Conservation Tillage Systems in Texas

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Introduction

Adoption of conservation tillage systems is expanding in many areas of Texas, accelerated by continuing technological advances. Economic pressures favoring use of production systems involving reduced tillage naturally favor the maintenance of large amounts of residues on soil surfaces, thereby encouraging use of conservation tillage technologies. Most producers are conscientious in their efforts to reduce soil erosion, and conservation tillage is an answer for many.

Recent passage of the Food Security Act of 1985, especially the conservation compliance provisions, will further accelerate use of conservation tillage in Texas, since it will be the most economical conservation alternative for many producers.

Research by the Texas Agricultural Experiment Station and Agricultural Research Service, field demonstrations by the Texas Agricultural Extension Service (TAEX), conservation plans by the Soil Conservation Service (SCS), and cost-sharing practices by the Agricultural Stabilization and Conservation Service encourage adoption and use of conservation tillage systems as appropriate. Some pioneering producers have taken the lead in adapting these new production technologies. Their cooperation in sharing their experiences with, other producers has sparked the spread of such systems.

Limited research-proven practices, together with inadequate, experience-taught management capabilities of producers relative to conservation tillage practices, are problems in many areas of the state. Weeds continue to be a major problem, particularly in no-till production systems, although new chemicals and experience with existing herbicides provide hope for solving this problem. Many other problems to be overcome remain before conservation tillage can become the "conventional" system. In recent years TAEX, working closely with SCS and other agencies, has focused major program efforts to encourage adoption of conservation tillage practices. In 60 targeted counties, surveys revealed that 37 percent of the producers either had adopted or planned to adopt conservation tillage practices after participating in educational programs. Also, of the producers who adopted conservation tillage, 40 percent reported equal or increased crop yields, 35 percent reduced their production costs, and 43 percent increased their net profits.

The types of conservation tillage practices used in Texas are as variable as the types of soils and cropping systems. The most common are those in which small grain, primarily wheat, is the principal component, although corn and grain sorghum residues are being used increasingly in conservation tillage systems in some areas of the state.

A national consortium of focused conservation tillage interests, established a few years ago and now called the Conservation Technology Information Center (CTIC), is located at 2010 Inwood Drive, Fort Wayne, Indiana 46815. Among its many functions, CTIC accumulates statistical data about the types and extent of conservation tillage being practiced. Those data, developed at the county level, are the best available estimates on the subject and will be used as a primary basis for discussion in this report.

CTIC defines conservation tillage as "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, maintains at least 1,000 pounds per acre of flat small grain residue equivalent on the surface during the critical erosion period."

CTIC defines the types of conservation tillage as follows:

No-till—"The soil is left undisturbed prior to planting. Planting is completed in a narrow seedbed approximately 1-3 inches wide. Weed control is accomplished primarily with herbicides."

Ridge-till—"The soil is left undisturbed prior to planting. Approximately 1/3 of the soil surface is tilled at planting with sweeps or row cleaners. Planting is completed on ridges usually 4-6 inches higher than the row middles. Weed control is accomplished with a combination of herbicides and cultivation. Cultivation is used to rebuild ridges."

Strip-till—"The soil is left undisturbed prior to planting. Approximately 1/3 of the soil surface is tilled at planting time. Tillage in the row may consist of a rototiller, in-row chisel, row cleaners, etc. Weed control is accomplished with a combination of herbicides and cultivation."

Mulch-till—"The total soil surface is disturbed by tillage prior to planting. Tillage tools such as chisels, field cultivators, disks, sweeps, or blades are used. Weed control is accomplished with a combination of herbicides and cultivation."

Reduced-till—"Any other tillage and planting system not covered above that meets the 30 percent residue requirement."

Types and Trends of Conservation Tillage Systems

Conservation tillage practice trends in Texas are somewhat difficult to trace since the basis for statistical data collection has changed through the years. Before

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1983 and before the CTIC was established, data collection and terminology were not uniformly defined. However, data collection since 1984 when the CTIC began operations has been fairly consistent.

Acreage of cropland planted in Texas has fluctuated during the past but has ranged from 20 million to 30 million acres (Table 1). Acreage of no-till production also has varied but has increased overall and now stands at about 270,000 acres. Acreages of ridge-till and strip-till in Texas have been variable and relatively minor at fewer than 90,000 acres. Mulch tillage and reduced tillage probably should be considered together since they are so closely related in Texas. The variation of these two in recent years in part reflects weather fluctuations and consequent production variations. In general, trends are for increases in use of mulch-tillage practices. More than 3.2 million acres are mulch-tilled.

Trends since 1974 show variations in acreage of conservation tillage from year to year but generally demonstrate increases in adoption during the early years at a rate of more than 200,000 acres per year. Expansion leveled off somewhat after 1980. New conservation regulations should spur another expansion of acreage.

Statewide data (Table 2) demonstrate that fall-seeded small grain is the predominant crop in conservation tillage systems in Texas, accounting for more than 2.2 million acres. Full-season grain sorghum and corn account for almost 670,000 and 310,000 acres, respectively. Other crops make up lesser acreages. Most of the small grain in conservation tillage is mulch-tilled, by far the largest of all categories. Small grain and permanent pasture make up the bulk of no-till acreages. Cotton and soybeans produced under conservation tillage systems are mostly grown with mulch- or reduced-tillage practices.

Cropping and Conservation Tillage Systems for Major Production Regions

A combination of Major Land Resource Areas and Texas Crop Reporting Districts was used to identify areas appropriate for discussions about specific types of tillage systems used in the state. Of the 22.8 million acres of croplands indicated in Table 1, the Major Crop Production Regions developed for this study and shown in Table 3 and Figure 1 represent 21.1 million acres. The other less extensive crop production regions are not included in these discussions.

Another source of data for these discussions is the Texas Agricultural Statistics Service (TASS), a division of the Texas Department of Agriculture, located at 300 E. Eighth Street, Room 555, Austin, Texas 78767. Some differences in total "cropland between TASS and CTIC data are due to different statistical techniques for information gathering.

Below are discussions of conservation tillage systems for each major production region in Texas:

Northern High Plains

The Northern High Plains is made up predominantly of soils with clay loam surface horizons and clay-textured subsoils except for the extreme northwestern portion, which has sandy-textured soils. This mostly level to gently sloping region is subject to wind erosion in western sections and to water erosion along breaks into drainageways.

TASS describes this 23-county area of 15 million acres as having 5.3 million acres of cropland, of which corn (473,000 acres), irrigated cotton (430,000 acres), dryland cotton (121,000 acres), irrigated grain sorghum (520,000 acres), dryland grain sorghum (400,000 acres), soybeans (63,000 acres), irrigated wheat (848,000 acres), and

TABLE 1. EXTENT OF CONSERVATION TILLAGE IN TEXAS[1]

Production Year	Acres" Cropland	No Till	Ridge Till	Strip Till	Mulch[3] Till	Reduced Till	Consv.[4] Till
				Acres (1000)			
1974	**23,500**	109	—	—	**1,101**	—	**1,210**
1975	**24,400**	**209**	—	—	**1,179**	—	**1,388**
1976	**26,702**	**209**	—	—	**2,121**	—	**2,330**
1977	**26,948**	**262**	—	—	**2,357**	—	**2,619**
1978	**23,436**	**147**	—	—	**1,501**	—	**1,648**
1979	**29,792**	**122**	—	—	**1,255**	—	**1,377**
1980	**27,483**	**125**	—	—	**3,500**	—	**3,625**
1981	**26,369**	**44**	—	—	**2,554**	—	**2,598**
1982	**29,469**	**45**	—	—	**3,154**	—	**3,199**
1983	**20,399**	**149**	110	33	**2,667**	**2,060**	**5,019**
1984	**24,583**	**336**	9	12	**1,178**	**1,320**	**2,855**
1985	**24,841**	**308**	45	20	**2,141**	**1,590**	**4,104**
1986	**22,819**	**269**	67	20	**3,201**	**219**	**3,776**

[1]Data for 1982-1986 from Conservation Technology Information Center annual reports. Data for 1974-1981 from Soil Conservation Service estimates.

[2]Total cropland planted.

[3]Data for production years 1974-1982 involved compiling all conservation tillage practices except no-till in one category called Reduced/Minimum Tillage, here combined under "Mulch till" since that represents the most extensive practice by current definitions.

[4]Total conservation tillage acreage.

TABLE 2. INDIVIDUAL CROP ACREAGE BY CONSERVATION TILLAGE TYPES'

Crop category	Acres cropland	No Till	Ridge Till	Strip Till	Mulch Till	Reduced Till	Consv.* Till
Corn (FS)	1,723,039	6,417	6,590	850	239,154	57,140	310,151
Corn (DC)	57,763	2,000	0	0	5,920	0	7,920
Small Grain (SpSd)	378,333	1,489	0	0	15,476	16,455	33,420
Small Grain (FlSd)	7,921,153	165,272	3,700	10,750	2,052,063	0	2,231,785
Soybeans (FS)	334,317	3,850	1,000	350	23,700	5,075	33,975
Soybeans (DC)	15,397	1,350	0	0	1,250	0	2,600
Cotton	5,477,804	5,875	5,126	5,040	87,971	32,035	136,047
Grain Sorghum (FS)	4,986,814	24,606	6,820	2,753	528,011	107,068	669,258
Grain Sorghum (DC)	394,511	9,885	0	100	54,589	50	64,624
Forage Crops	271,932	2,735	0	0	58,207	0	60,942
–Permanent Pasture	436,476	70,961	0	0	111,721	0	182,682
Other Crops	1,258,380	45,880	43,439	200	134,323	1,000	224,842
–Fallow	1,492,708	38,332	0	0	172,707	677	211,716
–Conservation Use	4,479,299	0	0	0	0	0	0
Totals	22,819,443	269,359	66,675	20,043	3,200,664	218,823	3,775.564

'Taken from Conservation Technology Information Center, 1986 National Survey of Conservation Tillage Practices, Texas County Summary.
*Sum of no-till, ridge-till, strip-till, mulch-till, reduced-till
FS—Full Season; DC—Double Crop; SpSd-Spring Seeded; FISd-Fall Seeded
Fallow includes cropland idled for the entire year
conservation use includes cropland idled for set-aside or diverted acres
–Not included in totals

TABLE 3. CONSERVATION TILLAGE SYSTEMS FOR MAJOR CROP PRODUCTION REGIONS IN TEXAS'

Production region	Acres Cropland[2]	No Till	Ridge Till	Strip Till	Mulch Till	Reduced Till	Consv. Till[3]
Northern High Plains	5,182,149	50,065	4,000	3,325	959,389	75,139	1,091,918
Southern High Plains	4,283,226	20,225	12,250	4,315	269,788	42,700	349,278
Northern Rolling Plains	1,671,289	1,960	2,750	2,300	402,700	5,450	415,160
Southern Rolling Plains	2,001,734	1,855	0	0	217.135	14,588	233,578
North Central Prairies and West Cross Timbers	869,368	19,480	0	0	187,144	1,925	208.549
Blackland Prairie and Grand Prairie	2,878,000	28,593	800	3	562,226	1,700	593,322
Northeast Texas	393,174	52,355	2,780	0	76,680	15,515	147,330
South Central Texas	1,080,113	26,423	300	10,000	116,009	7,960	160,692
Upper Coast Prairie	1,076,898	6,180	1,056	0	72,409	23,431	103,076
Coastal Bend	666,298	0	0	**0**	105,550	0	105,550
Lower Valley	962,647	100	41,739	0	30,085	21,100	93,024

'Major Production Regions based on Major Land Resource Areas and Texas Crop Reporting Districts.
Total cropland planted.
[3]Total conservation tillage acreage.

dryland wheat (2.13 million acres) comprise the major crops.

Mulch tillage is the predominate type of conservation tillage practice used, accounting for 87 percent of the total in conservation tillage acreage. Reduced-till accounts for 7 percent. No-till production systems represent only 5 percent, but the acreage is expanding.

Fall-seeded small grain, principally wheat, represents about 65 percent of the total conservation tillage in this region. Full-season grain sorghum is about 15 percent and full-season corn about 14 percent of the total conservation tillage being practiced. The USDA-ARS Laboratory at Bushland has shown clear advantages for farmers to adopt a wheat-fallow-sorghum cropping system. Where irrigation water is available, irrigated wheat-fallow should be followed by either dryland or irrigated sorghum. Wheat can be double-cropped after sorghum in irrigated systems. Yields have been superior with the conservation tillage systems, and profits have averaged $30 per acre more for no-tillage over conven-

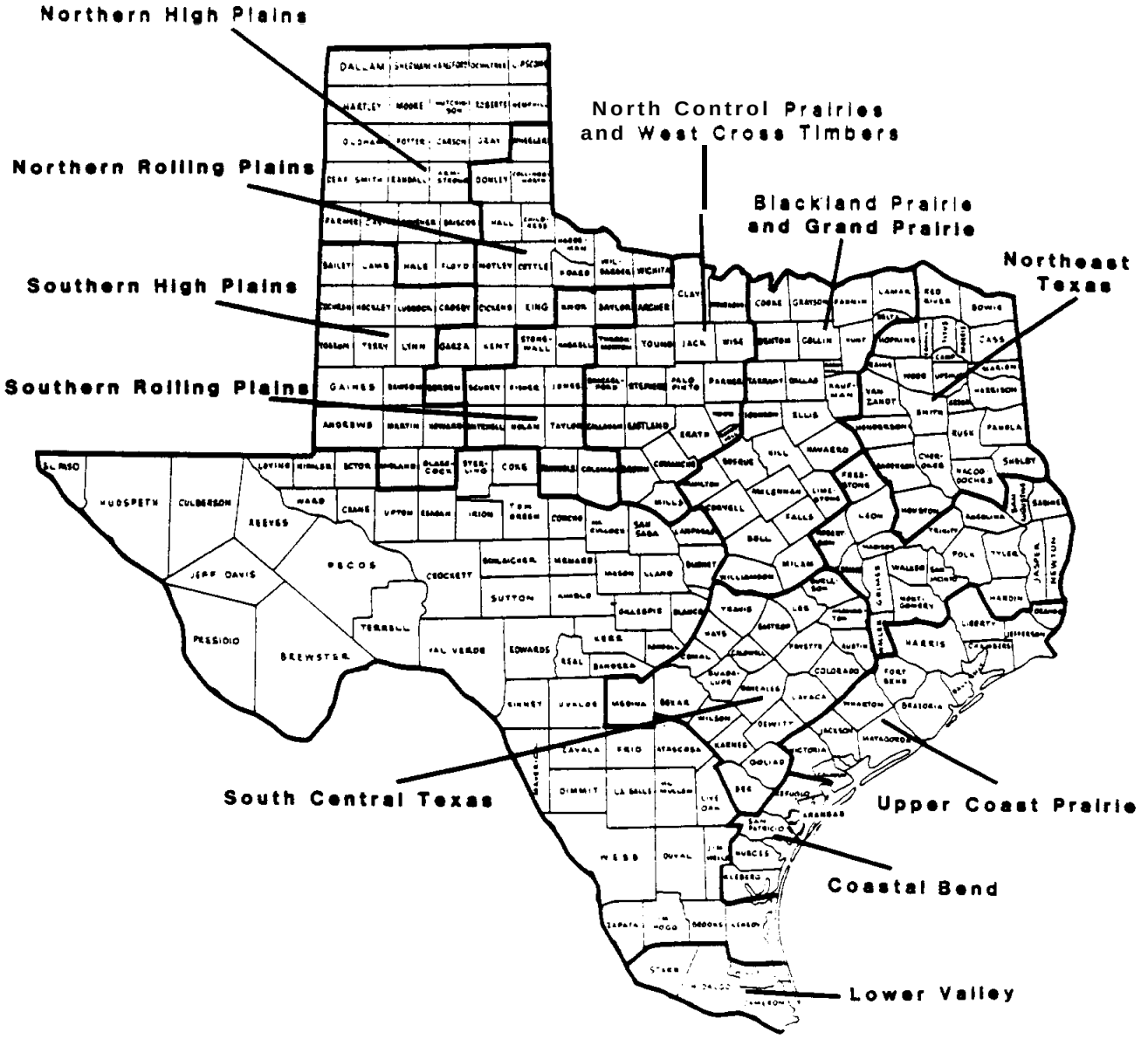

Figure 1. Major Crop Production Regions
(Portions of west and southwest Texas not Included)

tional systems involving inversion tillage practices in long-term research at Bushland.

Southern High Plains

The Southern High Plains, an area of sandy soils ranging from fine sands in the southwestern part to fine sandy loams in the northern areas, is comprised of 16 counties totaling 9.9 million acres, of which about 4 million acres are "planted croplands." Of those lands, according to TASS data, corn (70,000 acres), irrigated cotton (921,000 acres), dryland cotton (1.5 million acres), peanuts (47,000 acres), irrigated grain sorghum (141,000 acres), dryland grain sorghum (579,000 acres), soybeans (17,000 acres), irrigated wheat ((130,000 acres), and dryland wheat (470,000 acres) comprise the major crops. As with the Northern High Plains, nearly 270,000 acres of the 322,000 acres of conservation tillage systems are in mulch tillage in this region. Reduced tillage, a practice similar to mulch tillage, accounts for about 43,000 acres. Only limited amounts of other conservation production systems are used.

Fall-seeded wheat and other small grains make up about 55 percent of the total acreage of conservation systems. Full-season corn, cotton, and grain sorghum in-

dividually make up about 11 percent of the total conservation tillage systems. Double-cropped grain sorghum is about 10 percent of the total.

Conservation tillage systems are particularly difficult in the Southern High Plains region since the area has a dominance of cotton production and therefore low residue levels. Both dryland wheat and grain sorghum have relatively low production potential in most years, and inadequate irrigation is available for corn production. In about one year out of five, crop failures can be anticipated with wheat and grain sorghum. In many years, rainfall will be inadequate to allow planting of small grain following cotton. Severe wind erosion is common in the Southern High Plains, which makes surface residue cover valuable. A problem arises, however, in attempts to grow plant material that will provide adequate cover to protect the soil surface.

A few innovative farmers have developed no-till cotton production following wheat. However, the acreage of such systems is very limited. Also, farmers have commonly experienced near crop failures with attempts at conservation tillage because of weed control problems with herbicides on coarse, sandy soils.

Northern Rolling Plains

In general, this area has a gently rolling topography with cropland areas ranging from 1 percent to 5 percent slope. Soils vary in texture, ranging from small areas of sands to larger areas of fine sandy loams to clay loams. Both wind erosion and water erosion are problems for this region.

TASS indicates that this 16-county area of 8.7 million acres has about 1.7 million acres of cropland, of which corn (4,000 acres), irrigated cotton (36,000 acres), dryland cotton (496,000 acres), peanuts (6,300), irrigated grain sorghum (4,000 acres), dryland grain sorghum (76,000 acres), irrigated wheat (20,000 acres), and dryland wheat (890,000) comprise the major crops. Wheat, the dominant crop in this region of the state, represents more than 82 percent of the conservation tillage systems being used. Full-season grain sorghum makes up about 5 percent.

Mulch tillage makes up 97 percent by area of the conservation tillage systems practiced in this region (Table 3). Although other types of conservation tillage systems are minor in extent, some innovative systems have been developed for producing crops such as peanuts on sandy soils. Strip tillage, a relatively new practice in the area, has been quite successful in peanut production and is of great value in controlling wind erosion.

Research at Chillicothe-Vernon has shown definite advantages for using furrow diking in wheat, sorghum, and cotton rotations under reduced-tillage systems. Reduced production cost has been a primary driving factor in adoption of conservation tillage practices. Wind erosion control and protection of fragile soils from damaging runoff waters have been additional benefits. Principal problems with conservation tillage systems have been diseases, compaction, and weed control. Soil compaction is a particularly prevalent problem in this region, and considerable research has been directed toward preventing and correcting it. Destruction of plowpans is often necessary for successful conservation tillage systems in this region.

Southern Rolling Plains

This area is dominated by gently rolling landforms and soils with fine sandy loam surface textures. Soils with finer-textured surfaces occur more frequently in the eastern parts of this region. Both wind and water erosion are important problems with which farmers must deal.

TASS indicated that in this 12-county region of 7.26 million acres, about 2 million acres of cropland are planted each year. Corn (2,000 acres), irrigated cotton (27,000 acres), dryland cotton (505,000 acres), peanuts (7,500 acres), irrigated grain sorghum (6,000 acres), dryland grain sorghum (214,000 acres), irrigated wheat (15,000 acres); and dryland wheat (960,000 acres) are the principal crops.

Mulch tillage represents 93 percent of all acreage in conservation tillage in this area (Table 3). Reduced tillage, which is very similar, makes up most of the remainder. Fall-seeded wheat makes up about 86 percent of the acreage in conservation tillage, followed by full-season grain sorghum (6%) and foragecrops (7%). Few, if any, conservation tillage systems have been reproted for any other crops. As with the previously discussed areas, conservation tillage practices involve use of chemicals and sweep tillage to maintain a predominance of surface covering residues and avoid the use of inversion types of tillage implements. Rotation systems are common in this region, but few conservation tillage systems are coupled with them. Most of the conservation tillage being practiced is with continuous wheat production.

North Central Prairies and West Cross Timbers

Soils of this region vary from fine sandy loams to clay loam surface textures. Wind erosion is much less of a problem here than in the western areas of the state, but water erosion hazards are more severe.

TASS indicates that this 19-county area makes up a total of 10.47 million acres, of which 1.2 million acres are planted to crops annually, principally corn (2,000 acres), cotton (21,000 acres), peanuts (86,500 acres), grain sorghum (30,000 acres), and wheat (506,000 acres).

Mulch tillage constitutes about 90 percent of the total conservation tillage practiced in this region (Table 3). No-till production systems make up about 9 percent. Fall-seeded small grain, primarily wheat, makes up about 84 percent of the conservation tillage acreage in this area. The remainder, about 9.3 percent, is primarily in peanut production areas. In this region, about 5 percent of the conservation tillage acreage are attributed to permanent pastures.

Blackland Prairie and Grand Prairie

The Blackland Prairie is an extensive region of deep, clayey soils of relatively uniform texture throughout. The Grand Prairie also is dominated by soils with fine-textured surfaces, but they commonly overlie limestone

or similar material at shallow depths. Rolling topography with slopes varying from 1 percent to 5 percent dominate, and water erosion is a severe problem.

TASS indicates that this 25-county area has about 13.9 million acres, of which about 3.6 million acres are planted to crops annually. Of that acreage, corn (190,000 acres), cotton (126,000 acres), oats (340,000 acres), grain sorghum (660,000 acres), soybeans (15,000 acres), and wheat (1.4 million acres) constitute the major crops.

Mulch tillage makes up about 94 percent of the total conservation tillage acreage in this area (Table 3). No-till is used on about 5 percent of that area. Of that total conservation tillage acreage, fall-seeded small grains constitute about 65 percent. Full-season grain sorghum and full-season corn individually constitute about 9.5 percent of the total conservation tillage practiced. Continuous small grain production is the dominant cropping system in which conservation tillage is employed. However, throughout this region, crop rotation is practiced widely, and numerous examples of proper residue management and avoidance of inversion types of tillage implements can be found. In general, in such conservation systems, residues are left in place throughout the winter with the principal disturbance being bed reshaping using disk bedders.

Northeast Texas

Eastern and southern counties of this region are dominated by sandy soils ranging from loamy fine sands to fine sandy loams. The northern part has extensive areas of clay loams or finer-textured soils. Wind erosion problems are of little or no consequence, but water erosion hazards are severe in many areas.

TASS indicates that this 24-county area contains 11.16 million acres, of which 916,000 acres are planted to crops annually. Primarily, corn (16,000 acres), cotton (12,000 acres), oats (35,000 acres), rye (41,000 acres), grain sorghum (20,000 acres), soybeans (22,000 acres), and wheat 17,000 acres) are the major crops.

Mulch tillage and reduced tillage constitute 52 percent and 11 percent, respectively, of the total conservation tillage acreages in this region (Table 3). This area of the state has the greatest acreage percentage of no-till production in the state — 36 percent.

More than 65 percent of the conservation tillage in this area is fall-seeded small grain. More than 7 percent is on spring-seeded small grain. Conservation tillage in permanent pastures makes up about 21 percent of the total.

South Central Texas

Soils in this region range from extensive river valley, water-lain medium- to fine-textured soils to upland soils dominated by loamy fine sand and fine sand surface textures with heavy clay subsoils. Water erosion is a severe hazard on most of the upland soils. Soils tend to be finer-textured in the surface in the southern and western part of the region.

TASS indicated that this 21-county area of about 11.32 million acres has about 1.6 million acres annually planted to crops. Corn (230,000 acres), cotton (29,000 acres), oats (210,000 acres), peanuts (31,000 acres), grain sorghum (290,000 acres), and wheat (190,000 acres) are the major crops.

Mulch tillage makes up about 72 percent of the conservation tillage acreage in this area and no-till about 16 percent. Strip tillage is used on about 6 percent of the conservation tillage acreage.

More than 65 percent of the conservation tillage in this area is fall-seeded small grain. More than 7 percent is on springseeded small grain. Conservation tillage in permanent pastures makes up about 21 percent of the total.

Upper Coast Prairie

Extensive areas of soils with fine sandy loam surfaces and clayey-textured subsoils occur in the western counties of the region. Throughout the rest of the area, soils with clayey-textured surfaces dominate. Topography tends to be nearly level to gently sloping with most slopes less than 2 percent. Wind erosion is not a major problem, and water erosion problems are mostly related to sheet erosion and to a lesser extent rill erosion along breaks into drainageways.

TASS indicates that in this 13-county region, 7.67 million acres occur, of which about 1.2 million are planted to crops, including corn (248,000 acres), cotton (54,000 acres), oats (15,000 acres), rice (272,000 acres), grain sorghum (280,000 acres), soybeans (195,000 acres), and wheat (32,000 acres).

Mulch tillage and reduced tillage make up 70 percent and 23 percent, respectively, of the total conservation tillage acreage in this area. No-till production systems account for 6 percent.

Full-season grain sorghum and corn make up 52 percent and 33 percent, respectively, of the total crop acreage produced under conservation tillage systems. Fall-seeded small grains constitute about 5 percent. Spring-seeded small grains and permanent pastures each make up about 3 percent of the total.

In general, conservation tillage systems in this region favor maintaining surface residues produced by previous grain sorghum and corn crops, and avoiding the use of inversion types of implements.

Coastal Bend

This area is dominated by soils that are clayey-textured throughout their profiles, although small areas of soils that have fine sandy loam surfaces and clayey textured subsoils do occur. In general, the slopes are nearly level to gently sloping with most slopes less than 1.5 percent.

TASS indicates that this five-county area totals 2.24 million acres with 685,000 acres annually planted to crops. Of that cropland, corn (78,000 acres), cotton (150,000 acres), oats (4,000 acres), grain sorghum (400,000 acres), and wheat (16,000 acres) make up the major crops.

All of the conservation tillage reported for this region is mulch tillage. Eighty percent of the conservation tillage acreage involves full-season grain sorghum; 16 percent is in corn. These systems involve the maintenance of surface residues with disturbance being

primarily the use of disk bedders to shape beds. Alternatively, on flat-planted fields, light disking is used to control weeds and to prepare a seedbed.

Lower Valley

This area is dominated by zones of soils that vary in texture with distance from the Rio Grande River. Closest to the river are clayey-textured soils. On terraces farther from the river, soils with fine sandy loam surfaces and more clayey-textured subsoils occur. Slopes in general are nearly level to gently sloping with dominant slopes of less than 2 percent.

TASS indicates 2.75 million acres in this four-county area are present with 969,000 acres annually planted to crops. This region has a diverse agriculture with many crops being grown, primarily corn (96,000 acres), cotton (301,000 acres), oats (1,000 acres), grain sorghum (380,000 acres), wheat (3,000), and vegetables (86,000 acres). The long growing season makes double-cropping possible, and irrigation is used to supplement rainfall on most fields.

Of the conservation tillage acreages used in this area, 23 percent are reduced-till, 32 percent are mulch till, and 45 percent are ridge-till. Conservation tillage systems involving cotton constitute about 15 percent of the total acreage. Full-season grain sorghum makes up about 34 percent and vegetable production 44 percent. The majority of the ridge-till systems are in vegetable production. Mulch tillage is used mostly with grain sorghum production, and reduced tillage is used for cotton production where conservation tillage practices are involved.

Problems With Adoption of Conservation Tillage Systems

In general, problems encountered with adopting conservation tillage systems in Texas are the same as elsewhere in the United States. Weed control is the major problem, and diseases and insect problems also are reported. However, entomologists in the High Plains and Rolling Plains are increasingly indicating reduced insect problems on conservation tillage fields, possibly due to albedo. Research is underway to further elucidate this phenomenon. Limited availability of proper planting equipment has resulted in poor stands in many conservation tillage systems. Timeliness of operations is a major problem with conservation tillage on soils with a high percentage of clay. Problems with late-season weed control and low yields have affected some areas. Attitudes biased toward clean tillage are commonplace, and lack of understanding by landowners and individuals with financial institutions are a problem in some cases. In general, the lack of appropriate management skill has been a major limitation. The lack of farmer experience in dealing with such systems and a lack of appreciation for timeliness by many producers have led to disastrous results. For example, timing weed control with cultivation is far more flexible than with chemicals. In addition, the failure of chemicals to be effective in weed control is variable from year to year, dependent to some extent on weather. Such variations cause inexperienced producers trouble.

The new conservation provisions of the 1985 Food Security Act should stimulate widespread adoption of conservation tillage practices in many areas of the state. As one of the alternatives for controlling erosion, conservation tillage will be preferred in terms of cost by many. The conservation provision effects will be concentrated in those areas most susceptible to wind erosion and water erosion. The areas in Texas where erosion problems are most severe include the High Plains, Rolling Plains, North Central Prairies, West Cross Timbers, Blackland Prairie and Grand Prairie, and South Central Texas. Conservation tillage will be invaluable in maintaining the viability of agricultural production in many of these areas.

Financial institutions now have a major impact on the use of conservation tillage systems. Farmers throughout the state are facing some of the most critical financial challenges ever. Many are in limbo as to whether they will be allowed to continue farming. In such a situation, bankers and other lenders have a major impact on farmer decision-making. Most of the lenders are requiring that producers use "proven" production systems that are conventional and commonly used throughout the area in which they are located. Such requirements do not allow for use of conservation tillage practices in most areas.

Future Needs

The need for new technology has never been greater. Research is needed to define alternatives for adoption of these relatively unknown systems. Coincidental with expanded Extension educational programs to acquaint producers with available options, the conservation planning expertise of SCS will define more clearly than ever the areas where conservation tillage systems are needed. In general, a major increase in adoption of conservation tillage systems is expected in Texas.