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CHARTING A COURSE TO CUTOUT

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Cutout is an event of great significance to a cotton farmer. In practical terms, it designates the end of the boll loading period. To effectively manage crop development, it is useful to pinpoint the arrival of cutout. Nodes Above White Flower (NAWF) can be used as a road map to help locate this crop development landmark. This newsletter will discuss how to use NAWF to chart a course to cutout.

Off to the Races

Followers of horse racing or golf are familiar with handicaps. It is a variable value that helps equalize the competition. In a horse race, a handicap is the different weights the horses carry. In golf, it is the number of strokes subtracted from a player's total. In cotton, it is the head start given to vegetative growth.

Vegetative growth needs a head start to build up a lead prior to the arrival of active reproductive growth. Without that head start, there are insufficient plant resources (leaves and growing points) to sustain boll loading.

Competition between Vegetative and Reproductive Growth

There is competition between and within cotton plants. Between plant or interplant, competition occurs for the range of environmental resources required to support growth, including light, water, nutrients and space. Within plant or intraplant, competition occurs for the plant's internal resources such as water, nutrients and carbohydrates.

A cotton plant's carrying capacity and productivity is determined by the outcome of this inter- and intraplant competition. Minimal competition between plants (whether cotton or weeds) allows each individual to achieve its full biological potential, or carrying capacity. A well-developed leaf area can support many growth points.

The intraplant competition determines which of these growth points is supported, shoots and roots or bolls. Without balanced growth and development, two unacceptable outcomes are possible — premature cutout or rank growth. Premature cutout occurs when the leaf area and/or root mass are insufficient to support sustained boll loading. Rank growth describes vegetation gone wild. In this case, boll loading is insufficient to rein in the plant's vigor.

To maintain a scheduled yield development (boll loading) that avoids these opposing risks, the inter- and intraplant competition must be balanced.

The balance between plants is established by such early season practices as variety selection, row spacing, tillage, seeding rate, fertilization, insect and disease management and weed control. Once decisions are made on these production variables, they become fixed and part of the foundation of the crop season.

The balance within plants is not fixed, but ever changing. Each management decision and developmental event modifies the landscape and shifts the balance.

Sources and Sinks

To better understand this dynamic intraplant balance, a brief discussion of source/sink relationships is warranted. The terms "sources" and "sinks" are used by plant physiologists to designate the departure and arrival point of needed nutrients and carbohydrates. Nutrients and carbohydrates depart from roots, shoots and leaves (the sources) and arrive at root tips, shoot tips and developing fruit (the sinks).

Previously developed plant parts contribute to the continuing development of immature growth points. Growth points are sinks with high metabolic needs that must be met by the sources to sustain continued growth. The plant's continued growth and survival are dependent on these sinks and the sinks are dependent on the sources. And so on.

Vegetative Head Start

Early season vegetative growth lays the cornerstone for sustained boll loading. Producers who anticipate the crop's carrying capacity can take steps prior to bloom to establish a desired framework to set the crop. Maintaining vigorous prebloom growth is fundamental to supporting future yield production. Last month's newsletter (Monitoring Plant Vigor, June 1993) discussed the importance of monitoring and managing early season vegetative growth.

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The lead resulting from this head start reaches its maximum soon after first bloom. Prior to this point, all of the plant's horsepower has been devoted to building the yield factory — the leaves, shoots and roots. After this point, vegetative growth in well-managed cotton begins to slow as the bolls siphon progressively more of the plant's reserves. Additional vegetative growth must rely on the plant's left-over reserves not committed to boll development. When all the reserves are used by the bolls, vegetative growth ceases.

Nodes Above White Flower (NAWF)

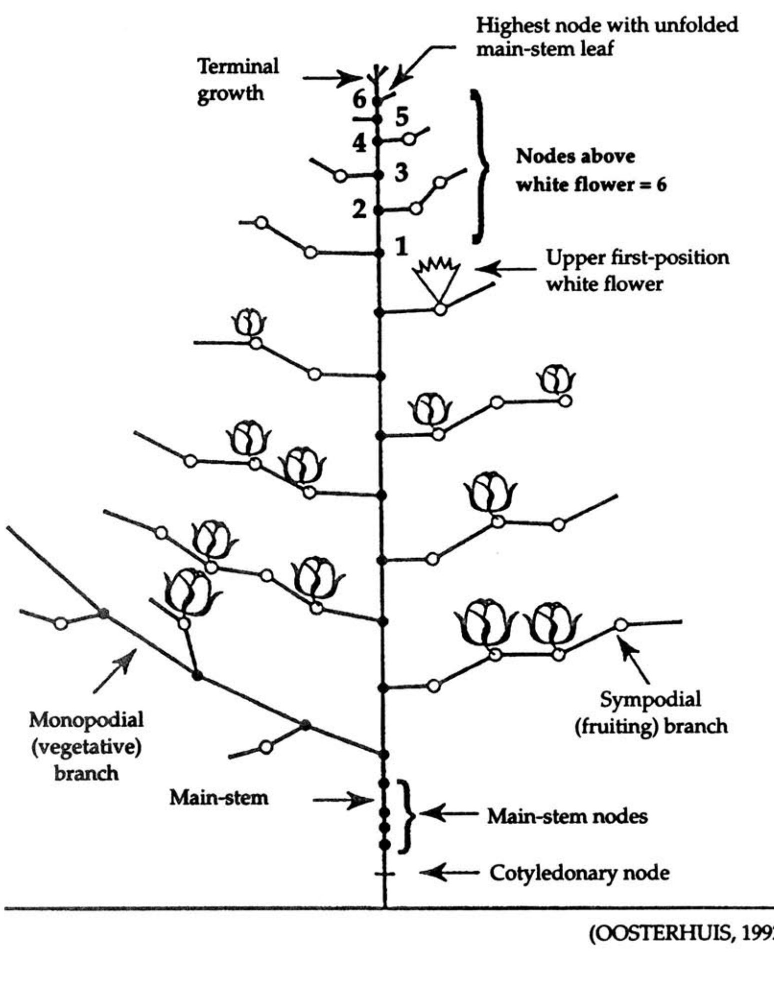
A remarkably straight-forward measure, Nodes Above White Flower (NAWF) expresses the status of this intraplant competition between vegetative and reproductive growth. The measure grew out of the observation that the vegetative growth lead enjoyed at early bloom begins to erode as boll loading commences. By following NAWF, a grower can track this shifting balance to modify management inputs.

In practice, NAWF measures the growth of the mainstem terminal relative to the progression of flowering toward the terminal. (Figure 1.) It is measured by counting the nodes above a first position white flower. The terminal node will have an unfurled mainstem leaf larger than a quarter (greater than 1 inch diameter). The NAWF is the current measure of the remaining potential boll loading sites. If there is sufficient energy to support continued terminal growth, the progression of flowering toward the terminal and cutout is delayed. If on the other hand most energy is committed to boll development, terminal growth slows allowing a more rapid progression toward the plant's carrying capacity and cutout.

NAWF at Early Bloom

The NAWF at early bloom will vary depending on the management decisions made by the producer and the level of stress encountered by the plants. Full-season varieties normally initiate the first fruiting branch at 1 or 2 nodes higher than shorter-season varieties. This increases their horsepower going into bloom, increasing the vegetative growth lead prior to the onset of competition from bolls. Full season varieties will normally have higher NAWF going into bloom than shorter season varieties.

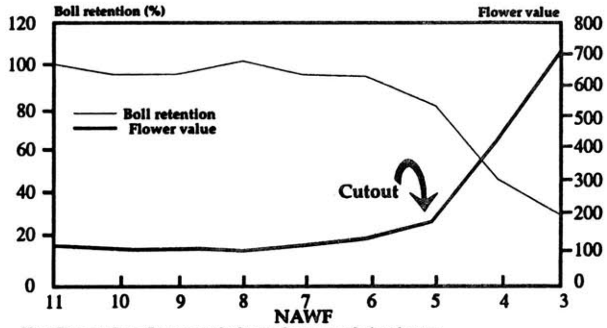
FIGURE 1
PLANT GROWTH MONITORING



(OOSTERHUIS, 1992)

FIGURE 2

Flower Value and Boll Retention vs. Nodes Above White Flower (NAWF)



Note: Flower value = flowers required to produce a pound of seed cotton (BOURLAND, 1992)

The degree of early season stress will also affect NAWF. Nighttime temperatures below 60° or above 80° may delay the initiation of the first fruiting branch by 1 or 2 nodes. Drought, disease and insects are just a few stresses that will reduce terminal growth and reduce NAWF at early bloom. Insects that remove squares, such as plant bugs, may actually increase NAWF at early bloom by reducing within plant competition.

At early bloom, NAWF may range from less than 6 for short-season varieties under stress to more than 12 for full-season varieties under vigorous conditions. This range in NAWF at early bloom can suggest growth tendencies in the boll loading period. Fewer NAWF at bloom indicates a shorter head start and greater likelihood of premature cutout. Higher NAWF indicates a larger head start, perhaps leading to rank growth.

NAWF During Bloom

As boll loading proceeds, NAWF declines. Normally, within 1 or 2 weeks of bloom, NAWF will begin to decline as the progressing bloom advances on the slowing terminal growth. The culmination of this process is the visible bloom "out the top," when the progressing bloom catches the mainstem terminal and all squares have either reached the bloom stage or shed.

Several studies have demonstrated that further significant yield production stops before this observable end of flowering. While this critical threshold indicating cutout does vary, it is agreed that when NAWF = 5, cutout is imminent. (Figure 2.) Those fruiting positions closer to the terminal are unable to effectively compete for the limited plant reserves and shed as squares or small bolls.

Rate of Decline as Indicator

The speed of the approach towards the plant's carrying capacity is reflected in the rate of decline in NAWF (Figure 3). Tracking NAWF can supply useful information for management decisions. A rapid decline indicates terminal growth has slowed significantly. This depression in growth may result from rapid boll loading (A) or severe stress (B). If the initial NAWF at early bloom was only 6 or 7, premature cutout is inevitable unless stress is relieved.

If NAWF were 10 or more at early bloom, a rapid decline can signify excellent boll retention and high demands for nutrients and water. High early bloom NAWF values may be followed by severe drought stress also causing rapid decline in the index. This drought-induced decline in NAWF signals a need for rapid irrigation response to avoid cutout.

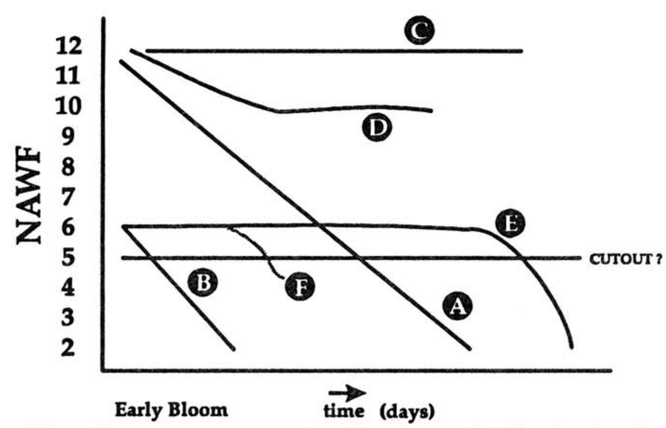
A closer investigation is warranted when NAWF does not decline after early bloom (C) or increases suddenly (D). The boll load is not developing sufficiently to prevent additional terminal growth. Immediate measures must be taken to increase boll set and reduce further growth. Otherwise rank growth, delayed maturity and reduced yield are probable.

A Cliffhanger

A recently recognized growth pattern shows a stable and low NAWF following bloom (E). This pattern, once recognized, must be managed carefully to realize acceptable yields. It results from early season stress that lessens NAWF going into bloom.

It may continue for several weeks or end abruptly (F). If early square retention is low (less than 75%), boll loading will slow in response to the sparse potential fruiting sites. This pattern (E) can still produce high yields with good late season conditions, although maturity delays put the crop at greater risk from late season insect pressures and less timely and effective harvest preparation.

FIGURE 3



If early square retention has been high, the leaf area may be insufficient to forestall premature cutout (B or F). Rainfall or irrigation may prolong boll loading if it occurs prior to significant boll set. Otherwise, rapid boll loading will have been at the expense of higher yields. This rapid loading with a low initial NAWF may be acceptable if boll retention is high coupled with higher plant populations (creating high boll numbers per acre).

Pulling the Plug

Nodes Above White Flower measures plant factors that determine the progress of boll loading. Weather factors also must be considered. Once set, a boll must have sufficient time to mature prior to the arrival of inclement weather (frost or prolonged rain). Each region has an effective bloom period (EBP) that defines the length of time that a crop has to produce a flower that can ultimately be harvested as a boll. The EBP begins with the first flower and ends when the crop produces blooms that do not mature as harvestable bolls. For much of the Cotton Belt, the EBP ends in August or early September. In long season regions, it may last 8 weeks or more. In northern regions or following late planting, the effective bloom period may last just a few weeks. Once the end of the EBP has arrived, further monitoring of NAWF is unnecessary. It is time to pull the plug on the crop. Concentrate on the bolls produced during the EBP as these will determine productivity and profit.

Phantom Bolls

Bolls produced after the end of the EBP are phantoms. They appear to be real but are not. They lead producers astray by tantalizing them with unobtainable yield. Plant monitoring can help separate real bolls from these phantom bolls. Bright ribbons placed on fruiting branches with a first position white flower at the end of the EBP can serve as landmarks to alert growers to these phantoms. If a grower is uncertain when the EBP concludes, they can date the ribbons and keep track of the development of the associated boll. Knowing the end of the EBP can enhance the management value of NAWF information.

Wrap Up

The patterns recognized in Figure 3 are examples of widely divergent growth profiles. There can be as many possible growth patterns as there are field situations. Ongoing research is helping to develop best management practices for the various growth patterns. While that work continues, it is clear that the first step in managing a particular pattern is recognizing which one you have. The only way to know that is through periodic in-field monitoring.

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