CONSERVATION TILLAGE IN GEORGIA COTTON PRODUCTION

RESULTS AND ANALYSIS OF A 2005 SURVEY

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No-Till Cotton Planted Into Rye Cover Crop

Photo Courtesy of Ronnie Barrentine, University of Georgia Cooperative Extension, Pulaski County

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Introduction

In 1983, Georgia cotton acreage had declined to only 120,000 acres planted. By 1995, acres planted had increased to 1.5 million. This level of acreage would be reached again in 2000. Since passage of the current farm bill in 2002, Georgia cotton acreage has declined 10-15% in response largely to enhanced economic opportunity for peanuts. Cotton remains, however, by far the state's largest crop in acreage and value.

The revival of cotton in the state is truly a remarkable story. The resurgence in acreage can be attributed to successful eradication of the boll weevil, farm policy which allowed new and existing growers to build "base", increased use of irrigation, and new-higher yielding varieties suited to the state.

In more recent years, genetic or transgenic varieties including herbicide-tolerant Roundup Ready cultivars have, for some producers, eased the transition from conventional tillage practices to conservation tillage and to do so economically.

There are many factors that determine the profitability of the cotton enterprise. Some are within the farmers' control, many are not. Inputs such as seed, fertilizer, and chemicals are often the first target for farmers trying to trim cost. Other factors often overlooked, however, are timeliness and efficiency of operations, labor and machinery costs of trips over the field, and overhead or fixed costs of machinery and equipment.

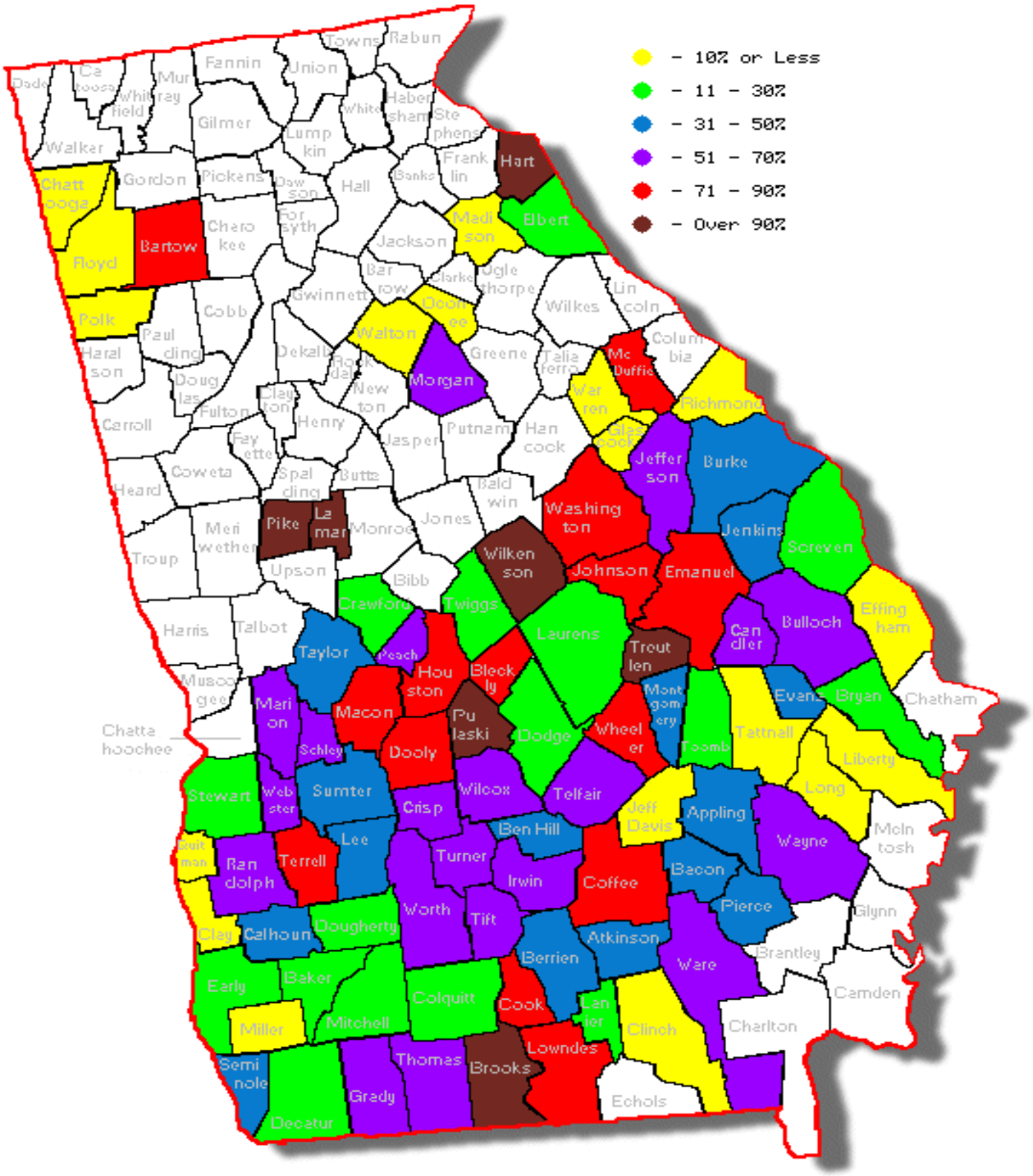
Survey

In April and May of 2005, a survey questionnaire (Appendix Table 1) was conducted to determine the use of conservation tillage practices in cotton production in Georgia and to determine farmers' perceptions about conservation tillage in cotton. The survey was sent to University of Georgia Cooperative Extension agents in all cotton producing counties. Agents were asked to complete the survey giving their best estimates and judgment based on their observations and the experience of cotton producers in the county. Ninety counties responded representing 97.6% of the state's cotton acreage planted in 2004 (Figure 1).

For the purposes of the survey, the following definitions were given:

Conventional tillage was defined as "any set of tillage operations that include disking and turning the soil and planting into bare ground. It typically, but not necessarily, includes ripping and bedding".

Figure 1. Counties Responding To The 2005 Georgia Cotton Tillage Survey, 90 Counties Responding Representing 97.6% of 2004 Acres Planted, Percent of Conservation Tillage Cotton Acres in Each County.



No-till was defined as “no tillage of the soil whatsoever and the hard-pan is not broken. Planting is directly into previous crop residue, winter fallow, or cover crop”.

Strip-till was defined as “tillage of only a small seed-bed area (approximately 10 to 14 inches wide) and may include ripping under the row”.

Reduced tillage was defined as “any other set of practices not otherwise defined as conventional, no-till, or strip-till”.

For some survey questions, the answer was to be given as a percentage of the cotton acres in the county. To then determine the acres and percentage for the state, the percentage given for each county was first multiplied by the cotton acres in the county. Then the acreage in each county summed to arrive at the total for the state.

Results, Analysis, and Discussion

County and State Acreage Profile

County Extension agents were asked to estimate the percentage of cotton acres in the county produced in each of the 4 tillage categories as defined. Figure 1 shows the percentage of conservation tillage cotton acres in each of the 90 counties responding including those counties (12) where there were no conservation tillage acres. The survey estimated percentage of acreage planted by tillage system by county is given in Appendix Table 2.

Of the 90 counties responding, 84 reported acreage of conventionally planted cotton (Table 1). Six counties, therefore, had no conventional acreage. Two of the 84 counties reported 10% or less conventional tillage cotton. Sixteen counties reported that over 90% of cotton acreage was conventional tillage. Of these 16 counties, 12 reported that all cotton acreage in the county was conventional tillage— i.e. 12 of the 90 counties responding to the survey had no conservation tillage cotton in 2004.

Of the 90 counties responding, 78 reported acreage of conservation tillage cotton (no-till, strip-till, or reduced-till). Seven counties had over 90% of cotton acreage in conservation tillage with 6 of these 7 being 100% conservation tillage. Six of the 78 counties reporting conservation tillage cotton acres had 10% or less.

Strip-tillage was the largest conservation tillage practice reported. Of the 78 counties reporting conservation tillage cotton production, 73 counties reported strip-till acreage (Table 1). In these 73 counties, strip-till comprised more than 50% of all cotton acres planted in 25 of the 73 counties. Four counties were 100% strip-till.

Twenty-four counties reported no-till cotton acreage. In most counties, this acreage was relatively small. In 20 of the 24 counties, no-till acreage was 30% or less of the acres planted. The remaining 4 counties, however, were over 50% no-till and 2 of these were 100% no-till.

Reduced-tillage was reported in 33 counties. Again, in most counties this acreage was relatively small. In 31 of the 33 counties, reduced-till acreage was 30% or less of the total acres planted.

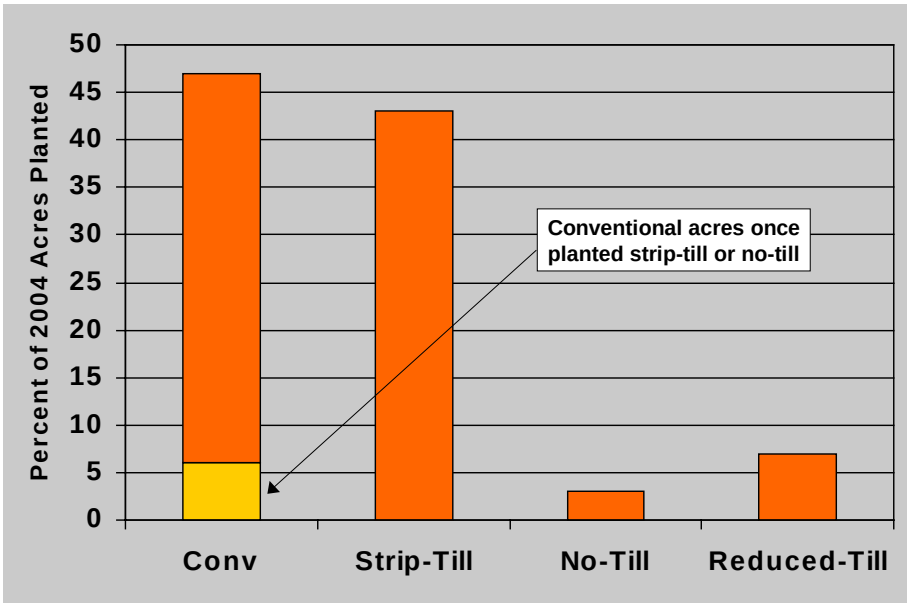
Table 1. Tillage System, Number of Counties Reporting Acreage of That System And Counties Reporting By Percent of Acres in That System, 90 Total Counties

Tillage	Total	10% or Less	11-30%	31-50%	51-70%	71-90%	Over 90%
Conventional	84	2	19	19	15	13	16
Conservation	78	6	16	15	20	14	7
No-Till	24	14	6	0	1	1	2
Strip-Till	73	9	21	18	16	4	5
Reduced-Till	33	22	9	2	0	0	0

The 2004 cotton acreage planted by county was available through the USDA Georgia Agricultural Statistics Service. In the survey, agents were asked for the county 2004 cotton acres planted and this number used when no USDA estimate was available.

The total acres planted in each county was multiplied by the percentage of cotton in each of the 4 tillage categories to estimate the acres planted in the county for each tillage method. The acreage by tillage method for all 90 counties was then summed to arrive at an acreage total and percentage by category for the state (Figure 2).

Figure 2. Use of Tillage Practices In Georgia Cotton Results of a April-May 2005 County Agent Survey



Over 50% of Georgia's cotton acreage is produced by a method other than the traditional conventional rip-bed method. Conventional tillage remains the largest single tillage method with 47 percent of acreage in conventional tillage while 53 percent is some form of conservation tillage (43 percent is strip-till, 3 percent is no-till, and 7 percent is reduced-till).

Extension agents were asked to estimate the percentage of 2004 cotton acres in the county that were at one time planted strip-till or non-till but had since reverted back to conventional tillage. Multiplying this percentage by the acres planted in the county and summing up across all counties provided an estimate for the state. Six percent of the total acres in the state are planted in conventional tillage but were once strip-till or no-till (Figure 2). This represents 13 percent of conventional acres.

Expectations on the Future of Tillage Practices

Extension agents were asked their opinion about the near future of tillage practices in their county. Specifically, the question was asked "In the next 2-3 years, do you expect the percentage of (strip-till/no-till) acres in your county to increase, decrease, or remain the same?" The survey was taken in 2005, thus this question could be applicable out to the period 2007-2008.

Eighty-eight of 90 surveys responded to the question about strip-till (Table 2). Of the 88 responses, 55 or 62.5% expect strip-till cotton acreage to increase. Thirty counties (34%) expect strip till acreage to stay the same. Interestingly, 53 of 73 (72.6%) of counties with strip-till production expect acreage to increase. However, in 15 counties responding having no strip-till acreage, only 2 (13.3%) expect acreage to increase.

Eighty-seven of 90 surveys responded to the question about no-till (Table 2). Of the 87 counties responding, 76 (87.4%) expect no-till acreage to remain the same or decrease. Among the 24 counties responding with no-till acreage, 15 or 62.5% expect acreage to remain the same or decrease. Among 63 counties responding without no-till acreage, 61 or 96.8% expect acreage to remain the same or decrease.

Table 2. Expected Change (2-3 Year Outlook) in Percentage of Acreage Planted to Strip-Till and No-Till Production.

Strip-Till	**Total**	**Increase**	**Decrease**	**Same**
Total Responses	88	55	3	30
Counties With Strip-Till	73	53	2	18
Counties Without Strip-Till	15	2	1	12
No-Till	**Total**	**Increase**	**Decrease**	**Same**
Total Responses	87	11	5	71
Counties With No-Till	24	9	2	13
Counties Without No-Till	63	2	3	58

Cotton Yields

Extension agents were asked the question “Compared to conventional tillage on the same soil type with average growing conditions, for your county would you say that yield per acre for (strip-till/no-till) would be higher, lower, or about the same?” Seventy-one of the 73 counties with strip-till acreage responded to the question. Twenty of the 24 counties with no-till acreage responded (Table 3).

Fifty-four of 71 counties (76%) said that cotton yield in strip-till production is the same as conventional yield. Fourteen counties (19.7%) said that strip-till yield is higher than conventional. Only 4.2% said strip-till yield was lower than conventional.

Ten of 20 counties responding (50%) said that cotton yield in no-till production is lower than conventional yield.

Table 3. How Strip-Till and No-Till Cotton Yields Compare to Conventional Tillage

	Total Responses	Higher	Lower	Same
Strip-Till Yield	71	14	3	54
No-Till Yield	20	4	10	6

If answering “higher” or “lower”, county agents were asked to briefly state the reasons why. If no-till yield was considered lower than conventional yield, the reasons given included hard pan soils which limit root development, later planting, lower/poor stand, poorer weed control, and inadequate nematode control. If no-till yield was considered higher than conventional yield, the reasons given included improved soil moisture, retention, and infiltration, reduced early-season drought stress, and reduced damage from blowing sand.

If strip-till yield was considered higher than conventional yield, the reasons given included improved soil moisture and water retention, improved fertility and organic matter, less soil erosion, and lower soil temperatures. If strip-till yield was considered less than conventional yield, the reasons given included reduced plant stand and colder soils.

Planting Practices

In conventional tillage practices, previous crop residue and winter weeds are disked under and planting is done into bare ground. In strip-till and no-till production, previous crop residue, winter fallow, or winter cover crop is left and must be managed. Planting will be into previous crop residue and winter fallow, winter fallow, winter cover crop, or double-crop after harvest of the winter crop.

The survey asked county Extension agents to estimate the percentage of the strip-till and no-till acres in their county that were planted into previous crop residue and winter fallow, into winter fallow only, into a winter cover crop, and into winter crop residue

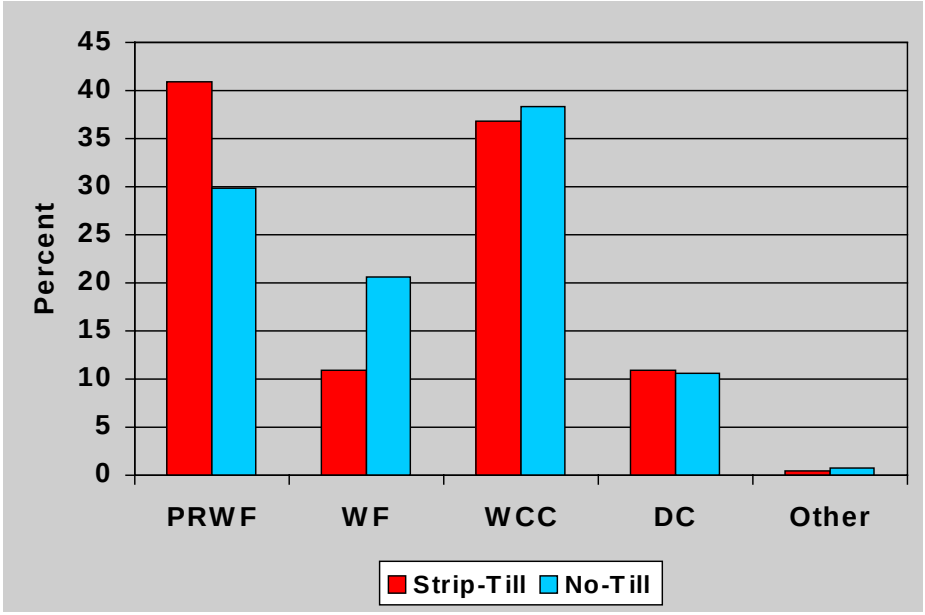
(double-crop planted after harvest of winter crop). The percentage in each county was multiplied by the estimated acres of strip till and no-till in the county then summed across all counties to give an estimate for the entire state (Figure 3).

In Georgia, winter cover crops largely consist of rye, wheat, and oats. In strip-till production, 40.9% is planted into previous crop residue and winter fallow (PRWF), 36.8% is planted behind a winter cover crop (WCC), 10.9% is planted into winter fallow (WF), and 10.9% is double-cropped (DC) after harvest of the winter crop.

In no-till production, 38.3% is planted behind a winter cover crop, 29.8% is planted into previous crop residue and winter fallow, 20.6% is planted into winter fallow, and 10.6% is planted after harvest of the winter crop (double-cropped).

Double-crop cotton is not a significant percentage of acreage in either strip-till or no-till production. Compared to strip-till, no-till cotton production takes place more often on winter fallow and less often on previous crop residue and winter fallow. Planting into a winter cover crop is very important in both practices.

Figure 3. Comparison of Strip-Till and No-Till Planting Results of a April-May 2005 County Agent Survey



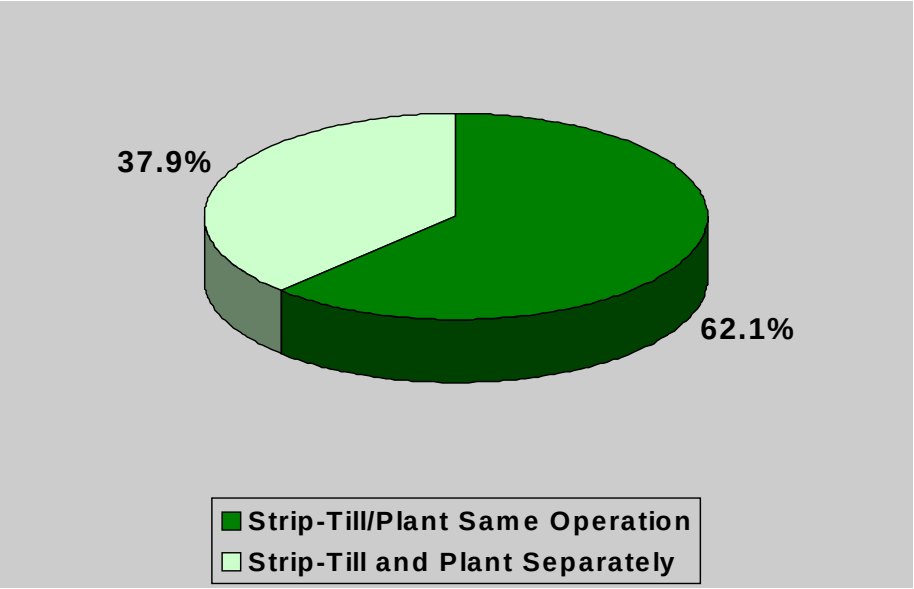
In strip-till production, the tillage operation and planting can be performed as separate operations requiring 2 trips over the field or strip-and-plant performed with one combination piece of equipment in one pass. Preference for how this is done may be a function of whether planting is into residue, fallow, or cover crop; the type and condition of the cover crop; the overall farm size and acreage of cotton; labor availability; tractor horsepower requirement; ability to stay on the strip-till bed when planting separately; and weather.

The survey asked county Extension agents the question "For strip-till, what would be your best estimate of the percentage of the strip-till acres in your county planted as follows: strip and plant in separate operations, strip/plant in the same operation?"

Seventy-two of the 73 counties with strip-till acreage (representing 99.96% of strip-till acres) responded to the question. In 22 of the 72 counties (representing 19.3% of all strip-till acreage in the state), all strip-till cotton in the county is planted in the same operation. In 43 of 72 counties (representing 45.2% of all the strip-till acreage in the state), 75% or more of the acreage is planted in the same operation.

Statewide, 62.1% of strip-till acreage is strip-tilled and planted in the same operation and 37.9% is strip-tilled then planted separately (Figure 4).

Figure 4. Cotton Planting In Strip-Till Production Results of a April-May 2005 County Agent Survey



Inputs in Strip-Till Compared To Conventional Tillage

The profitability of conservation tillage compared to conventional tillage is dependent on, among other factors, relative yields and costs. As previously reported in Table 3, in 68 of 71 counties responding with strip-till cotton production, strip-till yield was thought to be the same or higher than conventional tillage.

The survey asked county Extension agents how use of inputs in strip-till cotton production compared to conventional production– "higher", "lower", "about the same", or "don't know". The results are summarized in Table 4. All 73 counties reporting strip-till acreage responded to the question.

Use of seed and fertilizers was considered to be mostly the same for strip-till as in conventional tillage. Almost 1/4 (23%) of counties, however, reported more seed used in strip-till compared to conventional. For chemical inputs, use of insecticides, nematicides, and fungicides was reported mostly the same. For herbicides, however, 60% of counties reported higher herbicide use. Fuel and labor use is strongly thought to be less in strip-till than in conventional tillage. Over 90% of the counties reported less fuel and labor use in strip-till cotton.

Table 4. Use of Selected Inputs in Strip-Till Cotton Production Compared To Conventional Tillage

Input	Total Responses	Higher	Lower	Same	Don't Know
Seed	73	17 (23%)	1 (1%)	54 (75%)	1 (1%)
Nitrogen	73	12 (16%)	8 (11%)	52 (71%)	1 (1%)
P and K	73	3 (4%)	4 (5%)	62 (85%)	4 (5%)
Other Nutrients	73	2 (3%)	3 (4%)	62 (85%)	6 (8%)
Herbicides	73	44 (60%)	17 (23%)	12 (16%)	0
Insecticides	73	10 (14%)	9 (12%)	53 (73%)	1 (1%)
Nematicides	73	3 (4%)	5 (7%)	60 (82%)	5 (7%)
Fungicides	73	8 (11%)	1 (1%)	57 (78%)	7 (10%)
Fuel	73	0	71 (97%)	2 (3%)	0
Labor	73	0	68 (93%)	4 (5%)	1 (1%)

Perceptions on the Benefits of Conservation Tillage

The survey asked the question "On a scale of 1 to 5 with 1 being "not important" and 5 being "very important", how would you rate the following as factors why cotton producers employ strip-till and no-till practices." The survey listed 10 specific categories and a blank "Other" category which agents could fill in and rate.

Table 5 is a summary of the results. Seventy-seven of the 90 counties responding to the survey reported acreage of strip-till or no-till cotton. Table 5 shows the number of responses out of these 77 counties to each of the 10 factors and the rating of each.

Of the 10 factors, the 2 most important factors identified as why cotton producers employ strip-till and no-till production were labor savings (4.12) and the availability of glyphosate-resistant technology (4.09). This was followed by reduced erosion (3.89), machinery savings (3.88), and conserving soil moisture (3.79).

Higher yield was rated the lowest at 2.70. Government program incentives or cost share, at 2.94, was also ranked as relatively unimportant in the farmer's decision.

Fifty-seven of 75 responses (76%) rated labor savings as 4 or 5 on a scale of 1 to 5. Fifty-five responses (72%) rated reduced soil erosion as 4 or 5 and 51 of 73 responses (70%) rated machinery savings as 4 or 5.

Thirty-two of 70 responses (46%) rated government incentives and cost share as relatively unimportant (rated as a 1 or 2 on the 1-5 scale). Thirty-nine percent (28 of 71 responses) rated higher yield as relatively unimportant.

Three survey respondents identified "Other" factors as being important. These were "convenience" (received a rating of 5), "reduced rain and irrigation run-off" (received a rating of 4), and "getting the crop planted in a timely manner" (received a rating of 3). Convenience and getting the crop planted in a timely manner may be related to machinery and labor savings. Reducing rainfall and irrigation run-off may be related to reducing soil erosion and conserving soil moisture.

Table 5. Rating of Factors In Why Georgia Cotton Producers Use StripTill and No-Till Production Practices

		Scale (1=Not important, 5=Very Important)					
Factor In Decision	**Responses**	**1**	**2**	**3**	**4**	**5**	**Avg**
Machinery savings (cost, time)	73	4	5	13	25	26	3.88
Labor savings (cost, time)	75	5	2	11	18	39	4.12
Other cost savings	74	7	9	18	18	22	3.53
Glyphosate-resistant technology	76	3	8	10	13	42	4.09
Improved soil quality	75	7	10	19	18	21	3.48
Reduced erosion	76	4	6	11	28	27	3.89
Crop protection from wind/sand	71	7	9	22	20	13	3.32
Higher yield per acre	71	13	15	27	12	4	2.70
Conserve soil moisture	75	2	3	24	26	20	3.79
Govt incentive or cost-share	70	7	25	13	15	10	2.94

Challenges In Conservation Tillage

The final question in the survey asked Extension agents an open-ended question– "What would you consider as the number one challenge to producers in their ability to employ strip-till and no-till cotton production practices successfully and profitably?" The results are presented in Table 6. A total of 98 responses were received from the 90 survey respondents (some agents gave more than a single answer).

For the purpose of summarizing the results, an attempt was made to place the responses into several general categories. Some responses within a category may be closely related to another category. Over 26% responded that the number one

Table 6. Survey Respondents Perception of the Number One Challenge to the Success and Profitability of Strip-Till and No-Till Production Practices in Cotton.

CHALLENGES	Responses
EQUIPMENT Equipment cost, initial equipment investment, proper equipment selection, equipment availability, having the right equipment, efficient use of equipment	**21 (21.4%)**
SYSTEM Developing a system that fits well with tobacco and vegetables, adopting it to fit their farming practices, adapting strip-till rigs to their particular situation, determining a system/approach that works best for them, change in paradigm	**5 (5.1%)**
MANAGEMENT Time and management, management/timing	**2 (2.0%)**
MINDSET Reluctance to change/changing old habits, mindset, fear, making the commitment	**10 (10.2%)**
EDUCATION Lack of knowledge, educational efforts to strip-till's benefits	**2 (2.0%)**
LONG TERM Staying with the program/long-term results, not seeing the returns or benefits in the first couple of years, being patient to see benefits over time	**5 (5.1%)**
COVER CROPS, RESIDUE Managing cover crops, managing cover crops for soil improvement, residue management, decision to use or not use cover crops, getting producers to plant cover crops, dealing with previous years cotton residue	**8 (8.2%)**
SOILS Soil compaction, hardpan under conventional rows, breaking hardpan, flatwood and cold soils	**4 (4.1%)**
FERTILITY Fertility needs, soil ph and fertility harder to manage, fertilizer placement, learning to manage fertility compared to full tillage	**4 (4.1%)**
SEED TECHNOLOGY Increasing tech fees, beginning to look at other systems again, chemical and technology costs	**3 (3.1%)**
PLANTING Moisture management at planting time, getting a stand in dry or wet year, getting a good stand- nonirrigated, getting a good stand on heavier clay-type soils, planting on time, establishing a good seed bed, planting after burndown, getting a good stand	**12 (12.2%)**
WEED CONTROL Weed control, herbicide activation, glyphosate resistance, timeliness of herbicide applications, pigweeds, small seeded weeds, pusley, bermudagrass	**15 (15.3%)**
INSECTS AND NEMATODES Nematode control, insects	**3 (3.1%)**
YIELD Yield, getting yields up, thinking that yields are lower	**3 (3.1%)**
OTHERS Continuation of the current farm programs	**1 (1.0%)**
TOTAL OF ALL RESPONSES GIVEN	**98 (100%)**

challenge is related to “equipment” (cost, selection, and use)—21% and determining and adapting a system that works well for the particular operation— 5%.

Over 19% responded that the number one challenge has to do with “management-related issues”– managing practices and timing (2%), mindset and reluctance to change from current practices (10%), and need for improved education (2%). Also included as “management-related” would be a lack of patience to recognize long-term rather than short-term benefits, staying with the program (5%).

Almost one-third of the responses dealt with cover crop, soils, fertility, and planting issues. The challenges most often mentioned were managing cover crops, residue and getting a good stand. Other factors mentioned included soil-specific issues, fertilizer management, and increasing seed/technology fees. Pest management (weed, insect, and nematode control) was given as the number one challenge by 18 of 98 responses (18%). The majority of this dealt with weed control.

Implications

Prior to the survey, it was believed that strip-till was the most prevalent of the conservation tillage practices employed in Georgia cotton production. The survey clearly supported that hypothesis. However, 7% of Georgia cotton is neither “strip-till” or “no-till” but some form of “reduced-till” system as reported by 33 of the 90 counties responding to the survey (Table 1). Given the increasing costs of production and the challenges in strip-till and no-till production, perhaps other reduced tillage practices also warrant economic and agronomic investigation. It is possible that “reduced tillage”, as defined and responded to in this survey, is a set of modified practices fitting the specific needs of the operation- compatible with location, soils, and other agronomic factors.

Counties currently with strip-till acreage tend to be more favorable regarding its’ outlook (Table 2). Counties currently with strip-till could be those where it has proven to work best and thus are more positive on it’s future. Counties without strip-till tend to be less positive. Counties without strip-till could be those where it is not a good fit and thus do not expect acreage to increase further in the future. The acreage outlook for no-till is not as bright compared to strip-till production.

The results of the survey conclude that there is generally no yield advantage or disadvantage in strip-till production compared to conventional tillage (Table 3). This is further supported by very few agents responding that yield was a major challenge in success and profitability (Table 6) and the relative unimportance of yield as a factor in why producers choose strip-till and no-till practices (Table 5). Yield, however, does seem to be a challenge in no-till production (Table 3).

When county Extension agents were asked how the use of inputs in strip-till production compared to conventional tillage, the inputs where there seemed to be the widest difference of opinion (experience and observation) were seed, nitrogen, and herbicides (Table 4). While not specifically addressed by the survey, it is worth noting that these inputs typically comprise a very high percentage of the total cost of production per acre

for cotton. Thus, it is possible that the relative profitability of strip-till compared to conventional tillage may, in part, depend on relative yields (and gross income) and fuel and labor savings compared to the use and cost of these and other inputs.

Extension agents responded that use of herbicides is mostly higher in strip-till cotton production compared to conventional tillage (Table 4). The availability of glyphosate-resistant (Roundup Ready (RR)) technology was identified as a relatively very important factor in why producers have switched to strip-till and no-till production (Table 5). Weed control, however, was also given as the number one challenge in strip-till and no-till production in 15.3% of responses (Table 6). This survey was conducted in April and May 2005. Later, during the 2005 growing season, glyphosate resistance in Palmer amaranth (pigweed) was confirmed in some areas of central Georgia. Efforts are currently underway to determine how widespread this problem is and means to control it. This threat of resistance lowers the value of RR technology in the state and could potentially threaten strip-till acres or, at minimum, change the herbicide regime and cost in strip-till production.

This survey does not answer the question of whether or not conservation tillage of some type is more or less profitable than conventional tillage. However, the fact that over half of the cotton acreage in Georgia is conservation tillage is evidence that in works in some locations for some producers but may not work for everyone. Six percent of acreage in the state is planted conventional that used to be strip-till or non-till (Figure 2).

If conservation tillage is to increase, it must be proven profitable. In this regard, there are obvious agronomic and economic challenges ahead (Table 6). One major issue is equipment– the required investment in new equipment when existing equipment is already paid for, finding/adapting a system that works well and fits within the farm's total operation and other enterprises, and related to this– management of cover crops/residue and getting a good stand. Fuel prices have increased significantly since this survey was conducted. Machinery and labor savings were identified as very important (Table 5). Recent increases in fuel prices would seem to work to conservation tillage's advantage.

Another challenge is getting producers to (1) accept change and (2) make the commitment to stay with conservation tillage for more than just a few years in order to recognize longer-term benefits (Table 6). These are management, economic, and agronomic issues.

Cost of Production and Economic Comparisons

The Department of Agricultural and Applied Economics at the University of Georgia provides annual costs of production forecasts for all major row crop enterprises in Georgia. These estimates are available in both printed and spreadsheet format through local University of Georgia Cooperative Extension Service county offices and on the web at the following address: http://www.ces.uga.edu/Agriculture/agecon/agecon.html

The following analysis comparing strip-till and conventional production is derived from

2006 estimated costs and returns. Estimates for no-till production have not been developed. UGA estimates are intended to represent average situations following Extension recommended production practices and inputs. Individual farming operations may vary depending on soils, weather, specific conditions or needs, and management. Thus, cost comparisons will vary.

Comparison of Variable Cost

The major variable or direct operating costs in cotton production are seed, fertilizer, and chemicals. Slightly lesser costs but also important include fuel, repairs, and labor. UGA budget forecasts (Table 7) estimate that strip-till cotton production results in machinery and labor savings totaling approximately $10 per acre compared to conventional rip and bed production—a savings of approximately 13%. This savings, however, is largely offset by higher herbicide cost. Total variable costs are only slightly different between the 2 systems. Again, individual producer situations will vary from these estimates.

Table 7. Comparison of 2006 Per Acre Costs of Production, Conventional and Strip-Till Cotton, BR Technology, Non-Irrigated.

Cost or Input	Conventional Tillage	Strip-Till	Strip-Till Difference
Seed (Including Tech Fee)	$69.70	$69.70	
Fertilizer and Lime	$73.75	$73.75	
Chemicals			
Herbicides	$30.50	$39.25	+$8.75
Insecticides	$25.15	$25.15	
Nematicide	$0.00	$0.00	
PGR	$5.60	$5.60	
Defoliants and Boll Opener	$18.00	$18.00	
BWEP	$2.75	$2.75	
Machinery and Equipment			
Fuel and Lube	$27.83	$22.89	-$4.94
Repairs and Maintenance	$26.00	$24.50	-$1.50
Crop Insurance	$17.50	$17.50	
Labor	$23.50	$20.00	-$3.50
Interest on Operating Capital	$12.50	$12.45	-$0.05
Net Ginning and Warehousing	$44.52	$44.52	
Total Variable Cost	**$390.29**	**$389.06**	**-$1.23**
Tractors and Sprayer	$26.00	$23.50	-$2.50
Equipment	$15.00	$11.00	-$4.00
Picker	$56.00	$56.00	
General/Miscellaneous Overhead	$19.51	$19.45	-$0.06
Total Fixed Cost	**$116.51**	**$109.95**	**-$6.56**
Total Cost Excl. Land and Mgt.	**$506.80**	**$499.01**	**-$7.79**

Comparison of Fixed and Total Cost

Fixed costs include the annual "overhead" of owning assets used in farming—machinery, equipment, and land. These costs are depreciation, interest, and insurance and machinery and equipment; and interest and taxes on the value of land or the rent "opportunity cost" of the land. Fixed costs also include miscellaneous overhead and a return or payment to the farmer for his/her management decisions.

When comparing production systems, the type, size, and amount of machinery and equipment owned and utilized can vary just as trips over the field (that effect fuel, repairs, and labor) can vary. Thus, it is necessary to compared fixed costs also.

UGA budgets estimate that per acre fixed costs are approximately $7 per acre less for strip-till production than for conventional tillage—a savings of approximately 6%. Total cost (variable plus fixed, excluding land and operator management) is estimated to be approximately $8 per acre less in strip-till production—about 2% less than conventional tillage. Individual farm situations will vary.

Other Considerations

Based on UGA estimates, it is possible that cost differences between conventional tillage and strip-till could be relatively minor. In those situations, the economic advantage of either system would be largely dependent on yield and other factors. The amount of strip-till cotton acreage in the state is certainly testament to its' profitability, success, and advantage in some situations.

One advantage often mentioned when comparing strip-till and no-till to conventional tillage is machinery and labor savings and "convenience". Table 7 clearly illustrates this potential advantage in use and cost. As also shown, however, this savings can potentially be offset by increases in other costs.

What is not being considered, however, is the "opportunity cost" or value of that time saved. This is a difficult concept, but consider Table 8 for example. These data are also derived from 2006 University of Georgia, Cooperative Extension enterprise budget estimates.

Table 8. Comparison of Estimated Machinery and Labor Use, BR Cotton, Non-Irrigated, Georgia 2006

	Conventional	Strip-Till
Average Horsepower Per Hour	148.7	140.8
Pre-Harvest Fuel Use (Gallons Per Acre)	6.92	4.58
Pre-Harvest Tractor and Sprayer Hours Per Acre	.92	.64
Pre-Harvest Labor Use (Hours Per Acre)	1.11	.78

It is estimated that each acre of strip-till cotton saves approximately 30% in pre-harvest labor and machinery time. This savings could be used producing additional acres of cotton or other enterprises or being more timely and efficient on current acreage.

Summary and Conclusions

In recent years, genetic or transgenic varieties including herbicide-tolerant Roundup Ready cultivars have, for some producers, eased the transition from conventional tillage practices to conservation tillage and allowed them to do so economically.

In April and May of 2005, a survey was sent to University of Georgia Cooperative Extension agents in all cotton producing counties. County agents were the survey respondents and 90 counties representing almost 98% of the states 2004 cotton acres planted responded. The purpose of the survey was to determine the use of conservation tillage practices in cotton production in Georgia and to determine farmers' perceptions (in the judgment and experiences of county Extension agents) about conservation tillage in cotton.

Conventional tillage remains the largest single tillage method in cotton production with 47 percent of acreage in conventional tillage while 53 percent is some form of conservation tillage (43 percent is strip-till, 3 percent is no-till, and 7 percent is reduced-till). Over 60% of respondents expect strip-till cotton acreage to increase. Over 87% of respondents expect no-till acreage to remain the same or decrease.

The profitability of conservation tillage compared to conventional tillage is dependent on, among other factors, relative yields and costs. The survey results conclude that there is generally no cotton yield advantage or disadvantage to strip-till compared to conventional production. No-till yields, however, are generally believed to be less than conventional and thus, less than strip-till. For inputs, use of seed and fertilizers was considered to be mostly the same for strip-till as in conventional tillage. For chemicals, use of insecticides, nematicides, and fungicides was reported mostly the same while herbicide use was reported mostly higher. Fuel and labor use were clearly thought to be less in strip-till than in conventional tillage.

Machinery and labor savings, availability of glyphosate-resistant technology, reduced soil erosion, and conserving soil moisture were the highest rated reasons why cotton producers use strip-till and no-till production practices. The major challenges identified in the success and profitability of strip-till and no-till production were equipment cost and use, weed control, planting, and mindset (reluctance to change).

This survey was not specifically designed to answer the question of whether or not conservation tillage of some type is more or less profitable than conventional tillage. However, the fact that over half of the cotton acreage in Georgia is conservation tillage is evidence that in works in some locations for some producers but may not work for everyone. If conservation tillage in cotton production is to increase, it must be proven profitable and manageable within the total farm operation. It is hopeful that this survey has accurately described the use and perceptions of conservation tillage among Georgia cotton producers and identified benefits, opportunities and challenges in the successful use of conservation tillage.

Cost of production budget estimates developed by the Department of Agricultural and

Applied Economics, University of Georgia seem to support the survey findings. These budgets estimate lower machinery and labor costs and higher herbicides cost for strip-till compared to conventional tillage. Overall, variable costs were approximately the same for both systems but strip-till was estimated to have lower fixed costs. Total cost is estimated to be lower for strip-till compared to conventional tillage.

Based on results of the survey and considering estimated costs of production, the relative profitability of tillage systems depends largely on soils, weed control, machinery and equipment management, yield, and labor savings.

Recent events such as Palmer amaranth (pigweed) resistance and increased fuel prices are also factors that will help shape Georgia's future cotton acreage, profitability, management decisions, and tillage practices.

Appendix Table 1.
2005 Cotton Tillage Survey Questionnaire of Georgia County Extension Agents.

COUNTY AGENT
COTTON TILLAGE SURVEY
April 2005

Please see completion deadline and return instructions on the last page.

For the purpose of this survey, the following definitions apply:
Conventional tillage is defined as any set of tillage operations that include disking and turning the soil and planting into bare ground. It typically, but not necessarily, includes ripping and bedding.
No-till is defined as no tillage of the soil whatsoever and the hard-pan is not broken. Planting is directly into previous crop residue, winter fallow, or cover crop.
Strip-till is defined as tillage of only a small seed-bed area (approximately 10 to 14 inches wide) and may include ripping under the row.
Reduced Tillage would include any other set of practices not otherwise defined as conventional, no-till, or strip-till.

County _____

Acres and Trends

1. In 2004, cotton acreage planted in your county was _____ acres.

2. In 2004, what is your best estimate of the percentage of cotton acres planted in your county by tillage system. Percentages must add to 100%.

Conventional	_____
No-till	_____
Strip-till	_____
Reduced tillage	_____
TOTAL	100%

3. What would be your best estimate as to the percentage of cotton acres in your county that were at one time planted ***strip-till or no-till but reverted back to conventional tillage***? _____ %

4. Please mark (X) the appropriate answer. In the next 2-3 years, do you expect the percentage of ***strip-till*** cotton acres in your county to increase _____, decrease _____, or remain the same _____.

5. Please mark (X) the appropriate answer. In the next 2-3 years, do you expect the percentage of ***no-till*** cotton acres in your county to increase _____, decrease _____, or remain the same _____.

Production Practices

6. For ***strip-till***, what would be your best estimate of the planting situation as described below. Percentages must add to 100%.

Strip-plant into previous year's crop residue and winter fallow _____
Strip-plant into winter fallow _____
Strip-plant into killed winter cover crop not harvested _____
Strip-plant into harvested small-grain or other crop residue (double-crop) _____
Other _____
TOTAL 100%

7. For ***no-till***, what would be your best estimate of the planting situation as described below. Percentages must add to 100%.

Plant into previous year's crop residue and winter fallow _____
Plant into winter fallow _____
Plant into killed winter cover crop not harvested _____
Plant into harvested small-grain or other crop residue (double-crop) _____
Other _____
TOTAL 100%

8. For ***strip-till***, what would be your best estimate of the percentage of the strip-till acres in your county planted as follows. Percentages must add to 100%.

Strip and plant in separate operations _____
Strip/plant in the same operation _____
TOTAL 100%

9. Please mark (X) the appropriate answers. For ***strip-till***, how would you say that use of each of the following inputs compares to conventional tillage.

	Compared To Conventional Tillage, Use of This Input ***In Strip-Till*** Is			
Input Item or Category	Higher	Lower	About Same	Don't Know
Seed				
Fungicides				
Nematicides				
Nitrogen				
P and K				
Other Nutrients				
Herbicides				
Insecticides				
Fuel				
Labor				

10. What are the 3 most troublesome insect pests in ***strip-till*** cotton in your county? Please list.

_____
_____
_____

11. What are the 3 most troublesome weeds in ***strip-till*** cotton in your county? Please list.
    _____
    _____
    _____

Differences and Perceptions

12. Please mark (X) the appropriate answer. Compared to conventional tillage on the same soil type with average growing conditions, for your county would you say cotton yield per acre for ***strip-till*** would be higher _____, lower _____, about the same _____, don't know _____, or not applicable _____.

13. If your answer to Question 12 was "higher" or "lower", please briefly state the main reason why.
    _____

14. Please mark (X) the appropriate answer. Compared to conventional tillage on the same soil type with average growing conditions, for your county would you say cotton yield per acre for ***no-till*** would be higher ____, lower ____, about the same ____, don't know ____, or not applicable ____.

15. If your answer to Question 14 was" higher" or "lower", please briefly state the main reason why.
    _____

16. On a scale of 1 to 5 with 1 being "not important" and 5 being "very important", how would you rate the following as factors why cotton producers employ strip-till and no-till practices.

Machinery cost savings	_____
Labor cost savings	_____
Other cost savings	_____
Availability of glyphosate-resistant technology	_____
Improved soil quality	_____
Reduced erosion	_____
Crop protection from wind/sand	_____
Higher yield per acre	_____
Conserve soil moisture	_____
Government incentive or cost-share programs	_____
Other _____	_____

17. What would you consider as the number one challenge to producers in their ability to employ ***strip-till and no-till*** cotton production practices successfully and profitably?
    _____

PLEASE COMPLETE AND RETURN TO DON SHURLEY BY APRIL 15, 2005.
SEND AS AN EMAIL ATTACHMENT TO donshur@uga.edu
OR PRINT, COMPLETE, AND RETURN BY FAX AT 229-386-3440.

Appendix Table 2.
County Extension Agent Estimate of 2004 Cotton Acres Planted
Percent Planted By Tillage Method.

County	Conventional Tillage	Conservation Tillage			
		No-Till	Strip-Till	Reduced Tillage	Total
Appling	65	0	30	5	35
Atkinson	50	0	50	0	50
Bacon	50	20	20	10	50
Baker	80	5	10	5	20
Bartow	10	90	0	0	90
Ben Hill	65	0	30	5	35
Berrien	62	0	38	0	38
Bleckley	25	10	35	30	75
Brooks	0	0	100	0	100
Bryan	75	0	10	15	25
Bulloch	30	0	70	0	70
Burke	60	0	30	10	40
Calhoun	55	0	44	1	45
Candler	30	0	70	0	70
Chattooga	100	0	0	0	0
Clay	90	0	10	0	10
Clinch	100	0	0	0	0
Coffee	20	10	60	10	80
Colquitt	84	0	11	5	16
Cook	20	0	80	0	80
Crawford	85	0	0	15	15
Crisp	40	0	50	10	60
Decatur	70	0	20	10	30
Dodge	70	0	30	0	30
Dooly	14	1	60	25	86
Doughtery	75	5	10	10	25
Early	71	3	22	4	29
Effingham	100	0	0	0	0
Elbert	75	0	25	0	25
Emanuel	25	0	50	25	75
Evans	60	0	40	0	40
Floyd	100	0	0	0	0
Glascock	90	0	10	0	10
Grady	40	0	60	0	60
Hart	0	100	0	0	100
Houston	25	0	75	0	75
Irwin	40	5	25	30	60

County	Conventional Tillage	Conservation Tillage			
		No-Till	Strip-Till	Reduced Tillage	Total
Jeff Davis	95	0	5	0	5
Jefferson	33	12	35	20	67
Jenkins	50	0	50	0	50
Johnson	20	0	80	0	80
Lamar	0	0	100	0	100
Lanier	85	0	15	0	15
Laurens	75	0	25	0	25
Lee	59	1	40	0	41
Liberty	100	0	0	0	0
Long	100	0	0	0	0
Lowndes	15	70	5	10	85
Macon	20	0	60	20	80
Madison	100	0	0	0	0
Marion	40	0	60	0	60
McDuffie	25	0	25	50	75
Miller	95	0	5	0	5
Mitchell	73	3	20	4	27
Montgomery	60	0	40	0	40
Morgan	40	0	60	0	60
Oconee	100	0	0	0	0
Peach	45	5	20	30	55
Pierce	60	0	40	0	40
Pike	0	100	0	0	100
Polk	98	2	0	0	2
Pulaski	2	0	96	2	98
Quitman	100	0	0	0	0
Randolph	41	24	32	3	59
Richmond	100	0	0	0	0
Schley	45	0	55	0	55
Screven	70	0	30	0	30
Seminole	50	0	50	0	50
Stewart	75	0	25	0	25
Sumter	50	30	20	0	50
Tattnall	95	0	5	0	5
Taylor	55	0	40	5	45
Telfair	30	0	70	0	70
Terrell	22	10	65	3	78
Thomas	40	15	35	10	60
Tift	35	5	25	35	65
Toombs	70	0	30	0	30
Treutlen	0	0	100	0	100

County	Conventional Tillage	Conservation Tillage			
		No-Till	Strip-Till	Reduced Tillage	Total
Turner	30	0	65	5	70
Twiggs	70	0	30	0	30
Walton	100	0	0	0	0
Ware	30	0	70	0	70
Warren	100	0	0	0	0
Washington	25	20	45	10	75
Wayne	40	0	60	0	60
Webster	30	5	65	0	70
Wheeler	20	0	80	0	80
Wilcox	45	0	45	10	55
Wilkinson	0	0	100	0	100
Worth	35	0	65	0	65

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