Chapter 10:

Using COTMAN to Manage Defoliation and Harvest Efficiency

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Defoliation effectively marks the end of the cotton growing season; it is the final in-season management practice before harvest. A common goal is to reach an acceptable yield potential, defoliate, and harvest in the shortest period from planting for an early crop. The ability to exploit earliness greatly depends upon the timely recognition of the final stages of plant development and boll maturity. Harvesting cotton as early as possible increases the likelihood of more ideal weather conditions and higher lint quality during the first part of the harvest season. It is important to apply harvest aids early enough to take advantage of the benefits of early harvest, while avoiding application so early that yield and quality of the cotton are decreased. Furthermore, if the last effective boll population and its degree of maturity are not recognized promptly, insect pests may be treated to protect fruit that contributes little or no value to the crop.

Historical Development

The COTMAN™ program was developed over the past 20 years with input and testing by many researchers, extension workers, consultants, farmers, and graduate students. The founding principles of COTMAN are based on concepts of cotton plant growth and development and insect control, which began forming in the early 1900s. During that time, scientists recognized the need to establish early maturity in cotton to avoid the ravishing effects of the boll weevil, a newly introduced pest. Predictable and sequential development of cotton fruiting was soon realized, and concepts of crop maturity in cotton began to emerge. COTMAN initially focused on following the order and development of the cotton plant fruiting and predicting when to terminate insecticide application based on recognizing cutout and the time in heat units (HU) thereafter needed to protect the last effective boll population from insect attack. However, the idea of using the same principles was soon adopted to establish when to safely defoliate the crop without forfeiting yield or quality.

Timing Defoliation

When harvest aids first were introduced, they were applied according to historical harvest dates. However, factors such as weather, heat unit accumulation, and variation in cotton cultivars made this technique largely undependable. Traditional timings of defoliation include percent open bolls at 60% to 65%, cut boll technique, nodes above cracked boll (NACB)=4 or less, and heat unit accumulation beyond cutout. COTMAN provides growers with a more reliable timing of defoliation based on the actual development of the fruit load that is to be harvested. The program provides a means of defoliating as early as possible, which increases the likelihood of more ideal weather conditions and higher lint quality during the harvest season.

Timing of harvest aids continues to be a difficult decision for producers. Producers and crop advisors often are tempted to wait as long as possible on young immature bolls in the top of the plant before making the decision to defoliate. These bolls are often insect damaged, small, and account for little additional gain—but the perception of additional lint yield is difficult to overcome. The validation of the heat unit concept of timing defoliation beyond the last effective boll population, as defined by COTMAN, allows producers to make this decision with greater confidence and often provides for an earlier harvest.

Defoliation Timing Using COTMAN Based on Heat Units Beyond Cutout

The defoliation timing guidelines in COTMAN are based on heat unit (DD60) accumulation beyond physiological cutout (NAWF=5) or seasonal cutout (last date from which 850 HU can be expected prior to desired harvest completion date). White flowers at cutout represent the *last effective boll population* or the youngest cohort of bolls that will contribute significantly to yield and profit. Defoliation can be timed by the maturity of the last effective boll population or from the date a field has reached cutout. To achieve maximum yield and revenue, 850 HU should be accumulated from the date of cutout before defoliation (application of first defoliation) is initiated. The use of cutout (NAWF=5 or seasonal cutout) + 850 HU as a prediction of when to defoliate has been based on numerous field research trials over the past 15 years. Although results varied slightly from year to year, it is generally accepted that 850 HU after cutout are required to ensure earliness and the protection of the yield and quality potential.

Examples of Research to Verify the Cutout + 850 Heat Units Rule

Texas: Results from ten defoliation timing studies from 1998–2005 along the Texas Upper Gulf Coast to validate the COTMAN defoliation timing concept based on NAWF=5 + 850 HU showed that yields generally plateau between NAWF=5 + 850 and NAWF=5 + 1050 HU (Fig. 1A). In these studies, the traditional timings of defoliation (percent open bolls, cut boll technique, and nodes above cracked boll) were approximately equivalent to NAWF=5 + 1050 HU – 8 to 10 days later than COTMAN defoliation timing. COTMAN assists producers in defoliating as early as possible, which increases the likelihood of more ideal weather conditions and higher lint quality during the harvest season.

Arkansas: Results of field tests in northeast, central, and southeast Arkansas from 2001 to 2002 (with defoliation timings scheduled on 750, 850, 950, and 1050 HU beyond cutout) showed that yield tended to increase numerically as defoliation was delayed. However, yields generally reached a plateau between 850 and 1050 HU (Fig. 2B). Loan values calculated from HVI values (value per acre was calculated by multiplying pounds of lint produced by the calculated loan value) were greatest at the 850 HU timing. Defoliation prior to 850 HU resulted in lower yields and loan values. Defoliation at 850 HU resulted in the numerically greatest returns per acre.

Defoliation to Enhance Fiber Quality and Lessen Loss of Yield

Of the fiber quality parameters, micronaire (coarseness of fiber) and grade (trash and color) are most affected by timing of defoliation and subsequent harvest. Depending on expected micronaire, defoliation should be either moved forward or delayed to obtain optimal (i.e., non-penalty) micronaire. Expected micronaire is dependent upon the genetic potential of the cultivar (high or low micronaire cottons), specific fruit retention (bolls in early positions tend to have higher micronaire), and environmental conditions (complex interactions involving night temperatures and boll development). Micronaire of a field can be predicted by early sampling (e.g., via the Lewis method).

Trash may be increased by poor defoliation and/or by regrowth (resumption of vegetative growth after defoliation). When lush plant growth is present (e.g., tall, rank cotton), a more aggressive defoliation program is required to obtain proper leaf shed. However, an aggressive program may "stick" leaves (i.e., leaves die but fail to drop because the abscission layer is not formed) when temperatures are warm. Dead leaves that adhere to the plant will substantially increase trash. Regrowth causes additional green leaf material to be present at harvest, and may cause staining of fiber and/or increase leaf content in ginned cotton. The potential for regrowth increases as time between defoliation and harvest increases (i.e., delayed harvest).

Delaying harvest also increases the probability that cotton fibers will deteriorate and increases the likelihood of storm damage. Repetitive wetting of fibers in open bolls causes fibers to deteriorate. Deterioration of fibers disrupts the protective primary wall of fibers and increases microbial growth on fibers. Subsequently, fibers become discolored (thus, reduced color grade) and weight of individual fibers decline (thus, reduced yield). Storm damage because of wind and/or rain may also reduce yield by causing seedcotton to be detached from the boll and

fall to the ground. Field management to lessen fiber deterioration and storm damage is primarily dependent on reducing the time between defoliation and harvest. COTMAN assists with reducing this time by aligning fields by their crop maturation date. Multiple fields may then be defoliated based on their relative maturity, picking capacity of the producer, and expected weather conditions.

Sampling

COTMAN is a very sensitive measure of plant growth and development and can be linked to all late-season growth changes. The measured growth is an integration of all environmental and management conditions, i.e. a composite picture of that integration. Therefore, the value of COTMAN depends on the investment in the exact reading of the plant from the start to the end. For the COTMAN program to work effectively, it is important to understand the whole crop growth pattern (*See* Chapter 3) and follow it closely with careful recordings of SQUAREMAN and BOLLMAN (*See* Chapter 5). In this way, cutout can be accurately determined and the timing of defoliation accurately predicted. It is not sufficient to merely take a few NAWF measurements close to cutout as this practice may produce a distorted estimate of the actual cutout date, which then may cause misapplication of COTMAN principles. It is imperative to have a sound sampling method for plant fruiting development (*See* Chapter 5) in order to get a true representation of the development of the boll load so as to be able to reliably determine the last effective boll cohort (physiological or seasonal cutout). The timing of defoliation can then be determined with confidence without any loss of yield or fiber quality.

Summary

Defoliation timing based on heat units beyond cutout is an effective and easy way of determining the most economical time to terminate the crop without suffering from yield loss or discountable fiber qualities. Research over the past 20 years has shown that 850 HU after cutout for timing defoliation allow the cotton crop to be terminated in a timely manner without yield loss. Validity of physiological cutout (NAWF=5) and time between flower and open boll (850 HU) has been confirmed on a wide range of cultivars and growing conditions. Some conditions may merit adjustment of these rules, yet they can always serve as a baseline for making specific defoliation and harvest decisions.

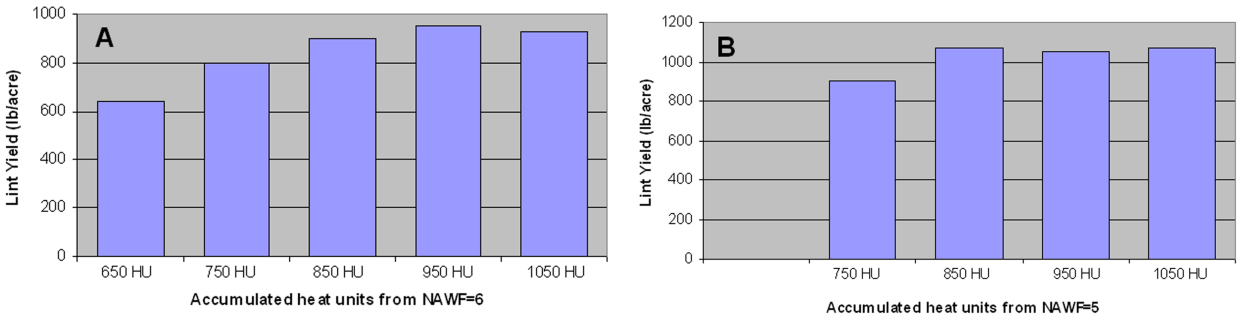

Fig. 1. Effect on lint yield from defoliation timing based on the number of heat units accumulated after cutout in (A) Texas and (B) Arkansas.