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Full Season Yields from Short Season Weather

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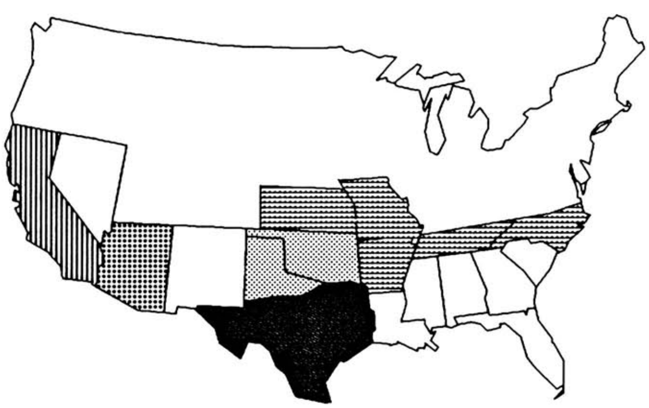
Short season production is often the only viable option in many parts of the Cotton Belt. To address this topic in our diverse production regions the following extension specialist have contributed to this article: J.C. Banks (Oklahoma), Claude Bonner (Arkansas), Tom Burch (Louisiana), Tom Kerby (California), Will McCarty (Mississippi), Paulus Shelby (Tennessee) and James Supak (Texas).

One of the common slights of hand in cotton production is the achievement of respectable yields despite late planting dates and cool springs. This magic trick is assembled from modern varieties and management tools, producer commitment to close crop monitoring and prompt reaction to field conditions. The need to produce healthy yields from a short growing season occurs every year in some part of the Cotton Belt. The following map lists the locations and justifications for using short season management practices.

Why Producers Use Short Season Production Practices



- Replanting after cool spring, drought.
- Avoid late pest in upland, and set pima crop prior to heat.
- Utilize rainfall, and avoid monsoons or late season insects.
- Cold spring and fall, and avoidance of 1st weevil flight.
- Cool spring and wet fall.

What is an Early Plant

In this issue of Cotton Physiology Today we will discuss the plant factors that promote earliness and the management inputs necessary to insure them. Several plant features contribute to earliness: fruiting branches starting at lower nodes, high retention of early fruit and rapid boll maturity and opening. As we discuss each one of these in detail we will see that variety, weather and management influence all of these, but we cannot emphasize strongly enough that producers control the most important factor in earliness, high retention of early fruit.

Node of the First Fruiting Branch: Variety Influence

The first component of earliness is the node of the 1st fruiting branch or the node number where we see the 1st square. Variety has a strong influence on the node of the first fruiting branch, and breeders have used this to move fruiting higher or lower on the plant. In the San Joaquin Valley, where producers throw dirt to the plant to cover small weeds in the drill row, breeders have selected plants that fruit high on the main-stem to allow mechanical harvesting. These plant types with delayed fruiting also allow big yields in full season production. In other regions, where earliness is critical and plants are not dirted, breeders have selected for fruiting branches at lower nodes. The variety with one of the highest 1st fruiting branches is "Acala Prema" which typically starts fruiting on node 8 or 9. Most varieties start fruiting at node 6 to 7 depending on weather and density. The "MAR" varieties from Texas are examples of short season varieties which typically begin squaring at nodes 5 to 6. To precisely translate these differences into harvest dates is impossible. However, a 1 node increase in fruiting branch height delays crop harvest by approximately 4-to-7-days. Thus, a 3 node range in varieties represents a potential delay of approximately 12 to 21 days.

Node of the First Fruiting Branch: Weather Influence

Weather also influences the node height of the first fruiting branch. If the weather is warm and ideal during the early weeks after planting, fruiting will start low on the plant. Conversely, if early weather is adverse, either cool (nights below 60°F) or unusually hot (nights remaining above 80°F) then the node of the first fruiting branch will be 1 to 3 nodes higher. The stage of growth when fruiting branch height is determined occurs shortly after emergence because the initiation of leaves and branches occurs long before we see them. At least 5 to 6 nodes and leaves are initiated before we see the first true leaf unfurl.

Also in this issue

Node of First Fruiting Branch: Management

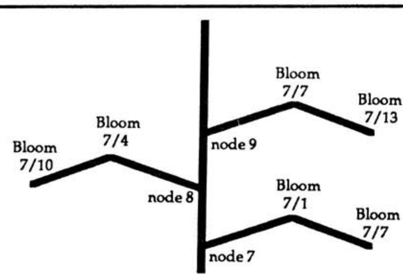
Management also can influence the node of the first fruiting branch. If plant density is excessively high then the node of the first fruiting branch is raised. Research by Tom Kerby demonstrates that at high plant populations (60,000 per acre) the node of the 1st fruiting branch is raised by 1 node compared to a low density (20,000). Additionally, high densities lengthen the time interval between blooms both up the plant and out the branch by approximately 10%. A three week bloom period that produces 6 nodes of bolls at normal densities might only produce 5 nodes at a higher density. Although high densities can theoretically develop many squares per acre, in practice, fields with moderate plant densities produce the earliest crop.

High Retention at Lower Nodes

The critical importance of a good bottom crop to earliness is best demonstrated by the adverse effects when early fruit sheds. All of the following effects delay crop maturity which in turn reduces yield and quality in short season cotton.

- The growth of the main-stem is directly related to the balance of "sources" and "sinks". Healthy, vigorous plants (strong sources) without fruit (sinks) represent an extreme imbalance resulting in abundant shoot growth. Shade induced shed, runaway growth and the need for high rates of plant growth regulators all result from early fruit loss.
- Plants compensate for shed by fruiting up the stalk, not out the branch. This compensation for shed delays maturity. If the first position boll is shed, retention of the second position boll is only increased by 25 - 30%. After the first position sheds, the second position boll has additional leaves to support boll maturation, but it is still dependent on its own subtending leaf during early boll growth. Last's month newsletter discussed the role of a boll's subtending leaf (attached to the fruiting branch at the same site as the boll) in supporting that young boll and preventing shed.
- The maturity delay caused by early square shed is similar to the delay from raising the node of the first fruiting branch. Every 1st position shed from the bottom of the plant delays plant maturity by 4-7 days.
- Cotton requires twice as many days to develop an additional square out the fruiting branch versus up the main-stem. Thus, when second positions reach bloom their subtending leaf is often buried in shade causing this young boll to shed.

Horizontal and Vertical Flowering Interval



Management to Increase Retention of Bottom Bolls.

Producers have heard some unreasonable goals regarding boll retention. Retaining 90% of the first position early squares is reasonable but not 90% of the first position bolls. If only 60 - 70% of the plants set bolls on the bottom 5 fruiting branches, this is considered good fruit retention. The following management practices contribute to early boll retention:

Variety: Variation exists between varieties as to their inclination to retain bottom bolls, although these differences are slight. Varieties that are short statured generally have higher retention at lower nodes. Boll retention is increased 25% in the case of some experimental Acalas, compared to the standard Acala SJ-2. Fast fruiting varieties in the Delta cotton states maintain high retention into the 3rd and 4th week of flowering. High retention during these 4 weeks is especially beneficial to earliness because it allows 80 - 95 % of the crop to be set within this period and open early for prompt harvesting.

Another component of fast fruiting varieties is "double blooms" caused by "side-by-side" fruiting branches. Fruiting branches that are "side-by-side" or close together on the mainstem, produce squares simultaneously, compared to the normal interval between fruiting branches of 3-4 days. "Double blooms" occasionally occur on fast fruiting Texas MAR varieties, but contribute little to earliness in Delta or SJV cottons. Except for "Double Blooms", the speed with which different varieties produce blooms up the main-stem is primarily controlled by temperature and boll load.

PIX: When an application of PIX is made at or before early bloom, boll retention is often increased. Whether this enhanced boll retention at lower nodes translates into increased yield depends on length of the growing season and plant vigor. The more vigorous the plant and the shorter the growing season, the greater will be the yield response to PIX. Clearly, cotton planted late when the weather is ideal for rapid vegetative growth is a strong candidate for PIX.

Crop Monitoring: Close crop monitoring is essential for successful short season cotton. If a problem exists with early square or boll retention it needs to be recognized and corrected as early as possible. Plant mapping fields right after first square and then 7 - 10 days later will identify square shed long before it becomes apparent by casually examining plants. Insect pests should be monitored twice a week during this critical early-square to mid-bloom period in short season fields.

Nitrogen: Nitrogen fertilizer can be used to control crop maturity. Stressing the crop for N will shorten the season when the plant runs out of N, but yields also suffer. More ideal is an adequate supply of N applied before bloom. Excess N fertilization in short season fields should be avoided, especially in the rain-belt, because N will delay maturity. High N rates in combination with humid weather results in large leaves that aggravate fruit shading problems and delay crop maturity.

Plant Population: High plant densities (+60,000 per acre) will aggravate fruit shed due to shading of squares and subtending leaves. Likewise excessively low densities (-15,000) are detrimental to earliness because time is lost while the few plants fill in the skips with longer fruiting and vegetative branches. The seeding rate should be reduced for later plantings due to the improved conditions for emergence and the need to avoid square and young boll shading.

Water: Water control for short season cotton poses a challenge to irrigators because both excessive and insufficient water can be deleterious to yield and maturity. Severe water stress at any time other than boll opening will decrease leaf function and growth. In general, optimum moisture availability during bloom is desirable because water stress that causes wilting will reduce fruit set (see December newsletter on "Environmental Causes of Shed").

Excess moisture prior to bloom increases plant attractiveness to insects and promotes excess vegetation. These two factors cause increased early square shed and boll shed due to insect feeding and lower canopy shading.

Speeding Up the Boll Period

Shortening the boll period or the days from white bloom to open boll, can increase earliness without sacrificing yield and quality. However the potential benefits to earliness from boll period shortening are not as great as from early boll retention and can only be realized if the lint and seed are mature. Fiber and seed growth occurs during most of the boll period, and thus during most of this period our management options are limited to maintaining a plant with good light penetration to the leaves close to the developing bolls. The later stages of boll maturation are boll wall cracking and drying. These stages can be successfully shortened with the use of boll openers and water stress. During all stages of boll development, producers should avoid management practices that lengthen the boll period, such as excessive N and water.

The following categories break the boll period into its various stages and discuss the management practices that shorten the boll period.

Small Boll Stage. No management tools available to speed up this stage. Maintain ample moisture and fertility to support boll set and healthy leaves.

Large Boll Stage with Immature Lint. Moderate water stress will increase plant temperature, speeding up boll weight gain and maturation. Avoid excess nitrogen that causes shading and rapid main-stem growth. Application of Harvest Aids should be avoided during this stage because they will invariably decrease yield and quality.

Large Boll Stage with Mature Lint. Water stress and defoliation will increase boll temperature and hasten opening. Application of a chemical boll opener will speed the splitting of the boll wall, allowing lint drying and fluffing. Excess nitrogen will slow boll opening by preventing adequate defoliation.

The ability to utilize water stress, nitrogen deficiency and boll openers to shorten the boll period is dramatically decreased when the crop suffers early fruit shed and sets bolls over a long time period. For more ideal short season crops where bolls are set over a 3 - 4 week period, the methods listed above to shorten the boll period can be utilized when the bulk of the crop is no longer vulnerable to shed or quality loss.

Variety selection also can be used to shorten the boll period. However, varieties with longer and stronger fiber also tend to have longer boll periods. For example, the cottons: **Pima, Acala, Texas MAR** and **Yugoslav** varieties are listed in descending order for both fiber length and the days required to mature a boll.

Management of Short Season Cotton

Estimates put the U.S. cotton crop at 16 million bales. The last time we produced a crop that large was in 1953, and that crop took 24 million acres and 1 million farms to produce. To reach these lofty yields in 1990, the late planted, cold start, or water short regions will need to successfully employ short season practices. These regions will need management inputs precisely timed to the plant and insect events as they unfold in the field. Without constant producer vigilance, a cotton field will revert to its natural "shrub" tendency putting on few fruit but plenty of stalk.

The components of a successful short season production system include:
A) selection of locally adapted early maturing variety,
B) high quality seed and seed-bed conditions,
C) rapid early growth,
D) uniform plant spacing of moderate density,
E) close monitoring and protection of early squares and bolls,
F) plant growth regulators where needed to keep plant height under control and enhance early boll retention,
G) ample water and nitrogen through peak bloom to avoid stress, adjust N level to yield potential,
H) moderate water stress and N deficiency during the later stages of boll maturation and
I) precisely timed harvest aids to maximize maturity and minimize field weathering.

Recommendations developed during the 60's and 70's regarding short-season or late-planted cotton were very appropriate for that time. These included water stress, low plant densities and reduced rates of nitrogen fertilizer. Though effective, these practices also limited crop productivity. The technology of the 80's has provided alternative approaches to short season cotton production, primarily better varieties, pest monitoring and control strategies and plant growth regulators. Additionally, we have raised our yield goals for short season cotton near to full season levels. For these yield goals we need a healthy plant that can intercept and utilize sunlight as efficiently as possible during the short time available.

Cotton Physiology Education Program Steering Committee

The steering committee for the Cotton Physiology Education Program will meet in San Antonio at the end of this month to plan future newsletters and projects. If there are specific topics that you would like addressed in upcoming newsletters please drop us a card or letter. I also would like to thank the steering committee for their excellent guidance during the last six months. Current committee members include: Lawrence Harvey, Kenneth Hood, Gay Jividen, Tom Kerby, Will McCarty, Joe Pennington, Scott Tollefson, Harvey Shaw, James Supak, Jackie Warren and Jim Brown.

About the Authors

Bill Meredith is a cotton Breeder and Geneticist with the USDA in Stoneville Mississippi. Besides extensive basic work in improving cotton breeding methods, Bill has contributed to our understanding of the management and genetic factors that control quality. If you would like a copy of his presentation at the 1990 Beltwide Cotton Production Conference on "Management Factors that Influence Quality", please write to Pat Yearwood at the NATIONAL COTTON COUNCIL.

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