PHYSIOLOGY TODAY

Newsletter of the Cotton Physiology Education Program — NATIONAL COTTON COUNCIL

January 1992, Volume 3, Number 3

# What Went Right in 1991

**Extension Cotton Specialists (Claude Bonner AR, Tom Burch LA, Charles Burmester AL, Charles Glover NM, Dave Guthrie NC, Lawrence Harvey SC, Tom Kerby CA, Steve Livingston TX, Bill Mayfield, Ray Nabors MO, Jeff Silvertooth AZ, James Supak TX) and Kater Hake**

*This issue will review plant growth and development of the 1991 cotton crop and identify some of the positive lessons learned last year. Although 1991 weather will never occur again, with careful attention to detail, we can pull many of the 1991 successes out of 1992, 1993 and 1994 weather.*

## Seedling Emergence

### Seed Quality

Across the Cotton Belt, seed quality was good to excellent. With the open fall in 1990 and increased focus on seed vigor, producers had high quality seed to plant. This allowed some successful planting during the adverse early part of the season. In California and Arizona, temperatures were cool during the traditional planting period, necessitating use of high vigor seed. In the Mid-South and part of the Southeast, the heavy spring rain kept most planters parked during the early planting season, but those producers that were able to get into the field between storms benefitted from the high quality seed that emerged rapidly thus avoiding crust and disease problems.

**LESSON 1:** If planting under potentially adverse (early, wet or cool) conditions, seek out and plant only high vigor seed.

### Seedbed Moisture

Seedbed moisture was generally adequate to excessive in most cotton states. 1991 was a year where careful attention to high seedbeds and good field drainage paid off for Mid-South producers who planted early. It was also a year where no-till was of benefit. Due to the stronger soil and better internal drainage, the no-till fields could support a tractor and be planted while conventional planters were kept in the shed.

### Temperatures

Temperatures were generally favorable for seed germination. Although cool temperatures prevailed in the San Joaquin Valley, they were not cold enough to cause chilling injury; the only loss from the cold April was time. Despite the cool temperatures, dry weather after planting helped to minimize seedling disease in the Far West.

## Root Growth

### Soil Temperature and Moisture

Optimum conditions for root growth include planting into warm, moist (yet well-drained) soil without further rainfall until the surface soil has been depleted of moisture. When the rains finally eased in the Mid-South and Southeast, the above prescription for excellent root growth was filled along with the added bonus of higher nitrate levels in the subsoil from leaching. Deep healthy roots proliferate in well-fertilized soil that later carried the plant through subsequent dry spells with less plant stress.

### Lack of Rainfall after Planting

Rain or irrigation on young cotton is generally undesirable for several reasons: (1) it cools the soil at a time when soil warmth is beneficial, (2) oxygen is excluded from the root zone, halting further root growth and nutrient uptake, (3) seedling root disease is aggravated, especially rhizoctonia which can damage seedlings under warm, moist conditions, (4) depth of rooting is limited when frequent irrigations are provided in the early season, and (5) weed seeds are sprouted. June rainfall was sparse in the Mid-South which allowed for the development of deep and healthy root systems. Cotton responds to restricted rooting just like a bonsai tree. If the root system is restricted, the above-ground portion or shoot will be restricted and highly vulnerable to short-term interruption in moisture supply.

**LESSON 2:** Strive for healthy seedlings. When seedling roots and shoots are strong and vigorous the plant can weather adverse conditions as well as take advantage of favorable conditions and set a rapid high yielding crop.

*Also in this issue*

## Squaring

### Warm Temperatures

When cotton emerges under favorable temperatures, not too cold—nor too hot, squaring starts low on the plant. In 1991, many areas experienced adequate to favorable early growth conditions that promoted squaring at nodes 5 and 6—sometime 7. These early squares were generally retained due to low insect pressure. In Arizona, the delayed early seedling growth caused a heavy, suicidal emergence of pink bollworms. When moths emerge in the spring, they fail to lay eggs if they cannot feed on squares, resulting in a suicidal emergence. In the San Joaquin Valley and the Mid-South, plant bug levels were light.

### Square Retention and Strong Vigor at 1st Bloom

The next positive development in the 1991 cotton crop was the condition of the plant at first bloom. If plants enter bloom with both a heavy square load and healthy, vigorous growth, heavy early boll retention usually results. Cotton plants follow a path during the bloom period that is as predictable as death and taxes. This path starts out with high boll retention at first bloom when there are few bolls on the plant to drain nutrients and carbohydrates. Then as the boll load builds, the drain on the plant's reserve and supply capacity brings root growth to a halt. Then new terminal growth is reduced, and finally boll retention is reduced. Plants that enter bloom with many squares and strong vigor are able to sustain growth and boll retention longer into the bloom period than plants that start out weakened by stress (drought, nutrient deficiency, leaf injury, disease etc.)

**LESSON 3:** Retain early squares. If the bloom period begins with a full deck of cards, the plant can take advantage of excellent boll retention conditions and push the limits of bolls set per plant. Just a short time ago producers (and researchers) were content with 50% boll retention at the key first position fruiting sites. But as our boll retention objectives climbed to expectations of 60 to 70%, we may need to start the bloom period with a higher proportion of squares on the plant. Monitor fields closely after first square to insure squares are sticking on the plant.

## Blooming

### Lack of Hot Temperatures During Bloom

As the boll load builds, the plants sensitivity to stress increases, especially a stress that decreases the carbohydrate supply. Hot day and night temperatures are a common stress that depletes the plant's supply of carbohydrates. When high temperatures coincide with a heavy boll load, both maintenance respiration (the plant has to expend more energy just to stay organized) and growth respiration (bolls develop more rapidly using nutrients and carbohydrates faster) increases. Although rapid boll development is desirable, it comes with the cost of increased demand on the plant, which causes earlier root, shoot and fruit retention cutout.

In 1991, temperatures were generally moderate during the peak bloom period. We observed boll retention continuing high up the plant, similar to 1987 when moderate late July/early August temperatures allowed superb late season boll set. Work in Arkansas and California demonstrated that boll retention is sharply curtailed when the Nodes Above White Bloom first drops to 4 or 5. This is the reason we rarely see large bolls within 4 to 5 nodes of the terminal at harvest. 1991 was the exception, with many states reporting large, healthy bolls near the top of the plant.

### Timely Rains

Several regions of the U.S. Cotton Belt had previously suffered from multiple years of drought (the Southeast and South Texas, especially). In 1991, timely rains kept the plant from entering moisture stress during the critical bloom period. In South Texas, cotton was planted with minimal soil moisture and depended on the timely rains that fell after planting. Producers with sprinkler or drip-irrigation systems have learned that light, frequent irrigations keep the plant setting fruit on up the stalk. This year, light, frequent summer rains were interspersed with bright, sunny weather, allowing much of the same benefits to occur in dryland fields.

**LESSON 4:** Avoiding stress during the early and mid-bloom period contributes to the rapid development of an early high quality, high yielding crop. Although most of the Belt avoided stressful conditions during bloom, the Southwest was hit especially hard by stress at this crop stage. Cloudy, wet weather retarded the crop, aphids or whiteflies severely damaged leaves and cold weather befell the plant early, chilling leaves and halting further boll growth.

### Plant Height Control

Many fields in the U.S. experienced vigorous growth. Not only does late planted cotton tend to grow tall, but also the high plant populations, timely rainfall and healthy seedling growth promoted rank plants. Many areas of South Texas also increased their planting of Delta picker varieties that have more growth potential than traditional stripper cottons. Despite early rank growth, height was finally brought under control by the early boll load and/or use of Pix. When conditions are favorable for rank growth, producers should apply Pix as early as possible (after matchhead square) to lessen the need for higher rates when the cotton gets rank. If the height increase of a vigorous plant is brought under control primarily due to the boll load, an excellent crop can be anticipated.

**LESSON 5:** Many parts of the Cotton Belt began the wet 1991 year after several years of drought (Southeast and South Texas). Producers had developed caution regarding Pix usage. If conditions favor rank growth (ample soil moisture and nitrogen, high plant populations, use of varieties with growth potential), these producers should not be concerned about using Pix too early, thus avoiding a necessity of high rates later.

## Boll Maturation and Opening

The same favorable weather that sustained boll retention during mid-to-late bloom also contributed to favorable boll maturation. Bolls that matured prior to the late October cold snap were generally large robust bolls. Due to the excellent boll retention, a high percentage of the crop came from first position bolls. Bolls set close to the mainstem are heavier, with higher quality strength, length and maturity. The high maturity of these bolls increased the micronaire and resulted in many bales that fell in the high discount range.

### Plant Nutrition

Producers and Extension demonstrated their ability to respond to changing nutrition needs in 1991. The heavy spring rains left many fields with an unknown amount of available nitrate in the root zone. In addition, the rapid boll set placed an extra burden on the plant for nitrogen and potassium. Use of petiole and leaf sampling in conjunction with sidedress and foliar fertilization applications kept many fields from limiting yield due to plant nutrients.

**LESSON 6:** Adjust nutrition to conditions in the field. The heavy spring rains leached an unknown amount of nitrogen out of the root zone. Producer flexibility to rapidly respond to unforeseen nutrition problems kept plants healthy during the critical mid to late bloom period when nutrient demand is heaviest.

### Boll Opening

A near disaster was averted in the Southeast and Mid-South during the boll opening period. Conditions were prime for a serious boll rot problem — higher than optimum plant populations, dense canopies and a heavy boll load. Fortunately, the rains halted shortly after boll opening started, and boll rot was kept to a minimum in these states. Georgia, traditionally the state most afflicted with boll rot, only suffered a 5% yield loss in 1991 compared to previous highs of 20% in other years.

In most picker cotton areas, the harvest season was close to perfect. Good harvest weather can increase yields 5-10% simply by increasing harvesting efficiency. Also, fall weather accounts for a major part of the very high grades which dominated the spindle-picked crop. We have had unusually good harvest weather for about 5 years and have generally come to expect it. In the future expect a return to more normal harvesting conditions and be prepared.

### WRAP-UP

Like a vintage year for wine, the 1991 U.S. cotton crop should result in the highest quality yarn and finished goods ever produced. The tables in the insert illustrate the general health of the 1991 U.S. cotton crop, with many record yields and near record production statistics. The quality of the 1991 crop was the longest ever (1.11 inches), having record HVI strength (27.6 g/tex) and the greatest length uniformity (81.5) ever recorded. A phenomenal 47% of the crop was classed middling or better.

From the many successes that occurred in 1991 cotton fields, one final lesson needs to be remembered:

**LESSON 7:** Although late planting will be of less concern to producers after this year's success with June planted cotton, keep in mind that summer and fall weather will not always cooperate as it did in 1991. Do not be lulled into thinking that a late planted crop will always yield so well or produce such high quality cotton.

# Cotton Comics


If healthy seed is surrounded by warm soil, moisture and oxygen it germinates, pulling the cotyledons up through the soil. Sunlight on the emerging plant greens the cotyledons and warms the soil. The soil is warmed after sunlight drys the surface, allowing heat to raise the temperature not just evaporate moisture. Once the soil warms, root growth is hastened along with the development of true leaves in between the cotyledons. Unlike other crops (corn, beans, wheat) which have preformed true leaves in the seed that unfurl upon emergence, cotton seeds only have cotyledons and has to develop true leaves from scratch. This process proceeds slowly if temperatures are cool and sunlight limiting.

The Cotton Physiology Education Program is supported by a grant from The Cotton Foundation, and brought to you as a program of the Technical Services Department of the National Cotton Council in cooperation with the State Extension Services.

Cotton Physiology Today: Edited by Kater Hake