
Conventional without moldboard plow	0.3	0.4	0.3	0.4	0.4	0.4	0.3	0.4	0.3	0.5	0.4
Mulch-till	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3
Ridge-till	id	id	0.1	id	0.1	0.1	0.2	nr	0.1	0.2	0.2
No-till	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1
Average[4]	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.3	0.6	0.3
Times over field:											
Conventional with moldboard plow	3.9	3.3	3.5	3.4	3.8	3.4	3.8	3.8	3.1	3.8	3.7
Conventional without moldboard plow	3.0	3.0	2.7	3.2	3.2	3.3	3.2	3.2	3.3	3.1	3.0
Mulch-till	2.3	2.3	2.2	2.4	2.6	2.4	2.4	2.6	2.4	2.7	2.3
Ridge-till	id	id	1.0	id	1.0	1.0	1.7	nr	1.0	1.0	1.5
No-till	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0
Average[4]	2.5	2.4	2.3	2.8	3.1	2.7	2.3	2.6	2.7	3.1	2.6

Source: USDA, ERS, Cropping Practices Survey, 1994.
id = Insufficient data. nr = None reported. * = Less than 1 percent. [1]Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 6—Tillage systems used in northern soybean production, 1988-94

Category	1988	1989	1990	1991	1992	1993	1994
				Thousands			
Planted acres[1]	36,550	37,750	36,400	38,350	38,150	39,000	40,300
				Percent of acres[2]			
Tillage system:[3]							
Conventional with moldboard plow	28	26	23	18	12	9	9
Conventional without moldboard plow	55	51	51	48	47	41	38
Mulch-till	14	18	21	25	26	27	26
Ridge-till	*	*	*	*	1	1	1
No-till	3	4	6	10	14	23	26
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	2	2	2	3	2	3	3
Conventional without moldboard plow	17	17	17	17	16	18	18
Mulch-till	39	37	38	39	40	40	39
Ridge-till	*	*	*	*	48	56	56
No-till	65	67	74	72	68	72	71
Average[4]	17	19	19	25	28	35	36
				Number			
Hours per acre:							
Conventional with moldboard plow	0.7	0.7	0.6	0.6	0.6	0.6	0.6
Conventional without moldboard plow	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Mulch-till	0.3	0.4	0.3	0.4	0.3	0.3	0.3
Ridge-till	*	*	*	*	0.2	0.2	0.2
No-till	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Average[4]	0.5	0.5	0.5	0.4	0.4	0.3	0.3
Times over field:							
Conventional with moldboard plow	4.2	4.3	4.2	4.3	3.9	4.0	3.9
Conventional without moldboard plow	4.0	4.1	4.1	4.1	3.7	3.6	3.6
Mulch-till	3.1	3.4	3.1	3.2	2.8	2.8	2.9
Ridge-till	*	*	*	*	1.6	1.7	1.5
No-till	1.0	1.2	1.1	1.1	1.0	1.0	1.0
Average[4]	3.8	3.9	3.7	3.6	3.1	2.8	2.8

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
*Included in no-till for these years. [1] Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 7—Tillage systems used in southern soybean production, 1988-94

Category	1988	1989	1990	1991	1992	1993[1]	1994[1]
				Thousands			
Planted acres[2]	12,200	13,380	11,850	10,800	10,480	3,500	3,450
				Percent of acres [3]			
Tillage system:[4]							
Conventional with moldboard plow	3	4	4	3	3	nr	nr
Conventional without moldboard plow	85	82	78	80	76	82	87
Mulch-till	5	5	7	6	8	7	8
No-till	7	10	12	11	14	12	6
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	2	2	1	1	1	nr	nr
Conventional without moldboard plow	8	13	10	8	8	8	7
Mulch-till	40	42	40	43	42	43	40
No-till	72	72	65	72	63	75	64
Average[5]	14	15	19	17	18	18	13
				Number			
Hours per acre:							
Conventional with moldboard plow	1.1	0.8	1.0	1.0	1.3	nr	nr
Conventional without moldboard plow	0.5	0.6	0.5	0.5	0.5	0.4	0.4
Mulch-till	0.4	0.3	0.3	0.2	0.3	0.3	0.2
No-till	0.2	0.1	0.2	0.1	0.2	0.1	0.1
Average[5]	0.5	0.5	0.5	0.5	0.5	0.4	0.4
Times over field:							
Conventional with moldboard plow	4.1	4.3	4.3	4.5	4.5	nr	nr
Conventional without moldboard plow	4.6	4.8	4.4	4.6	4.7	5.0	4.9
Mulch-till	2.8	2.5	2.5	2.4	2.4	3.0	2.6
No-till	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Average[5]	4.3	4.3	3.8	4.1	4.0	4.4	4.5

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
nr = None reported. [1] Only AR surveyed. [2] Preliminary. [3] May not add to 100 due to rounding. [4] See box, "Tillage Systems." [5] Weighted average based on acreage.

Table 8—Tillage systems used in northern soybean production for major producing States, 1994

Category	IL	IN	IA	MN	MO	NE	OH	Area
				Thousands				
Planted acres[1]	9,600	4,700	8,800	5,700	4,600	2,900	4,000	40,300
				Percent of acres[2]				
Tillage system:[3]								
Conventional with moldboard plow	3	9	4	32	1	2	15	9
Conventional without moldboard plow	38	31	44	33	50	38	30	38
Mulch-till	27	13	34	29	22	39	16	26
Ridge-till	**	nr	nr	1	**	4	nr	1
No-till	32	46	18	4	26	18	39	26
				Percent of soil surface covered				
Residue remaining after planting:								
Conventional with moldboard plow	3	2	3	3	1	2	3	3
Conventional without moldboard plow	18	18	20	17	15	21	17	18
Mulch-till	39	42	39	38	40	38	36	39
Ridge-till	56	nr	nr	56	56	56	nr	56
No-till	73	70	74	67	71	75	65	71
Average[4]	41	44	36	21	35	39	37	36
				Number				
Hours per acre:								
Conventional with moldboard plow	0.5	0.5	0.6	0.5	0.8	0.6	0.6	0.6
Conventional without moldboard plow	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.4
Mulch-till	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.3
Ridge-till	0.1	nr	nr	0.2	0.5	0.2	nr	0.2
No-till	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Average[4]	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.3
Times over field:								
Conventional with moldboard plow	4.3	3.8	3.7	4.1	5.0	3.3	3.6	3.9
Conventional without moldboard plow	3.8	3.3	3.4	4.1	3.7	3.1	3.6	3.6
Mulch-till	3.0	2.7	2.9	3.4	2.5	2.6	3.0	2.6
Ridge-till	1.0	nr	nr	1.2	2.0	1.6	nr	1.5
No-till	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0
Average[4]	2.7	2.2	2.8	3.7	2.7	2.5	2.5	2.8

Source: USDA, ERS, Cropping Practices Survey, 1994.
** = Less than 1 percent. nr = None reported. [1]Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 9—Tillage systems used in southern soybean production, 1994

Category	AR
	Thousands
Planted acres[1]	3,450
	Percent of acres[2]
Tillage system:[3]	
Conventional with moldboard plow	nr
Conventional without moldboard plow	87
Mulch-till	8
No-till	6
	Percent of soil surface covered
Residue remaining after planting:	
Conventional with moldboard plow	nr
Conventional without moldboard plow	7
Mulch-till	40
No-till	64
Average[4]	13
	Number
Hours per acre:	
Conventional with moldboard plow	nr
Conventional without moldboard plow	0.4
Mulch-till	0.2
No-till	0.1
Average[4]	0.4
Times over field:	
Conventional with moldboard plow	nr
Conventional without moldboard plow	4.9
Mulch-till	2.6
No-till	1.0
Average[4]	4.5

Source: USDA, ERS, Cropping Practices Survey, 1994.
nr = None reported. [1]Preliminary. [2] May not add to 100 due to rounding.
[3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 10—Tillage systems used in cotton production, 1988-94

Category	1988	1989	1990	1991	1992	1993	1994
				Thousands			
Planted acres[1]	9,700	8,444	8,730	10,860	10,200	10,360	10,023
				Percent of acres[2]			
Tillage system:[3]							
Conventional with moldboard plow	28	15	14	21	12	16	10
Conventional without moldboard plow	72	84	84	76	88	83	89
Mulch-till	id	id	1	1	id	**	**
No-till	id	id	1	1	id	1	1
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	0	0	0	0	0	0	0
Conventional without moldboard plow	3	3	3	3	3	2	3
Mulch-till	id	id	51	51	id	41	62
No-till	id	id	63	54	id	24	33
Average[4]	2	2	3	3	3	2	3
				Number			
Hours per acre:							
Conventional with moldboard plow	0.8	0.9	0.8	0.8	0.8	0.8	0.8
Conventional without moldboard plow	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Mulch-till	id	id	0.3	0.4	id	id	0.5
No-till	id	id	0.1	0.1	id	0.2	0.2
Average[4]	0.8	0.8	0.7	0.7	0.7	0.7	0.7
Times over field:							
Conventional with moldboard plow	6.2	7.2	6.6	6.4	6.3	6.6	6.8
Conventional without moldboard plow	6.1	6.4	6.2	6.2	5.9	6.2	6.1
Mulch-till	id	id	2.8	2.8	id	id	3.0
No-till	id	id	1.0	1.0	id	1.6	1.5
Average[4]	6.1	6.5	6.2	6.1	5.9	6.2	6.2

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
id = Insufficient data. ** = Less than 1 percent. [1]Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 11—Tillage systems used in cotton production for major producing States, 1994

Category	AZ	AR	CA	LA	MS	TX	Area
				Thousands			
Planted acres[1]	313	980	1,100	900	1,280	5,450	10,023
				Percent of acres[2]			
Tillage system:[3]							
Conventional with moldboard plow	64	nr	3	nr	1	14	10
Conventional without moldboard plow	36	100	97	99	97	86	89
Mulch-till	nr	nr	nr	nr	nr	**	**
No-till	nr	nr	nr	1	2	**	1
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	0	nr	0	nr	0	0	0
Conventional without moldboard plow	1	2	2	2	2	3	3
Mulch-till	nr	nr	nr	nr	nr	62	62
No-till	nr	nr	nr	36	33	32	33
Average[4]	0	2	2	2	3	3	2
				Number			
Hours per acre:							
Conventional with moldboard plow	1.3	nr	1.4	nr	0.8	0.8	0.8
Conventional without moldboard plow	0.6	0.6	1.1	0.6	0.6	0.7	0.7
Mulch-till	nr	nr	nr	nr	nr	0.5	0.5
No-till	nr	nr	nr	0.2	0.2	0.2	0.2
Average[4]	0.9	0.6	1.2	0.6	0.6	0.7	0.7
Times over field:							
Conventional with moldboard plow	6.9	nr	7.4	nr	6.0	6.8	6.8
Conventional without moldboard plow	5.7	5.8	7.2	6.1	5.8	6.0	6.1
Mulch-till	nr	nr	nr	nr	nr	3.0	3.0
No-till	nr	nr	nr	2.0	1.5	1.0	1.5
Average[4]	6.5	5.8	7.2	6.0	5.7	6.1	6.2

Source: USDA, ERS, Cropping Practices Survey, 1994.
id = Insufficient data. nr = None reported. ** = Less than 1 percent. [1]Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 12—Tillage systems used in spring wheat production, 1988-94

Category	1988	1989	1990 [1]	1991	1992	1993	1994
				Thousands			
Planted acres[2]	9,780	16,580	15,800	13,500	17,350	16,950	17,250
				Percent of acres [3]			
Tillage system:[4]							
Conventional with moldboard plow	16	9	12	7	8	9	8
Conventional without moldboard plow	62	61	63	60	61	57	56
Mulch-till	21	29	23	30	25	26	30
No-till	1	1	3	3	6	7	5
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	2	2	2	3	3	3	3
Conventional without moldboard plow	12	16	16	15	15	15	15
Mulch-till	39	40	39	43	41	41	43
No-till	63	id	64	65	53	61	57
Average[5]	17	22	21	24	23	24	25
				Number			
Hours per acre:							
Conventional with moldboard plow	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Conventional without moldboard plow	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Mulch-till	0.3	0.2	0.2	0.2	0.2	0.2	0.2
No-till	0.1	id	0.1	0.1	0.1	0.1	0.1
Average[5]	0.4	0.3	0.3	0.3	0.2	0.2	0.3
Times over field:							
Conventional with moldboard plow	4.7	3.3	3.7	3.7	3.3	3.7	3.2
Conventional without moldboard plow	4.4	4.1	4.1	4.0	3.9	4.0	3.9
Mulch-till	3.1	2.8	2.7	2.5	2.4	2.4	2.4
No-till	1.0	id	1.0	1.0	1.1	1.0	1.0
Average[5]	4.1	3.6	3.7	3.4	3.3	3.3	3.3

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
id = Insufficient data. [1] Idaho not included after 1989. [2]Preliminary. [3] May not add to 100 due to rounding. [4] See box, "Tillage Systems."
[5] Weighted average based on acreage.

Table 13—Tillage systems used in durum wheat production, 1988-94

Category	1988	1989	1990	1991	1992	1993	1994
				Thousands			
Planted acres[1]	2,500	3,000	3,100	3,000	2,200	1,950	2,450
				Percent of acres[2]			
Tillage system:[3]							
Conventional with moldboard plow	5	4	4	5	7	3	1
Conventional without moldboard plow	69	57	62	55	55	57	60
Mulch-till	24	39	34	37	35	36	33
No-till	2	1	id	3	3	5	6
				Percent of soil surface covered			
Residue remaining after planting:							
Conventional with moldboard plow	3	2	3	4	3	3	4
Conventional without moldboard plow	14	16	17	18	16	18	17
Mulch-till	39	43	42	39	42	44	42
No-till	72	id	id	40	68	61	63
Average[4]	21	21	25	26	26	29	28
				Number			
Hours per acre:							
Conventional with moldboard plow	0.3	0.3	0.3	0.2	0.3	0.5	0.2
Conventional without moldboard plow	0.4	0.4	0.3	0.3	0.3	0.4	0.4
Mulch-till	0.2	0.2	0.2	0.2	0.2	0.2	0.2
No-till	0.1	id	id	0.1	0.1	0.1	0.1
Average[4]	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Times over field:							
Conventional with moldboard plow	3.0	4.2	2.6	2.7	3.2	4.7	4.0
Conventional without moldboard plow	5.2	5.0	4.5	4.4	4.5	4.5	4.5
Mulch-till	2.9	2.8	3.0	2.9	2.5	2.4	2.6
No-till	1.0	id	id	1.0	1.0	1.0	1.0
Average[4]	4.5	4.1	3.9	3.7	3.6	3.5	3.7

Source: USDA, ERS, Cropping Practices Surveys, 1988-94.
id = Insufficient data. [1]Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage.

Table 14—Tillage systems used in spring and durum wheat production for major producing States, 1994

Category	Spring wheat					Durum wheat
	MN	MT	ND	SD	Area	ND
			Thousands			
Planted acres[1]	2,600	3,450	9,100	2,100	17,250	2,450
			Percent of acres[2]			
Tillage system:[3]						
Conventional with moldboard plow	16	1	9	6	8	1
Conventional without moldboard plow	77	61	50	53	56	60
Mulch-till	6	25	39	32	30	33
No-till	nr	13	3	9	5	6
			Percent of soil surface covered			
Residue remaining after planting:						
Conventional with moldboard plow	2	2	3	3	3	4
Conventional without moldboard plow	15	14	15	15	15	17
Mulch-till	43	43	44	39	43	42
No-till	nr	72	40	45	57	63
Average[4]	15	28	26	25	25	28
			Number			
Hours per acre:						
Conventional with moldboard plow	0.4	0.5	0.3	0.3	0.4	0.2
Conventional without moldboard plow	0.3	0.3	0.3	0.3	0.3	0.4
Mulch-till	0.3	0.2	0.2	0.1	0.2	0.2
No-till	nr	0.1	0.1	0.1	0.1	0.1
Average[4]	0.3	0.3	0.3	0.2	0.3	0.3
Times over field:						
Conventional with moldboard plow	3.8	4.0	3.0	2.3	3.2	4.0
Conventional without moldboard plow	3.6	4.7	4.0	3.1	3.9	4.5
Mulch-till	2.8	2.5	2.4	2.4	2.4	2.6
No-till	nr	1.0	1.0	1.0	1.0	1.0
Average[4]	3.5	3.6	3.2	2.6	3.3	3.7

Source: USDA, ERS, Cropping Practices Survey, 1994.
id = Insufficient data. nr = None reported. [1]Preliminary. [2] May not add to 100 due to rounding. [3] See box, "Tillage Systems." [4] Weighted average based on acreage

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