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US Cotton Growers Respond to Natural Resource Survey

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Introduction

In late summer and fall of 2008 Cotton Incorporated, with assistance from the Cotton Board, National Cotton Council, and OrgWide Services, conducted a Natural Resource Survey to gather information on U.S. production practices and grower attitudes about the environment. The online survey consisted of 77 questions and was divided into two sections. In the first part, the growers were asked to respond to general questions about water and soil management practices (irrigation practices, crop rotation, soil erosion, soil health, fertilizer, tillage practices), pests and weeds, precision agriculture, energy, and wildlife and habitat. In the second part growers answered questions about a specific field that represented their predominant yield and production practice.

The primary objectives of the survey were to 1) Provide an enhanced data set to capture current successes and provide new information for the global cotton industry; 2) Establish a benchmark to monitor current and future trends in the sustainability of cotton production practices; and 3) Improve U.S. cotton by identifying areas of greatest need for additional research. A secondary objective was to elevate the discussion among producers and other agricultural leaders regarding the long-term sustainability of U.S. cotton and cotton production in general.

Participation in the survey was high with over 1300 valid responses representing 16% of U.S. cotton acreage and over 1.7 million acres of rotational crops. The robustness of the survey made it possible to analyze regional production practices as well as those of individual States (Table 1). The geographic distribution of survey participation correlates closely to USDA's 2007 cotton production distribution (Figure 1).

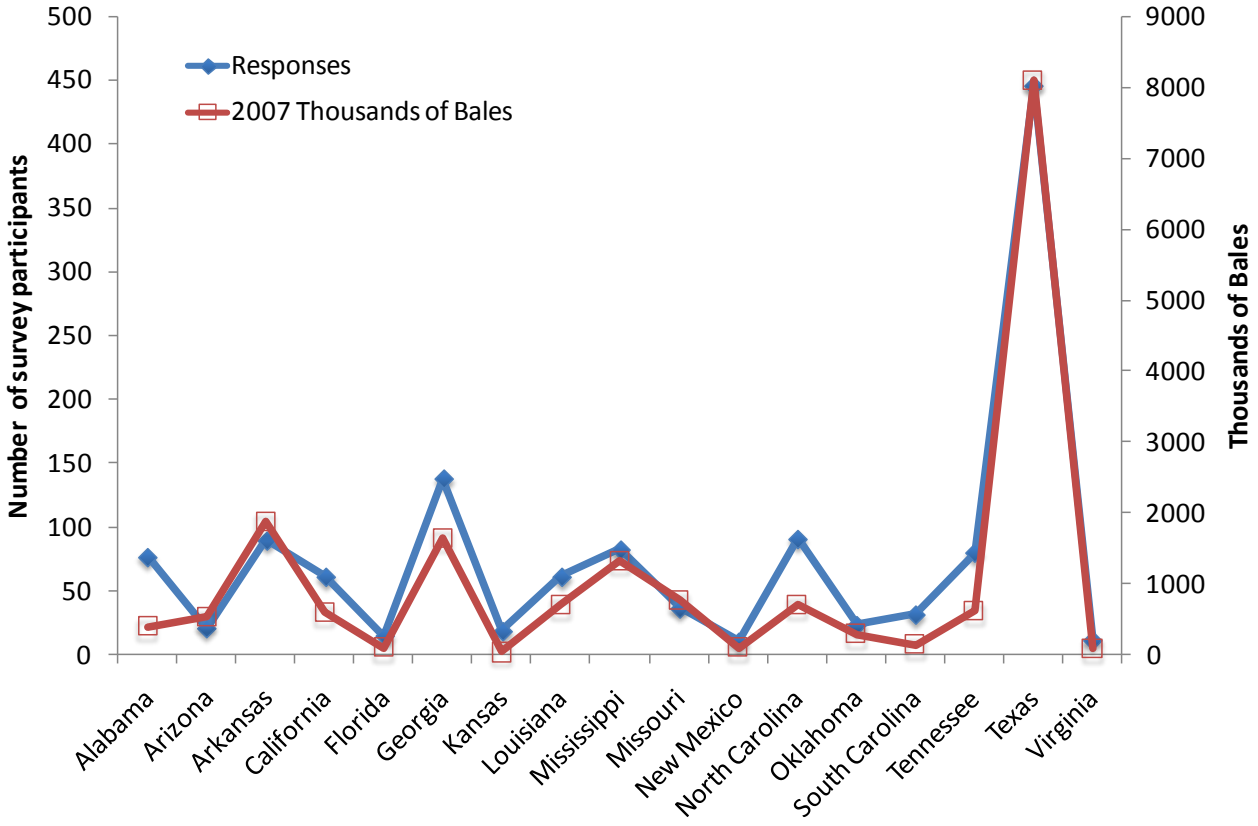
In cotton production, the United States is among the first to adopt new technologies that drive environmental and economic improvements. U.S.-based cotton research and implementation is a vital catalyst for advancing the global cotton industry since the innovations and technologies that originate in the U.S. ultimately find their way into the global arena. Biotech plant varieties, integrated pest management (IPM) strategies, conservation tillage, precision farming, and water optimization strategies are examples of some of the technologies with U.S. origins that have contributed to cotton's environmental gains over the last 13 years.

This article highlights the findings of the Natural Resource Survey (NRS) and cotton's progress in reducing its impact on water, soil, energy, and habitat.

Table 1: Regional distribution of Natural Resource Survey respondents and cotton acreage farmed by survey respondents

	Far West	SouthWest	Mid-South	SouthEast	Total
Valid Responses	106	477	352	370	**1305**
Cotton Acres (1000's)	124	559	428	272	**1,383**

Figure 1: Geographic distribution of survey participation and 2007 U.S. cotton production (Source: USDA)



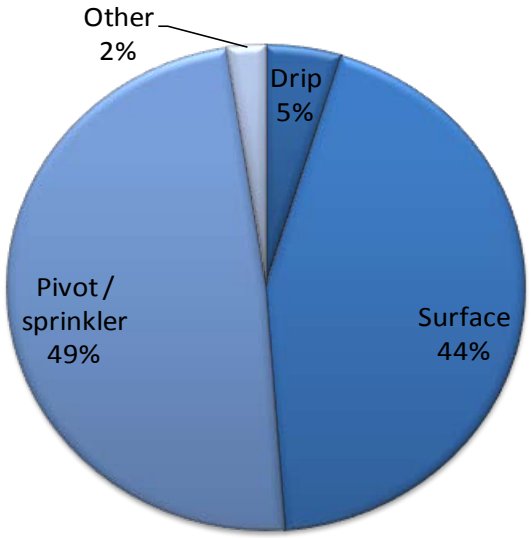
Results

Water

Figure 2. Drip irrigation lines recently installed in a Texas cotton field (photo courtesy of James Bordovsky, Texas A&M).

Water consumption for cotton production is often misunderstood. Cotton is a highly drought-tolerant plant and can prosper in high salt soils. These attributes enable cotton to be grown in areas where it is often not feasible to grow any other crop. And while a harvestable crop of cotton is possible from an annual supply of only 250 millimeters of water, supplemental irrigation as for most crops ensures a consistently high yielding crop. Irrigation water is used in cotton production throughout the world but the amount and distribution varies widely depending on region, climate, available technologies and governmental policies. In the U.S., rainfall supplies most of the water needed to grow a good cotton crop. According to the 2007 USDA Census of Agriculture (http://www.agcensus.usda.gov/) 64% of U.S. cotton acres are grown without irrigation and rely solely on rainfall. The remaining 36% of cotton acres under irrigation are grown using the most advanced irrigation systems that growers can afford.

Figure 3: Type of irrigation and percent adoption by U.S. cotton growers



Although abundant yields of high quality cotton are a primary goal of U.S. cotton growers, water-use efficiency –growing more using less water – is a common sense priority for them, as well. The survey shows that 72% of U.S. cotton growers list an adequate water supply as one of their top five concerns. This helps explain why 81% of the cotton growers who do use supplemental irrigation upgraded their irrigation systems within the last 10 years. The survey also showed that growers are moving away from surface irrigation systems (where leaching and non-uniformity of water application are a greater challenge) to the more uniform sprinkler systems. These include highly efficient technologies such as subsurface drip irrigation (SDI), and Low Energy Precision Application (LEPA). SDI is a system which as the name describes delivers water via underground tubes where it is not subject to evaporation (the photo beginning this section shows drip lines that were recently installed). LEPA is also energy efficient since it requires less pressurization and the water is delivered precisely to the base of the plant where it's needed. These and other irrigation systems are made further efficient by various kinds of sensing or application technologies such as water-saving nozzles, soil moisture probes, or infrared leaf thermometers that detect when a plant is becoming water-stressed, in which case, the plants are only watered on an as needed basis. Remarkably, since 2002, the number of cotton acres being grown under the more efficient drip irrigation methods increased by 400%. The greatest adoption of drip irrigation has been in the western states where water is most limited (Table 2). The Far West still uses a significant amount of surface irrigation; however, in this region the fields have been precisely leveled to increase the uniformity of water applied.

Based on yield, irrigation and rainfall data collected as part of the field specific part of the survey, these improved technologies and practices account for a 20% increase in irrigation water use efficiency since the 1990's.

Figure 4: Conversion to more efficient irrigation systems is evident from the steady decline in percent of irrigated cotton acres that rely on surface irrigation.

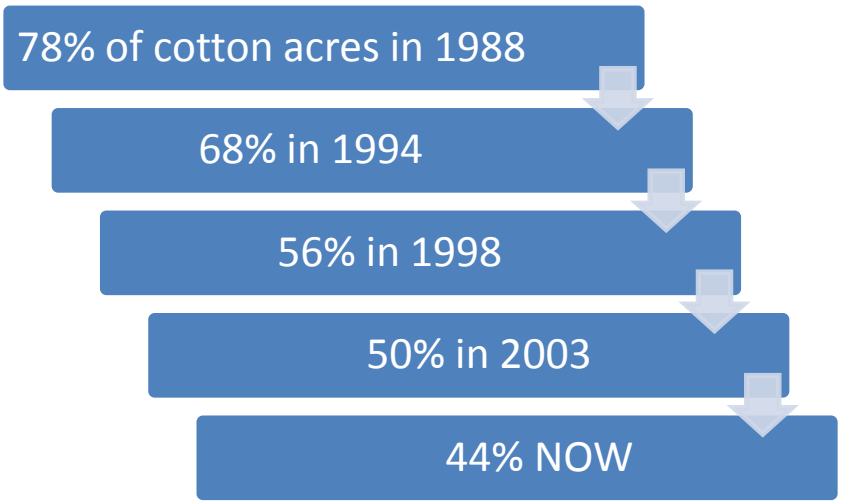


Table 2: Irrigation system by region and percentage usage by growers

	Far West	SouthWest	Mid-South	SouthEast
Percent irrigated	87	41	56	21
Percent Sprinkler	12	73	42	99
LEPA	2	64	11	19
Percent Drip	8	8	1	0
Manage Tail Water	77	38	36	2

Soil

Figure 5: Conservation tillage field – cotton planted directly into a wheat cover crop

Top soil depth and soil quality are integral to cotton producers' livelihoods. U.S. growers recognize that preserving soil resources is paramount as evidenced by the survey responses. One key technique in maintaining soil quality is conservation tillage, a practice that leaves plant residues on the soil surface for erosion control and moisture conservation. Of the U.S. cotton producers responding to the survey, more than two-thirds have adopted some form of conservation tillage with the greatest adoption occurring over the past decade. The survey shows that:

- 67% use reduced tillage practices
- 82% rotate cotton with other crops, which also helps prevent disease buildup.
- 71% maintain ground and surface cover to reduce erosion
- 86% use soil test recommendations to set fertilizer rates and reduce inputs
- Crop rotation is a common practice
- These management practices are having a positive impact on soil quality (Fig.7)

Figure 6: Percentage of growers practicing crop rotation and the top five rotational crops by region

Far West 91%	SouthWest 76%	MidSouth 77%	SouthEast 90%
• Alfalfa • Wheat • Vegetables • Orchards • Corn	• Wheat • Sorghum • Corn • Pasture • Native vegetation	• Soybeans • Corn • Wheat • Rice • Sorghum	• Soybeans • Corn • Peanuts • Wheat • Native vegetation

Figure 7: Percentage of U.S. growers reporting improved soil characteristics on their farm.

Conservation tillage and crop rotation improve soil quality

- **Greater soil productivity - 97%**
- **Increased organic matter – 92%**
- **Improved soil structure – 89%**
- **Reduced soil compaction – 86%**
- **Less soil crusting – 86%**
- **Lower soil salinity – 56%**

Wildlife Habitat

Biotech cotton varieties with enhanced pest-resistance are allowing growers in countries like India and China to increase yields, while decreasing pesticide applications and lowering their environmental impact (Brookes and Barfoot 2008). In the U.S. as well, biotech cotton has been responsible for a significant reduction in pesticide usage. According to the survey, 75% of U.S. growers have reduced their use of pesticide by 40% (or more) compared with 10 years ago. And most farms (94%) employ beneficial insects as part of their Integrated Pest Management program (Table 3). When insecticides are used, they are not applied to all cotton acres. In fact, the survey found that 44% of U.S. farms did not even require foliar insecticides on some fields and remarkably, 29% of U.S. cotton acres were not treated at all.

In addition to a vested interest in the environmental health of their own farms, U.S. cotton growers are also concerned with the effects of cotton farming on local wildlife. The good news is that modern farming practices have contributed to a more robust biodiversity in and around cotton farms. In fact, high percentages of U.S. growers report that the wildlife, beneficial insects, bird populations and diversity of bird species have increased over the past ten years (Table 4).

Table 3: Insecticide use practices and percent adoption by U.S. cotton producers

	Far West	SouthWest	Mid-South	SouthEast
Mode of Action rotation	85	76	92	85
Beneficial insects	98	94	92	91
Avoid sensitive areas	93	84	88	87

Table 4: Wildlife habitat

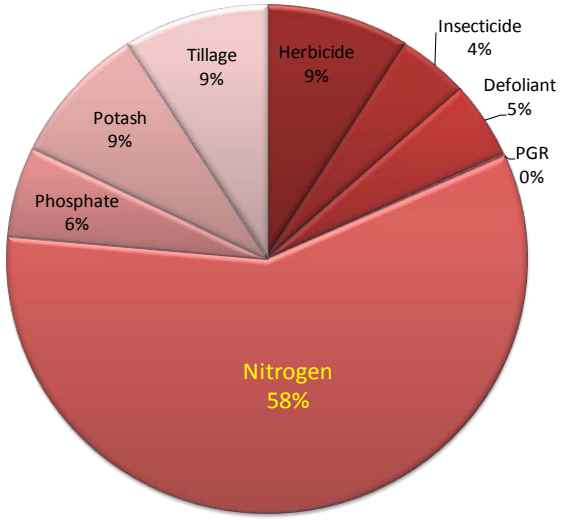
Compared to 10 years ago have you noticed any changes to wildlife on and around your farm?			
	Agree	**Not Sure**	**Disagree**
Bird population increased	61%	26%	13%
Bird diversity increased	48%	41%	12%
Beneficial insects increased	62%	30%	8%
Wildlife increased (deer, beavers, porcupines, frogs, rabbits, foxes)	78%	16%	6%

Energy

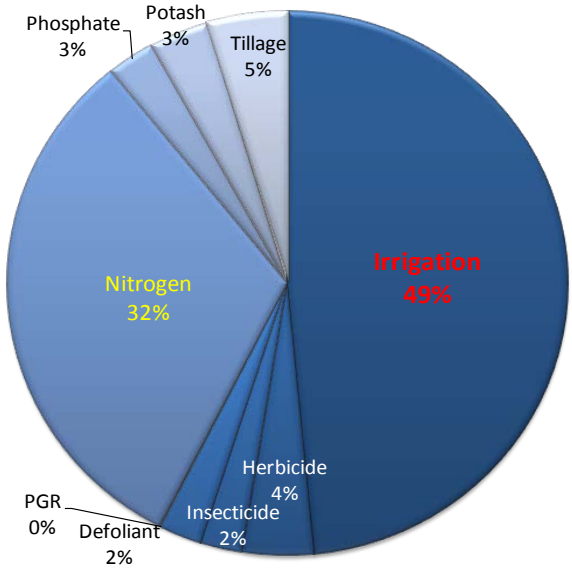
Previous studies show that cottonseed contains twice the amount of energy needed to grow the fiber. Using coefficients from West and Marland (2002), survey results indicated nitrogen fertilizer production and irrigation water pumping are the largest energy consumers in cotton production.

Figure 8: Where energy is used in producing cotton:

NON-IRRIGATED



IRRIGATED



Both water use efficiency (WUE: lbs of fiber per inch of irrigation water) and nitrogen use efficiency (NUE: lbs of fiber per pound of N fertilizer) vary across the U.S. WUE increases from West to East following rainfall

gradients, while NUE is more variable likely due to the greater number of variables influencing residual soil nitrogen (Table 5).

Table 5: Water Use Efficiency and Nitrogen Use Efficiency in cotton production across the U.S.

	Far West	SouthWest	Mid-South	SouthEast
Water Use Efficiency (pounds of lint per inch water)	46	58	63	68
Nitrogen Use Efficiency (pounds of lint per pound of N applied)*	25	32	23	37

* NUE of this table does not include estimates of residual N in the soil or N from cover crops as this information was not recorded in the survey.

Based on these results, Cotton Incorporated will continue its support of research to evaluate every technology available to improve water and nitrogen use efficiency. For example, efforts are underway to refine nitrogen recommendations through a nationally coordinated study started in 2009 and progress is being made to use equipment mounted sensors to detect cotton's nitrogen needs and then apply the fertilizer accordingly. Other examples include studies to screen for more drought tolerant cotton varieties and development of improved crop coefficients that will lead to more accurate predictions of cotton's water needs to improve irrigation scheduling tools.

Grower concerns

Other needs identified in the survey were identified by ranking the top grower concerns. The top concern was not a surprise; in recent years a number of weeds have developed herbicide tolerance and has complicated weed management strategies in many parts of the U.S. Cotton Incorporated has been working with weed scientists around the country to develop region-specific best management practices to help address this concern (Burgos et al., 2006) and growers are actively engaged in managing herbicide resistance on their farms (Table 6).

Figure 9: Top five grower concerns

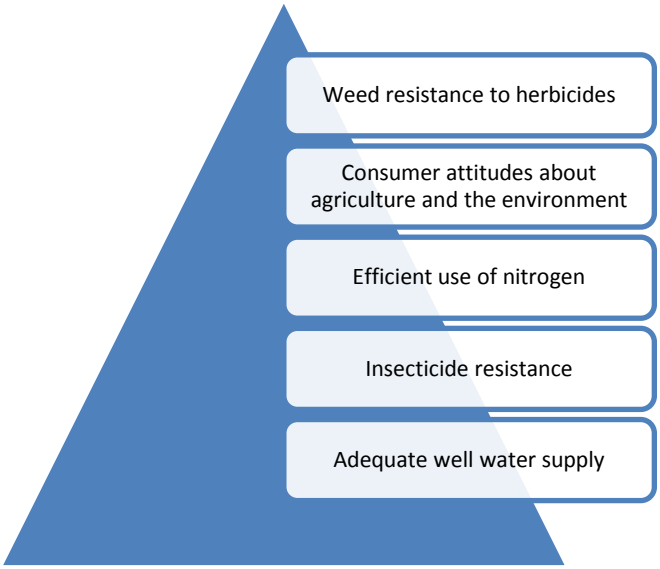


Table 6: Practices to manage herbicide tolerant weeds and percent adoption by U.S. cotton producers

	Far West	SouthWest	Mid-South	SouthEast
Check for escapes	76%	69	811	79
Pre-emergent herbicides	63%	71	67	74
Rotate herbicides	47	54	65	72
Cover crops	6	21	16	48
Cultivate escapes	67	58	31	27

Perhaps it is not surprising that producers willing to participate in a natural resource survey are concerned about consumer attitudes, and this may reflect some producers' frustration that the tremendous gains they have made in minimizing their environmental footprint over the last ten years has not always been acknowledged by the popular press. It is interesting that the two energy intensive operations identified from analysis of the field specific data were also listed in the top five grower concerns – water and nitrogen. The concern of insecticide resistance may be indirectly related to the top concern of weed resistance. Growers experiencing loss of herbicide efficacy may be reminded that without continued stewardship of integrated pest management strategies, they could face similar issues in preventing insect damage in their fields in the future as well.

Summary

The Natural Resource Survey shows that U.S. cotton growers care about the environment and are making responsible investments and decisions regarding use of the world's natural resources. U.S. cotton growers are innovative and dedicated to continually finding ways to increase efficiency and yield. The technological and environmental gains made by cotton growers over the last 10 years are evidence that cotton can effectively meet or exceed the future demands of the world's growing population while also safeguarding precious natural resources. Results from this survey have been useful in identifying issues that will challenge U.S. cotton producers in the future, including the need to maximize water and nitrogen use efficiency.

References

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