

CONSERVATION TILLAGE IN GEORGIA COTTON PRODUCTION: RESULTS OF A 2005 SURVEY

W. Don Shurley
Department of Agricultural and Applied Economics
University of Georgia, Tifton

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 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.

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".

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 on 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 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.

Of the 90 counties responding, 84 reported acreage of conventionally planted cotton (Table 1). Six counties had no conventional acreage. Of these 6, 4 counties were 100% strip-till and 2 counties were 100% no-till. Twenty-two counties were over 75% conventional tillage and 20 of these 22 were 100% conventional tillage.

Twenty-four of 90 counties reported some acreage of no-till cotton production. Of these 24 counties, 14 reported 10% or less of cotton acres as no-till and 19 reported 25% or less. Three counties reported over 75% of acres as no-till with 2 of these being 100% no-till.

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	11-25%	26-50%	51-75%	Over 75%
Conventional	84	2	13	25	22	22
No-Till	24	14	5	1	1	3
Strip-Till	73	9	14	25	17	8
Reduced-Till	33	22	6	5	0	0

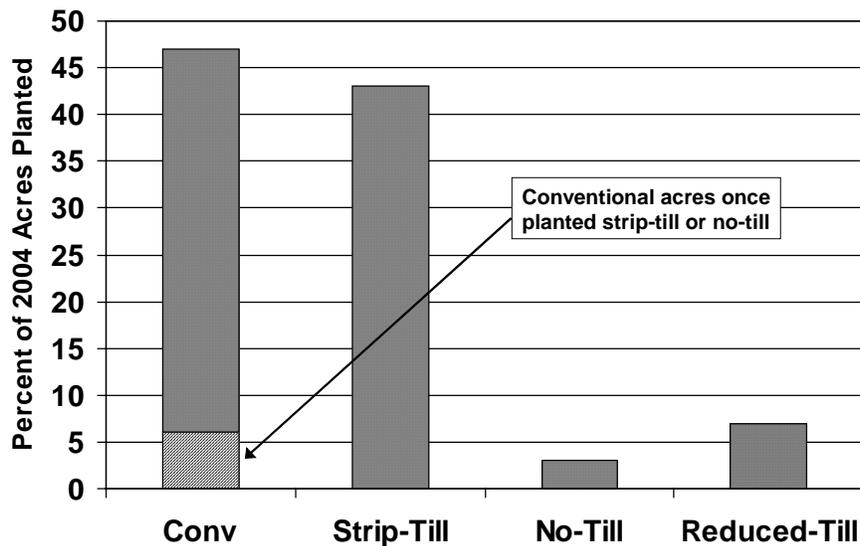
Seventy-three of the 90 counties responding reported acreage planted strip-till. Eight counties were over 75% planted as strip-till with 4 counties 100% strip till. Most counties (42 of the 73) reported 26 to 75% of the acreage planted strip-till.

Reduced-tillage practices (other conservation tillage not defined as no-till or strip-till) were reported by 33 of the 90 counties. In most instances (in 22 of the 33 counties) this was 10% or less of the acreage planted.

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 1).

Figure 1. 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 1). 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, 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

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 2).

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.

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 combined 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; 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 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?”

Figure 2. Comparison of Strip-Till and No-Till Planting Results of a April-May 2005 County Agent Survey

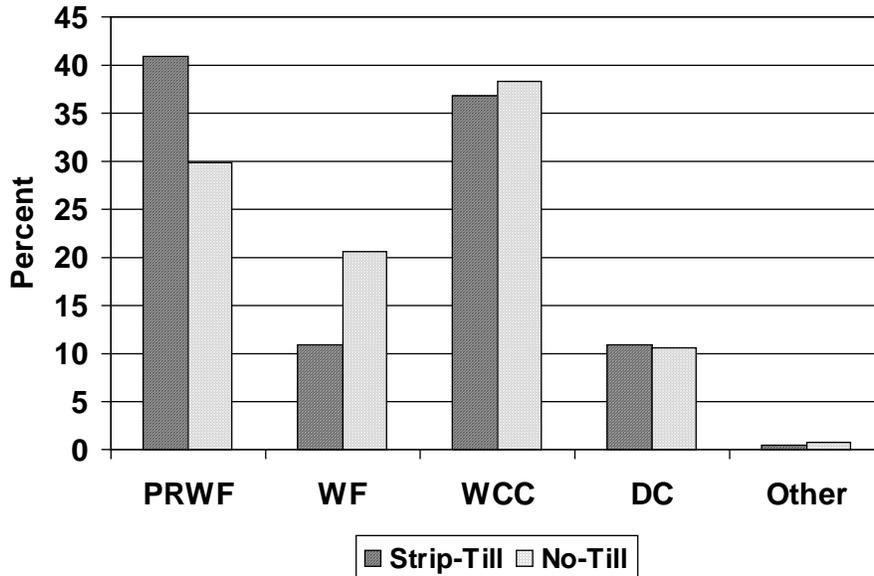
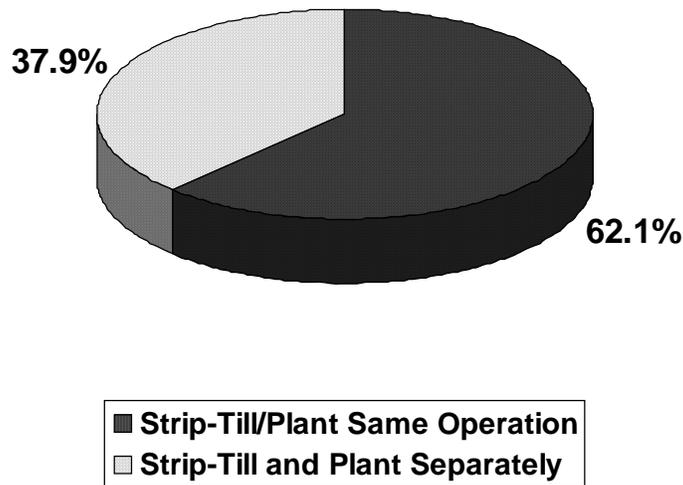


Figure 3. Cotton Planting In Strip-Till Production Results of a April-May 2005 County Agent Survey



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 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 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 tilled and planted in the same operation and 37.9% is tilled then planted separately (Figure 3).

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 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 (2.70) and government program incentives or cost share (2.94) were the lowest rated and 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 not important (rated as a 1 or 2 on the 1-5 scale). Thirty-nine percent (28 of 71 responses) rated higher yield as relatively not important.

Table 5. Rating of factors in why Georgia cotton producers use strip-till and no-till production practices.

Factor In Decision	Responses	Scale (1=Not important, 5=Very Important)					
		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

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.

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

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

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.

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%)

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 its 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 does, however, 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 (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 was 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 it 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 1).

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.

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 it 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.

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

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