NODES ABOVE WHITE FLOWER: INDICATOR TO USE TO TERMINATE COTTON INSECT SCOUTING AND INSECT CONTROL

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Abstract

Field tests (1993 - 1996) were conducted in Southwest Oklahoma to determine the uppermost harvestable boll that contribute to yield and develop a termination procedure to accurately predict when to stop insect scouting and insect control in cotton. No cotton was harvested above 4NAWF. Following NAWF procedures based on cotton development measured as plant mainstem nodes above white flower and heat unit (HU) accumulation resulted in the early termination of cotton compared to basing decision on personal opinion. Approximately 1 to 2 insecticide applications can be saved following the NAWF procedure that are applied to protect bolls set above 4NAWF. Production practices and growing conditions will influence the uppermost harvestable boll. Monetary value of bolls indicates that 4NAWF bolls values does not justified the expense of insect control for protection against late-season insects. Termination of fields should occur once cotton reach 5NAWF for irrigated fields plus 350HU and 6NAWF for dryland fields plus 350HU.

Introduction

Termination of cotton scouting and insect control at the end of the production season is very important decision facing cotton producers and consultants annually. Protection of the harvestable crop is a goal that must be balanced between insect control, crop potential and impact on resistance insect problems. Late season insect damage can be avoided by managing for earliness (Isely 1957). An earlymaturing crop enhances net profits by reducing the need for late-season insecticide applications to protect the "top crop". Currently there is no guideline or procedure for determining which of the uppermost bolls contribute to yield and are worth protecting. Plant mapping focuses on the development and retention of the first position bolls produced on the first 10 fruiting branches. The degree and type of shed at these key fruiting positions affect management decisions such as use of plant growth regulators, insect management, irrigation, fertilization, termination of scouting and insecticidal control, timing harvest-aid applications, and yield predictions. This discussion will highlight how to accurately predict the uppermost boll that will contribute to the crop=s yield by monitoring the flower-to-node ratio.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1326-1329 (1998)
National Cotton Council, Memphis TN

The number of terminal nodes above the uppermost white flower (NAWF) can give a quick reference to the stress status or the plant's vegetative potential relative to fruit load. As a plant's fruit load increases relative to its capacity to mature the set fruit, development of new nodes in the terminal slows, then ceases. Consequently, first position white flowers occur progressively closer to the plant's apex until the plant blooms at the top. A plant in a well-managed field will initiate fruiting with 7 to 10 NAWF.

Crop status can be measured during the flower and boll period using the NAWF procedure (Borland et al. 1992). The nodal position of the highest white flower on the main axis relative to the plant apex between fruit set and rate of plant terminal growth. By using NAWF + accumulated heat units (HU), termination decisions can be made based on the last boll population that will contribute to yield. Arkansas researchers have reported that the harvestable portion of the crop is generally safe from bollworms and boll weevils at 5 NAWF + 350 HU (Bernhardt et al. 1996, Bagwell and Tugwell 1992). Further field validation in Louisiana (D.K. Torrey et al. 1996) and South Texas (Bennett et al. 1997) confirmed that stopping insecticidal protection when cotton reached 5 NAWF + 350 HU did not impact yields. However confinement studies conducted in Texas emphasized the need to scout the field and determine the level of infestation before terminating it. Their data suggests third- and fourth-instar bollworm larvae are capable of injuring 350 HU to 600 HU bolls. Termination based strictly by the number of HU accumulated could lead to significant yield loss if third-instar or larger larvae are present at damaging levels.

Results and Dicussions

Crop termination studies based on NAWF in Oklahoma between 1993 and 1996 confirmed the previous findings. Hand harvesting bolls by position on the plant revealed no lint was produced above the 4 NAWF. No insect damage was noticed on any of the uppermost harvestable bolls when insect scouting and insect control was stopped using 4 NAWF plus 350 HU. The uppermost population of bolls that contributed to yield varied annually depending on production scheme, growing conditions, and HU accumulated (Table 2).

Yearly heat unit total ranged from 2,403 HU in 1996 to 2,711 HU in 1994. Sufficient heat units accumulated each year to produce an average crop. Irrigation allows plants a chance to mature bolls higher up the plant (5 NAWF) than dryland cotton (7 NAWF). To help explain the importance of boll location to yield, a money plant was developed (Figure 1 and Figure 2).

The dollar value from each position was computed and values posted as it contributed to yield. First and second position sites accounted for over 75% of the total crop. Variety and production practices influenced the importance of each position to overall yield. First position bolls accounted for over 87% of the monetary returns in irrigated cotton versus slightly over 50% for dryland cotton. The uppermost bolls regardless of variety or management scheme had limited impact to overall crop value. Maintaining a insect control program to mature these bolls is expensive. Protecting bolls from insects (for 3 weeks) until sufficient heat units (350 HU) accumulated for uppermost bolls to resist insect costs between $ 15.00 and $ 32.00/acre depending on the insect pest and infestation level. Significant losses would results due to decreasing value if 5 NAWF or 4 NAWF position bolls required protection during the entire maturity period. These uppermost bolls have greater importance in dryland cotton than irrigated fields. These figures suggest stopping spray programs earlier one to two positions below 5 NAWF.

Prior to categorizing cotton growth and development by heat unit accumulations, producers relied on cutting bolls to determine the level of boll maturity. Producers randomly selected bolls in the terminal area of plants to slice. Fields were determined to be insect safe when most of the uppermost bolls resisted cutting.

Field tests were initiated to determine if keeping track of NAWF related to HU accumulations could increase the accuracy of terminating insect scouting and insecticidal control without sacrificing yields. Boll position related to the uppermost white flower is the key to predicting when insect protection and scouting can cease. In all years, the NAWF method accurately predicted when to terminate scouting and insect control. In fact the NAWF method prevented 1 or 2 late-season applications compared to basing termination decisions on the boll cutting method. Besides reducing insecticide inputs and environmental risk, precise termination also saved labor by earlier termination of scouting. The main discrepancy between the two methods is the value and position of the last, harvestable boll that will contribute to yield. Before plant mapping, the Extension Service suggested that bolls set on or before September 1 had sufficient time to mature and contribute to the yield. This view is still correct if the bolls in question are 4 or 5 NAWF position bolls. However many producers and consultants continue to protect the top crop consisting of 2 and 3 NAWF position bolls until they are 20 days old, if they were set on or before September 1.

Predicting Crop Termination Using NAWF

There are several steps or information required to insure the NAWF method will accurately predict the termination of insect scouting and insect control. Failure to incorporate all these steps will reduce the accuracy of this technique to predict boll maturity increasing the chance of late-season insect damage. These steps include:

1. Record individual fields= planting dates
2. Keeping track of daily heat unit accumulations throughout the season
3. Begin monitoring NAWF when heat units exceed 1,600
4. Follow proper plant selection or sampling guidelines
5. Record NAWF data weekly

1. Planting Date

Planting date of each field is the first thing cotton producers and consultants must record if they are interested in testing the NAWF method. Without the actual planting date or week planted you cannot accurately categorize plant development with HU accumulated throughout the summer.

2. Heat Units

Keeping track of HU can be accomplished by several different means:

1. Manually by using this formula: heat units =(daily high temperature + daily low temperature) ÷ 2 - 60° F,
2. Subscribing to the Oklahoma Mesonet - a unique, statewide environmental monitoring network, or by
3. Periodically contacting your county or area extension office.

3. Begin Monitoring NAWF

Irrigated cotton planted in 1993, 1994, and 1996 approached 5 NAWF when HU exceeded 1,600 (Figure 3). At this point begin monitoring NAWF by plant mapping select plants.

4. Plant Selection

At this point begin sampling plants at random. Sample at least 10 plants per field. If there is a lot of variability in stand age, plant vigor or development, increase the number sampled to 20 or 30 plants per field. Before mapping the selected plant, check to see if the uppermost white flower is located at the first position on the fruiting branch, if not disregard and select another plant.

5. Record NAWF Weekly

Proceed if the uppermost white flower is located at the first position. This flower is the reference point to count the number of nodes above it. Record the number of nodes above it and the first fully expanded quarter-size leaf in the terminal area (Figure 4).If the field average is above the targeted NAWF, repeat the procedure in 3-to-5 days. However if the field average equals the targeted NAWF, this field will be insect safe after an additional 350 HU have accumulated from this date. Bolls set after this growth stage may be damaged but will not contribute significantly to yield.

Conclusions

Consultants and producers scouting cotton should continue to monitor insect populations and protect plants until 350

HU have accumulated for the last boll cohort projected to contribute significantly to yield.

Results of this study indicates the uppermost cohort of bolls that contributes to yield for irrigated cotton is 5 NAWF. Irrigated cotton properly management will approach 5 NAWF approximately 1700 HU after plants emerge. Oklahoma growing conditions during the test period prevent the maturation of bolls above 4 NAWF regardless of the HU accumulated.

Dryland cotton yields during this study indicated the uppermost boll that contributes to yield is 2 to 3 nodes below the 4 NAWF. Retention of higher 4 and 5 NAWF bolls will depend on available moisture and growing conditions each year. The upper position bolls contribute more to the overall value of the dryland crop than in irrigated cotton. Under the growing conditions experienced in 1995 and 1996 stopping dryland cotton scouting and insect control once 6 NAWF bolls are mature enough to resist attack (350HU later) should protect most of the uppermost bolls which contribute to yield. Besides insect pressure, growing conditions, HU accumulations, and soil moisture are factors that influence the uppermost boll that contributes to yield. Under ideal growing conditions dryland cotton is capable of maturing 5 NAWF and 4 NAWF bolls. Termination decisions must be tailored made to fit individual field's needs to prevent significant late-season yield loss due to premature stoppage.

Literature Cited

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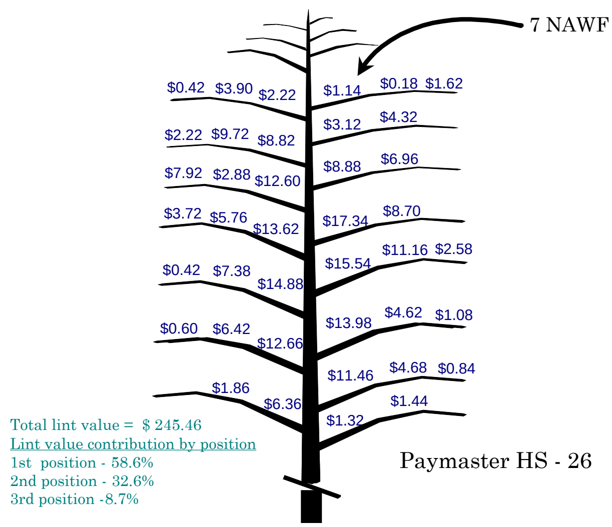
Table 1. Heat unit accumulations for individual growing seasons 1993 to 1996.

Year	Planting Date	Harvest Aid	Heat Units Accumulated: Yearly Total	Heat Units Accumulated: 40-year Avg	Lint lbs/acre	Top NAWF Boll Harvested
Dryland						
1995	5/11	10/10	2,592	2,768	556	7
1996	5/15	9/24	2,678	2,624	299	7
Irrigated						
1993	5/15	10/11	2,569	2,569	845	5
1994	5/16	9/15	2,711	2,479	1,080	4
1996	5/16	10/9	2,649	2,768	675	4



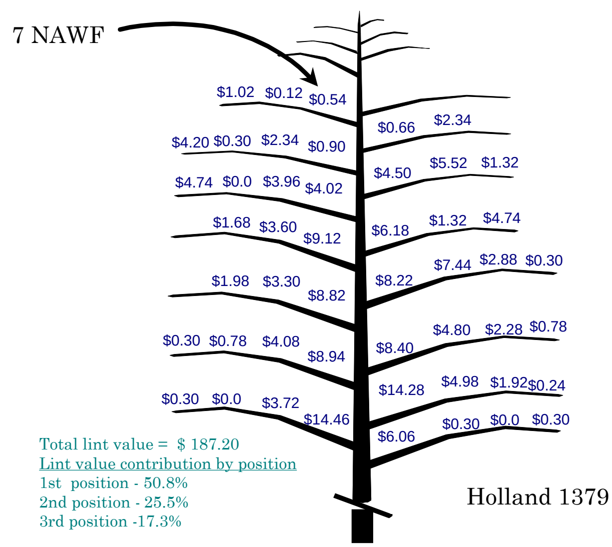


Figure 1. Monetary breakdown of lint production by boll position, dryland production, 1995 and 1996.

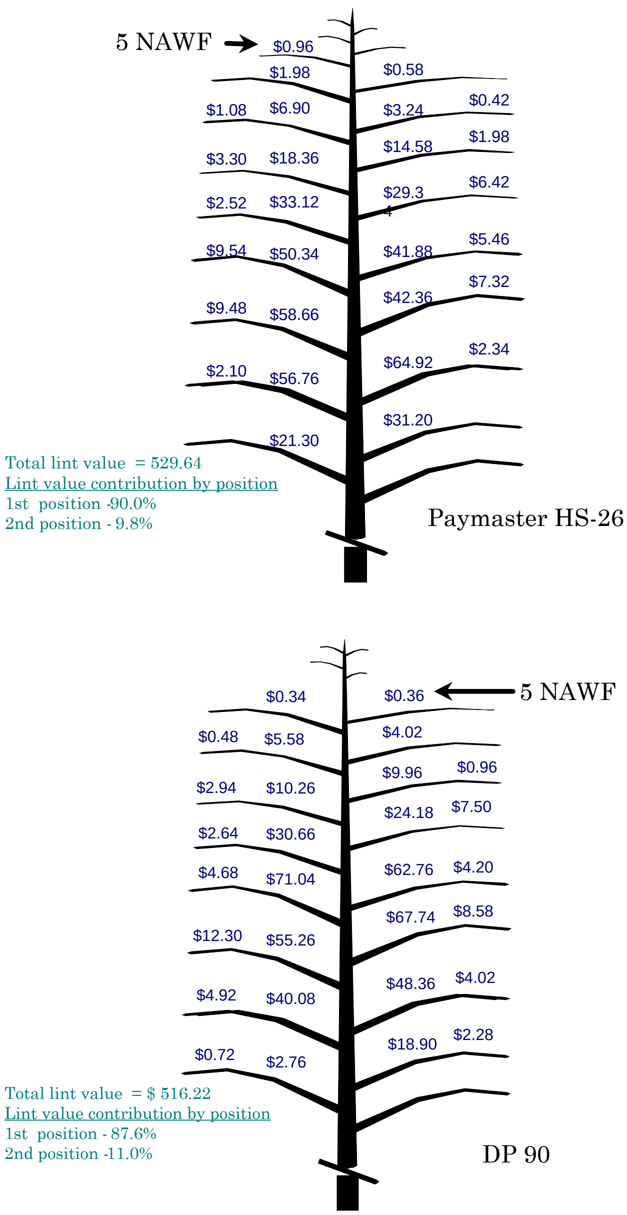


Figure 2. Monetary breakdown of lint production by boll position, irrigated production, 1993, 1994 and 1996.

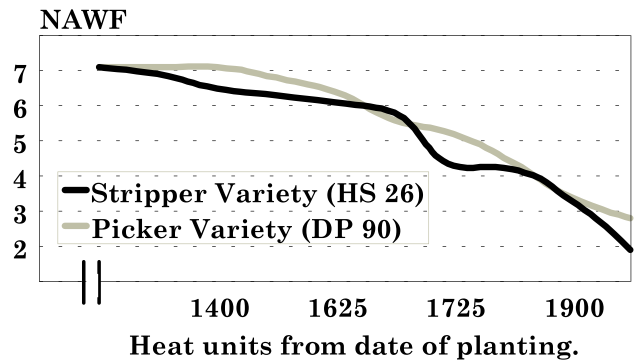


Figure 3. NAWF development related to heat units accumulated during the growing season, 1993, 1994, & 1996.

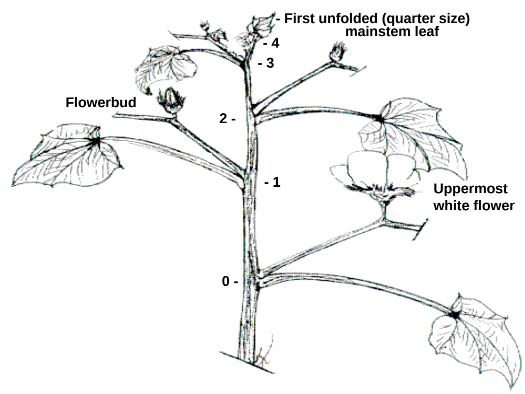


Figure 4. Uppermost part of the cotton plant.