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1994 Crop Review

Dave Guthrie, Dave Albers, J. C. Banks, Claude Bonner, Tom Burch, Charles Burmester, Johnny Crawford, Keith Edmisten, Charles Glover, Kater Hake, Will McCarty, Dale Monks, Jeff Silvertooth, Gene Stevens, James Supak, Ron Vargas

The 1994 cotton crop turned out to be a pleasant surprise. Despite early and mid-season disappointments, overall production was the highest on record. Seven states produced record yields. However, this success was not universal as California and Texas producers can attest. This newsletter will revisit the 1994 season to highlight the factors responsible for the season's fortunes and disappointments.

Each cotton crop is unique -- shaped and molded by an array of circumstances. Which of these determinants play dominant or minor roles depends on the season and region. Dominant features in California may be virtually non-existent in the Carolinas. Similarly, situations influencing the outcome one year may be forgotten the next.

We discussed the excellent 1991 crop in Vol. 3, No. 3, of the *Cotton Physiology Today* newsletter, "What Went Right in 1991." Among the factors responsible for that year's successes were excellent early season grow-off and square retention as well as moderate temperatures and rainfall during bloom. What began as a "behind the eight ball" season, due to late planting, turned into a banner year in maturity, yield and quality.

Last year's newsletter, Vol. 5, No. 1, "1993 Crop Yields -- Explaining the Highs and Lows" noted the elements responsible for the High Plains success and sifted through the rubble of the Mid-South and Southeast crops. The High Plains benefited from timely rains and tolerable pre-bloom insect pressure which supported excellent vigor and square retention at early bloom. Rapid boll loading and maturation helped contribute to high quality and yields. The Eastern crop was far more troublesome. Delayed planting, impaired vigor, chronic drought stress and unrelenting heat limited yield possibilities. To add insult to injury, persistent and, in some instances unmanageable, insect pressure increased costs.

The Eastern and Western regions traded fortunes this year. For example, California yields in 1994 are down an estimated 10-15% from last season. The High Plains, which enjoyed widespread success in 1993, was less consistent in 1994. Irrigated fields produced remarkable yields while some dryland sites were virtually barren. The Eastern U.S. cotton crop was more uniformly rewarding (Table 1). Georgia is particularly notable, where acreage increases and record yields combined to produce 50 percent more cotton statewide (1,500,000 bales) than was optimistically forecast prior to planting.

Table 1

U.S. Upland Cotton
1994 Yields and Production

	Harvested Acres (x1000)	Yield/Acre (Lb.)	Production (Bales x 1000)
Southeast	2,147	782	3,497
Alabama	460	772	740
Florida	68	706	100*
Georgia	875	812*	1,480
North Carolina	486	751*	760
South Carolina	216	800*	360
Virginia	42	650	57
Mid-South	4,100	805	6,880
Arkansas	970	866*	1,750
Louisiana	890	809	1,500*
Mississippi	1,310	788	2,150
Missouri	345	835*	600*
Tennessee	585	722*	880*
Southwest	5,566	452	5,236
Kansas	1	480	1
Oklahoma	365	309	235
Texas	5,200	462	5,000
West	1,459	1,188	3,610
Arizona	312	1,200	780
California	1,095	1,205	2,750
New Mexico	52	738	80
Total	13,272	695	19,223*

* Record.
NASS, USDA, 12/94

Field performance, whether successful or disappointing, can be traced back to events or circumstances encountered earlier in the year. This review will note these landmarks as the crop is followed from field preparation to harvest.

Early Season

Spring is inherently unsettled, which routinely contributes to inconsistency across fields and regions. Fortunately, field preparation

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across the Belt was timely this season, in marked contrast to the situation that existed in the Mid-South and Southeast in 1993. A dramatic increase in stale seedbed preparation, mainly in response to last season's setbacks, helped keep cultural timetables on schedule. Planting in those two regions was similarly on schedule, with the few accounts of stand failures or replanting due to a series of slow-moving cold fronts that arrived the last 7 to 10 days of April and the first few days of May. Early growth also was slowed by cool and wet conditions that prevailed throughout much of May in the Northern tier of the Eastern belt.

Although winter and spring rains failed to fully replenish soil moisture reserves in large portions of South and Central Texas, the rains were sufficient to allow timely seedbed preparation which in turn allowed planting to begin on schedule. Most of the initial plantings survived spotted heavy rains, some hail and near freezing temperatures in late March. These factors generally slowed crop development and caused some replanting and contributed to non-uniform stands in many fields, primarily in the Coastal Bend (Corpus Christi) area.

Planting was initially delayed by wet conditions in areas of the Texas High Plains and Oklahoma. However, once planted, these fields made excellent progress as heat unit accumulations approached record levels.

The California season stuttered at the start, with the untimely arrival of several cold fronts. In some instances, planting was delayed, with stands less uniform due to chilling injury and severe seedling disease pressure. Early season vigor was reduced, delaying development and constraining field performance.

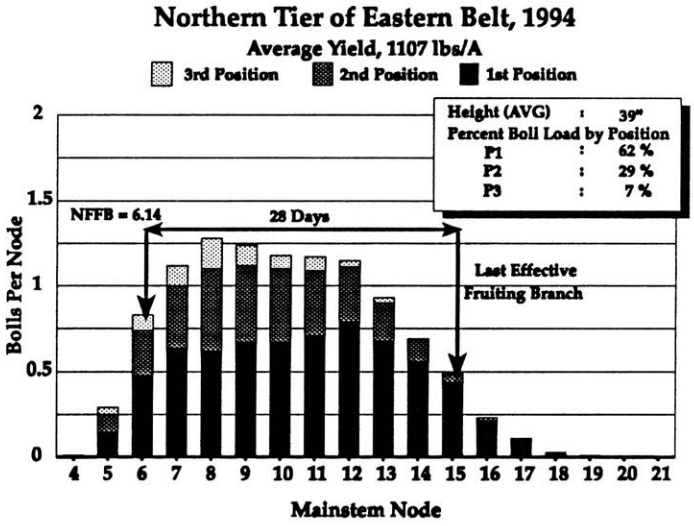
Early Square to Bloom

Research findings and plant mapping data document the importance of the early square to bloom period to crop development and yield. Vigorous growth, coupled with high square retention, creates the foundation for rapid boll loading and early maturity. Prebloom drought stress in 1993 reduced the plant vigor as indicated by low height-to-node ratios (HNR) and nodes-above-white-flower (NAWF) at early bloom. This predisposed the upper Mid-South and Southeast crop to premature cutout and reduced yields. Alternately, poor prebloom square retention, as noted in the lower Mid-South in 1993, delayed maturity and heightened that crop's susceptibility to late-season insect infestations, such as the beet armyworm.

In contrast, this year the earliest hints of superior performance in the Eastern cotton crop were visible in June. During this pivotal month, heat unit accumulations and rainfall amounts were higher than average. These conditions favored excellent vigor, which created the framework to set a record crop. One indication of this vigor, NAWF, averaged 8-10 in the Mid-South and Southeast in 1994 versus only 7-8 in 1993.

The benefits of excellent vigor and high production potential may be nullified if prebloom square retention is poor. The captured photosynthetic supplies may be dispersed in counterproductive terminal growth, generating pulpwood rather than lint. Square shed prior to bloom is overwhelmingly associated with insect pressure, whether plant bug, boll weevil, bollworm, etc. Limited evidence from the Mid-South does not suggest less prebloom insect pressure this year; rather better success in detection and control. According to plant mapping data, prebloom square retention generally was higher in the northern zones of the Mid-South and Southeast in 1993. This same pattern was followed in 1994, which helps explain the high productivity on the first seven fruiting branches (Figure 1). The combination of vigor and retention elevated yield expectations across the Eastern half of the Cotton Belt.

Figure 1



Despite the early delays, California cotton entered bloom with acceptable HNR and excellent square retention. Lygus pressure was below average in the San Joaquin Valley. New acreage reintroduced into the Sacramento Valley suffered from lygus-induced square shed on the lower fruiting branches which required treatment.

In Texas, non-uniform stands, excessive rainfall and other weather-related factors delayed crop development during the first 1 to 2 weeks of squaring and complicated insect management, especially in the Coastal Bend region. By early bloom, however, most crops were at 6 to 9 NAWF and exhibited good-to-excellent fruit retention. Irrigated cotton in the Valley appeared to be headed for above average yields with below average costs for insect control.

The High Plains continued to enjoy the benefits of record heat unit accumulations. Unfortunately, the rain that was necessary to rescue moisture-deficient fields did not arrive and drought stress intensified in dryland fields. In contrast, irrigated fields capitalized on the heat. The hot and dry conditions also favored high insect pest mortality, resulting in first position square retention levels greater than 90 percent.

Bloom to Cutout

Hot, dry conditions coupled with limited soil moisture reserves transformed much of the Central Texas crop from one that had above average production prospects to one that produced a below average yield. Excessive rains shortly after a heavy irrigation contributed to heavy fruit shedding in the Valley, reducing its yield potential to that of an "average" crop. Although rains in the Upper Coast region and North Texas contributed to insect management problems, the timely moisture greatly enhanced yield prospects. The early rains that contributed to various problems in the early season also replenished soil moisture reserves in the Coastal Bend and ultimately contributed to the above average yields in that area.

At early bloom, crop conditions on the High Plains ranged from NAWF = 7 on irrigated fields to 2 on severely drought-stricken sites. Non-irrigated fields produced less than 100 pounds of lint on 4 inches or less of total seasonal moisture. Irrigated fields with acceptable vigor and high square retention loaded rapidly, advancing 2 to 3 weeks ahead of schedule.

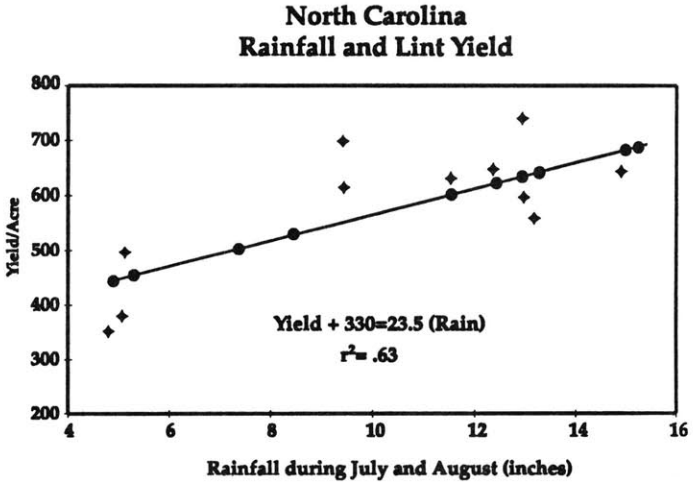
The promise of the Eastern crop quickly dissipated with the arrival of rain. Weather systems parked over the Southeast leaving 10-plus inches of rain and floods in areas of Georgia and Alabama. The Mid-South rains were less intense but equally prolonged. Concerns surfaced regarding pollination, plant nutrition, insect scouting and control. Cloud cover was implicated as an additional source of shed due to inadequate photosynthate production. Insecticide treatments that were applied between rains were constantly threatened with wash-off. Talk of record yields was replaced with hopeful optimism for good yields, to dire forecasts of widespread disaster.

Sand and Rain

It is reasonable to question why these despairing predictions did not materialize. Unfortunately, in some instances they did, particularly in those low-lying fields that were submerged in flood waters. Yields also were negatively impacted in fields where leached soil nitrogen was not replaced or worm pressure coincided with the inclement weather.

Nonetheless, observers familiar with the loamy sands of the Coastal Plain recognize the dominant impact of rainfall on cotton yields. Soils across the region typically hold less than 2 inches of available water in the rooting zone. Rainfall must surpass 1.5" every week during the effective bloom period to avoid drought stress. North Carolina cotton yields over the last 15 years are associated closely with July and August rainfall (Figure 2). Regions with more retentive soils, such as the Mid-South, are less subject to rapid onset of drought. Nonetheless, similar close relationships between rainfall and yield are likely to influence production in other areas where mid-season insect pressure is absent or contained.

Figure 2



The impact of prolonged rain and cloudy weather on boll retention requires further examination. In-season plant maps would record decreased boll retention directly or indirectly, through a flattening in the NAWF descent and a renewal of vigorous terminal growth. Mid-South and Southeast plant map data for 1994 should reflect significant weather disturbances.

Cutout to Harvest

Rain that was abundant in July diminished in August. Fortunately, many Southeast locations received in excess of 5 inches that month, a real benefit on these coarse-textured soils. Mid-South sites received varying amounts, and initial supplemental irrigations were applied. In some Mid-South fields, the approach of cutout was accompanied by increasing plant bug and boll weevil infestations.

Conditions were typically hot and dry during this period in South and Central Texas. Some problems with defoliation and desiccation were encountered in the Central Texas area due to the heavily stressed condition of the plants. In North Texas (from Dallas to the Oklahoma border), fall rains are causing prolonged harvest delays; much of that crop is still in the field – and it's raining again.

Boll maturation on the High Plains fluctuated with alternate hot and cool weather patterns. Overall, the ma-

turity was advanced several weeks and the killing freeze was 3 to 4 weeks late. This combination helped set the stage for significant increases in harvest aid usage and fiber quality.

Profile of Boll Loading

Final maps of the 1993 crop revealed one or two patterns in the Southeast/Mid-South. Boll loading and yield were limited by drought stress and inadequate plant vigor or poor fruit retention, prolonged fruiting and increased susceptibility to insects.

Boll loading profiles this season depart from last season's patterns in at least four ways (Figure 3):

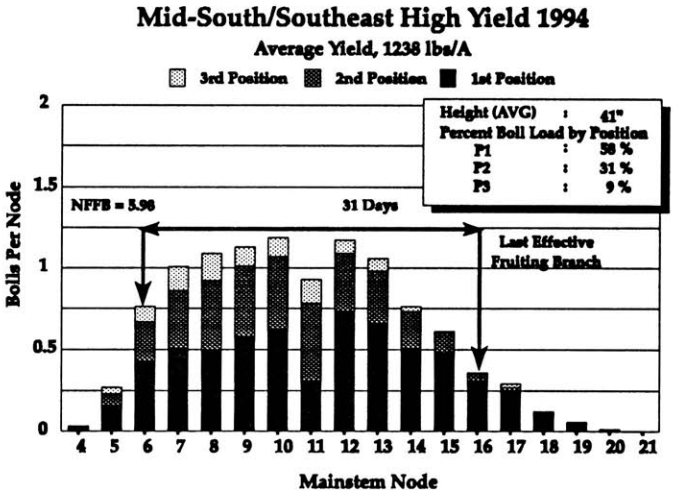
1. Early boll set was markedly higher, a further indication that square protection and retention were improved.

2. Boll production per node was significantly higher in 1994, probably a result of increased plant vigor.

3. Unlike those fields which cutout prematurely in 1993, the 1994 fields maintained excellent boll retention beyond node 10.

4. Yields were at least 200 to 300 pounds higher in the most productive fields yet the boll loading period was shortened 10 to 14 days.

Figure 3



Wrap Up

Although several factors contributed to the record yields of 1994, including favorable weather in June, water made this crop. Whether on the Texas High Plains or Carolina Coastal Plains, growers were reminded of the water's value. Too much at the wrong time can upset a production scheme, but too little anytime steals success. It is not surprising that investment in irrigation continues to rise. Some systems were little used in 1994, but all were needed.

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