# NORTH CAROLINA COTTON PRODUCTION PRACTICES S.G. Bullen Jonathan Phillips A.B. Brown Ada Wossink North Carolina State University Raleigh, NC

#### **Abstract**

Cotton acreage has increased significantly in the last six years in North Carolina, with 486,000 acres in 1994 compared to 930,000 in 2000 (N.C. Statistical Service). North Carolina ranks seventh in the nation in cotton production. Many reasons have been attributed to this dramatic increase in North Carolina cotton production including, relative low prices for other commodities, loss of tobacco quota and changes in the farm program. Much of the increase in cotton acreage comes from new cotton growers replacing grain crops with cotton acreage rather than an increase in acreage of exisiting cotton farms. Several new technologies have been introduced since 1994, such as Roundup Ready, Boll Guard, and Stacked (BT/RR) seed varieties. A survey was conducted to document the production practices and technology changes of North Carolina cotton growers. Yields were evaluated based on several factors such as seed type, location, planting and harvest dates.

#### **Objective**

This paper is part of a larger study entitled "Whole Farm Analysis of Conventional and Ultra-narrow Row Cotton". The objectives of this study were to document the production practices of North Carolina cotton farms and model the economic efficiency of new technologies and various production practices. This paper describes the data collected in this project.

#### **Methods**

The North Carolina cotton production practices survey was adapted from a USDA-NASS cotton survey. In the spring of 2000, personal interviewers collected two hundred and eight useable surveys covering four of the statistical districts in North Carolina. Detailed information on chemical and fertilizer use, seed types, yields and cotton quality grades were collected on one randomly selected field. Weather and soil type was collected later on the selected field. The data collected was for the 2000 crop year.

### **General Description**

The average cotton field size was almost 22 acres with almost fourteen percent of the fields being less than five acres, sixtysix percent under twenty acres, and sixteen percent were over thirty acres. Ninety-five percent of those surveyed reported farming as their main occupation. Over sixty percent of the cotton farms were organized as a sole/family proprietorship and twenty and eighteen percent being operated under a partnership and s corporation respectively. Income for cotton was reported as the largest portion of income on sixty-three percent of the farms surveyed. Tobacco was the largest source of income on twenty-eight percent of the farms. Farmers owned thirty-six percent of the fields surveyed. Cash rent was the most common type of rental arrangement with sixty percent of the fields being cash rented and only four percent being farmed under a share rental arrangement. Only two percent of the cotton farms reported any type of irrigation, with all the reported irrigated fields being in the Southern Coastal region.

### Adoption of Transgenic Cotton Varieties

Over the last five years three dominant cotton biotechnologies have been introduced to the market: Bollguard, Roundup Ready, and stacked with Bollguard/Roundup Ready genes. Bollguard (BT) introduced in the market in 1996 has been engineered to make the cotton plant resistant to lepidoptera pests. Roundup Ready (RR) was introduced to the market in 1997. Round up Ready varieties have been engineered to tolerate glyphosate herbicide. Stacked varieties were available in 1998.

In 2000, seventy-seven of the fields surveyed had been planted to a transgenic cotton variety. Herbicide resistant varieties were planted on almost thirty-six percent of the fields, and stacked varieties were planted on almost thirty-nine percent of the fields. BT was planted on four percent of the fields. In 1999 thirty-five percent of the fields were planted to conventional varieties compared to twenty-three percent in 2000, while fields planted to a stacked variety increased from twenty-five percent to thirty-eight percent. Percent of seed type planted in 1999 and 2000 are given in Table 1.

There were some regional differences in the seed type planted in 2000. Conventional seed varieties were planted on twentyeight percent of the fields compared to almost nine percent in the Southern Coastal region. Stacked varieties were planted on sixty-eight percent of the fields in the Southern Coastal region. Round up Ready was planted on the fewest fields in the Southern Coastal region. The 2000 seed varieties planted in the different regions are given in Table 2.

Cotton growers were asked to rate the reason for adopting a resistant seed variety. Increased yields through improved weed and insect control were the most common reason given at sixty-one percent. Thirteen percent cited improved ability to use some type of conservation tillage. Decreased input costs were given as the reason by ten percent of the respondents. Cotton growers who had used a transgenic variety in 2000, were asked if they would have used the selected stacked variety if a non-stacked transgenic variety had been available. Fifty-six percent of the respondents said they would, while forty-four percent said they would not have used a stacked variety if they had other seed variety available. Growers who used a conventional variety were asked if they would have used a transgenic variety if a non-stacked variety were available. Seventy-two percent said they would not have used a BT or RR variety if the varieties had been available.

Numerous studies have looked at the reason cotton growers have adopted transgenic so quickly. Several studies have focused on the perceived cost savings of transgenic varieties through reduced herbicide or insecticide costs. A Texas Tech University study found that Round up Ready varieties had higher operating costs as compared to conventional cotton varieties. However, Round up Ready cotton was found to be more profitable due to increased yields (White, Jones and Johnson 2000). A South Carolina study found mixed results when evaluating BT cotton varieties. The study compared costs for conventional varieties with BT varieties in two locations. They reported increase profits for one site due to yields increases (ReJesus). The second reported reduced yields for the BT varieties compared to conventional varieties. A Georgia Cotton Commission study found that BT cotton varieties had a yield advantage in seventy percent of the producers evaluated (Stark).

# **Adoption of New Technologies**

Cotton growers were asked if about any new technologies that had been used on the field on or before 2000. A GPS unit had mapped Thirteen percent of the growers' fields. Five percent of the respondents had their fields remotely sensed. Seven percent had fertilizer or lime spread by variable rate technology. Only two percent of the growers reported having a yield monitor on their cotton picker, while half the grower having a monitor made a yield map.

#### **Yields**

Respondents were asked to give their yield goals for the 2000 crop year. North Carolina cotton grower yield goals were within twenty-one pounds of the actual average yield of 792 pounds per acre. The average yield was 792 pounds per acre for the state, which was almost 150 pounds above the five-year average of 645 pounds. Central Coastal region had the highest yield at 831 pounds, followed by North Coastal region at 807 pounds. Southern Coastal yields averaged 767 pounds. Southern Piedmont had the lowest yields of 720 pounds per acre. There was considerable farm to farm yield difference with a range of approximately 150 pounds across all regions.

The average state yield for conventional cotton varieties were 813 pounds. BT had an average state yield of 808 LBS. The stacked varieties average yield was nineteen pounds less than conventional varieties at 794 pounds. Round up Ready varieties average yields were 776 pounds, which is thirty-seven pounds less than conventional varieties. However, when comparing the different seed varieties across regions, Round up Ready varieties had the highest yields in Southern Coastal region and Southern Piedmont region. The Central Coastal region had the least mean yields variance between the different seed types, with only forty-four pounds difference between the highest and lowest yields, compared to over three hundred pounds difference in the varieties in the Southern Coastal region.

#### **Yield Effects of Planting and Harvest Dates**

North Carolina Cotton specialists recommend an optimum planting date is before May 5. Yields decline approximately twelve pounds per day when cotton is planted after May 5 (N.C. State Cotton Information 2001). Research from the Milan Experiment Station found cotton planted in the last two weeks of April had forty-four percent higher yields than cotton planted the first two weeks of May (Chambers). Most of North Carolina growers are following the early planting recommendations. Almost eighty-eight percent of the fields were reported planted by May 7. Almost forty-five percent of the cotton was planted before the week of April 30–May 6. However, the growers who were able to plant two weeks before April 30 received the highest mean yields of the year, sixty pound more than those growers did who planted two weeks later did. The planting dates and yields are given in Table 4.

By the week of October 22 fifty-one percent of the cotton fields were harvested. The week of October 22 had the most fields harvested at twenty-four percent. Growers, who harvested before October 22, yielded an averaged thirty-nine pounds of cotton more than ones that harvested after October 22. Yield by harvest dates by region is given in Table 5.

### **Fertilizer Applications**

The North Carolina Cotton Information recommends nitrogen rates from fifty to seventy pounds per acre. North Carolina Cotton growers applied an average of seventy-five pounds per acre. The Southern Coastal region applied the highest rate of ninety-seven pounds per acre and the Southern Piedmont applying the lowest rate of fifty-nine pounds per acre. Less than thirty percent of the cotton growers reported using the soil test to make nitrogen applications. Sixty-five percent of the growers relied on their own experience to apply nitrogen. Only six percent of the growers based their nitrogen application decisions on the costs of nitrogen fertilizer.

An average of thirty–five pounds of phosphate was applied in 2000. The Northern Coastal region applied the largest amount at forty-two pounds per acre. The other three regions applied a similar amount at twenty-six pounds in Central Coastal, twenty-eight pounds in Southern Coastal, and twenty–four pounds in the Southern Piedmont.

Cotton growers applied an average ninety-seven pounds of potash. There was very little difference in means across the regions ranging from one hundred and four pounds in the Central Coastal to ninety-two pounds in the Southern Piedmont region. Fertilizer application rates are given in Table 6.

# **Chemical Applications**

Ninety-five percent reported scouting for weeds and insects and eighty-three percent scouted for diseases. Approximately fifty percent of the operators did their own scouting. Consultants scouted almost a quarter of the fields for weeds and thirty-four percent of the fields for insects. While ninety-five percent of the operators reported scouting for insects, only forty-eight percent applied insecticides based on scouting data. Forty-six percent relied on their experience in applying insecticides. Thirty-one percent applied insecticides as a preventive schedule. Cotton growers were asked to choose where they receive their pest management information. Forty percent reported receiving their pest management information. Twenty-one percent reported chemical dealers as their source.

# **Insecticides**

Respondents were asked to list the insecticides they applied in 2000. Counter, Temik, Orthene, Baythroid, and Karate were the five most commonly applied insecticides. Non transgentic varieties applied more insecticides than stacked or Round up Ready varieties. Counter and Baythroid was applied almost twice as many conventional fields as Round Up Ready fields. Karate was the most common post planting insecticide applied to stacked variety fields. The insecticide applications are given in Table 7.

#### **Herbicides**

Cotton growers were asked to list the herbicides that were applied to their fields. The nine most common herbicides were MSMA, Cotoran, Treflan, Bladex, Staple, Caparol, Round up Prowl, and Enquik. Prowl and Cotoran were the most common herbicide for the conventional fields. Caparol and Enquik were applied on a similar number of fields in 2000. The herbicide applications are given in Table 8.

#### **Rotations and Tillage**

Cotton was planted in the fields surveyed from one to ten years. The average for the state was less than three years, with two being the most common. Fields in the Southern Coastal region are rotated slightly less often than the rest of the state. Tobacco, peanuts and soybeans were the crops most often planted in a cotton rotation, with approximately thirty percent of the fields planted to each crop over the last three years. Corn was rotated on about ten percent of the fields each year. Approximately twenty-five percent of fields had a cover crop.

Conventional tillage is used on fifty-six percent the cotton acreage in North Carolina, twenty-seven percent is strip-till and seventeen percent is no-till. Regional convention tillage was used on sixty-seven percent of the acreage in the Southern Coastal, compared to forty-eight percent in the Northern Coastal region. The Northern Coastal region had the higher percent of strip till at thirty eight percent. Seed type planted did not have any influence in the tillage utilized across regions. Types of tillage by region are given in Table 9.

### **Summary**

Several new technologies have been introduced since 1994, such as Roundup Ready, Bole Guard, and Stacked (BT/RR) seed varieties. The survey found seventy- seven percent of North Carolina cotton growers had planted a transgenic variety of seed in 2000. Increased yields improved weed and insect control was the most common reason given for planting a transgenic variety.

Conventional seed varieties yielded nineteen LBS more than stacked varieties and thirty-seven more than the RR varieties. However, regional variations seem to explain most of the yield differences between seed varieties. Early planting important is a factor in higher than average yields. Eighty-eight percent of the crop was planted by May 7. The most common harvest date in 2000 was October 22. The growers who planted the first two weeks of April had the highest yields. Conventional tillage is utilized on fifty-six percent of the cotton farms with, twenty-seven percent utilizing strip till and seventeen- percent no-till.

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Seed Type	1999	2000
	Percent	
RR	35.6	35.7
BT	2.9	2.9
Stacked	25	38.9
Con.	36.5	23.3

#### Table 2. Seed Type Planted By Region

Seed Type*	STATE	CC	NC	SC	SP		
Percent							
RR	35.7	38.6	41.2	20.6	-		
BT	2.9	-	-	-	-		
Stacked	38.6	38.7	28.9	67.6	40		
Con.	23.3	19	28.1	8.8	60		

\*BT was not included due to only 6 observations for the state

Table 3. Yields By Seed Type and Region

Seed Type*	STATE	CC	NC	SC	SP		
LBS Per Acre							
State	792	831	807	767	720		
RR	776	811	755	926	0		
Stacked	794	837	792	754	720		
Con.	813	855	823	698	667		

\* BT was not included due to only 6 observations for the State.

Table 4. Planting Dates and State Yields

Planting Date	Percent	Yield
4/9	3.3	679
4/16	7.7	851
4/23	12	836
4/30	44.5	791
5/7	20.1	779
5/14	9.6	761
5/21	2.9	758

Table 5. Harvest Dates and Average State Yields						
Harvest Dates	Percent	Yield				
9/24	2.6	834				
10/1	6.7	771				
10/8	10.8	839				
10/15	10.3	850				
10/22	16.9	802				
10/29	24.6	787				
11/5	11.8	782				
11/12	7.2	765				
11/19	3.6	786				
11/26	2.6	790				

Table 6. Fertilizer Application by Regions

Fertilizer	STATE	CC	NC	SC	SP		
LBS Per Acre							
Nitrogen	75	75	68	97	59		
Phosphate	35	26	42	28	24		
Potash	97	104	96	94	82		

 Table 7. Percent of Fields Selected Insecticide Applied

 By Seed Types

Insecticide	RR	Stacked	Con				
Percent							
Conter	28	14	66				
Temik	58	49	72				
Orthene	13	19	16				
Baythiod	28	14	66				
Karate	40	31	13				

Table 8. Percent of Fields Selected HerbicideApplied By Seed Type

Herbicide	RR	Con				
Percent						
MSMA	34	20	49			
Cotoran	37	21	78			
Treflan	17	12	8			
Bladex	16	12	18			
Staple	3	10	37			
Caparol	24	24	24			
Round Up	86	90	47			
Prowl	22	24	80			
Enquik	26	25	30			

# Table 9. Tillage Type and Region

Tillage	STATE	CC	NC	SC	SP		
Percent							
Conventional	56	67	48	71	-		
Strip	27	12	38	18	-		
No-till	17	19	13	12	100		