Cotton Monitoring For In-Season Management Decisions

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The unique and predictable growing and fruiting pattern of cotton, combined with a knowledge of how the plant grows, allows us to develop in-season management inputs based on how the cotton plant is developing at any time during the season. The level of cotton management is not constant throughout the season, but there are specific stages in development that require more intense examination, and correct decisions made at these stages will determine potential, capacity, production and finally yield of the cotton crop.

Plant mapping has been practiced by researchers for many years, but through efforts of the National Cotton Council Cotton Physiology Education Program, it has developed as a tool that can be used by producers to monitor plant development throughout the season. The previous chapter addressed how a cotton plant grows. This chapter will use some of these growth concepts at key times during the season. Critical evaluation periods that can be developed into management tools are : 1. Early plant vigor; 2. Time of first pin-head square formation; 3. First bloom and Nodes above white flower; 4. Mid season fruiting development and retention; and 5. Nodes above cracked boll. Each of these stages and evaluations will be discussed in this chapter.

Early Plant Vigor

Early season plant vigor is reflected in the relative spacing of nodes on the plant. As discussed in the previous, a node develops approximately each 45-55 heat units (DD-60's). This approximation is accurate enough in early season to approximate the age of an emerged plant by counting nodes. Plant height, or spacing between nodes, is a measure of how rapidly the plant is growing. Nodes measure plant age and height is a measure of plant vigor. Within reason, node development is insensitive to environmental stress and accurately measures plant age. The section of stem between each node (internode) is insensitive to plant age, and very sensitive to environmental conditions. This makes internode length a reliable indicator of plant growth and vigor. By evaluating the node-internode relationship, the amount of stress, and the approximate time period of stress can be determined. In order to utilize this information, a method of assigning numbers to this relationship is needed. This number is called the height/node ratio. It is actually the average internode length and can be determined by dividing the height of the plant in inches by the number of nodes. When the developing plant is stressed by cool soil conditions, seedling disease, drought, compaction, nematodes, or wind and sand damage, the height/node ratio will be low. The reason for stress should be isolated and control measures should be taken if possible. Many times a low height/node ratio can alert producers to annually occurring problems that can be resolved in following years. Water conservation measures in land preparation and early cultivation, prevention of compacted soil layers, or cultural systems utilizing residue from a previous or interseeded crop may help increase the height/node ratio. Plant height is measured from the plant's cotyledon leaves (or scars) to the top of the plant. Cotyledon leaves are the leaves that appear at emergence of the plant. They are the only leaves on the stem that are exactly opposite each other. Later, cotyledon leaves will likely fall from the plant, but the node scars opposite each other can easily be located. The number of main stem nodes is also measured from the cotyledon nodes or scars. These nodes are counted as zero, and nodes on the main stem are counted up the plant. As a node develops on the plant, it is always

accompanied by a main stem leaf. This main stem leaf remains attached to the stem, while a vegetative or fruiting branch develops immediately next to the leaf stem. When counting, as the top of the plant is approached, nodes will become less obvious due to their close spacing, but main stem leaves will be obvious. As the count progresses, a main stem leaf will indicate the presence of a node, and will be used to count nodes. If the developing leaf in the active growth area in the terminal of the plant is larger than a quarter (approximately 1 inch) it is counted as a node. As a general rule, height/node ratio prior to early bloom should be in the 1 to 1.5 range. As an example, a plant with 12 nodes should be 12 to 18 inches tall. Yield potential will be limited if the ratio is less than 1. Many times, weather and environmental conditions make this beyond control of the producer, but there are many factors over which the producers does have control. After mid bloom, the height/node ratio will start decreasing due to increasing fruit load stresses placed on the plant. This is normal and expected. If this ratio remains high, or increases, after mid bloom, this indicates the plant is experiencing excessive vegetative growth due to lack of fruit set or excessive nitrogen fertilization. This cotton will normally benefit from an application of plant growth regulator such as Pix.

First Square

Time and location of the first pinhead square is a critical measurement in cotton production. The first square should be found at approximately 450 heat units or at 30 to 35 days after planting. Microscopic square initiation can occur as early as expansion of the second true leaf, or 9 to 12 days prior to observance of the pin head square with the naked eye. Pin head squares normally form on the fifth or sixth node and approximately 21 to 25 days prior to bloom. Understanding this concept becomes very important as heavy insect pressure (thrips) is evident in the young cotton. Location of first square sets the framework for fruiting. All branches above the first square location are classified as fruiting branches. It is extremely rare if vegetative branches are present above the first fruiting branch. It is important to set and hold this first square. If the square is shed, cotton plants can become more vegetative leading to later problems in fruit retention. The first squares formed on the plant are extremely susceptible to loss from damage by insects such as thrips or fleahoppers. The cotton plant will rarely shed the first squares due to environmental stresses. If first squares are missing, look for insect damage as the culprit. All Oklahoma cotton fields should be treated for insects at early squaring.

First Bloom and Nodes Above White Flower (NAWF)
First bloom should follow 21 to 25 days after first square formation. Evaluation at this time should provide one of the most accurate mid season predictors of yield. The cotton plant needs to be growing rapidly at first bloom. Vigorous cotton plants have more momentum or “horsepower” to take the plant further into the fruiting cycle before cutout. A method to measure this horsepower is Nodes Above White Flower (NAWF). NAWF is measured on the same principle that early season nodes are, but NAWF count starts at the node with a first position white flower. A first position white flower is the flower on the first fruiting position closest to the main stem. This node is counted as 0 and nodes are counted to the top of the plant with the last node as the terminal main stem leaf as large or larger than a quarter.

Nodes above white flower measurement is a accurate measure of the status of the balance between vegetative and reproductive (fruiting) growth. As the plant starts flowering, measurement of the height/node ratio becomes less important, and nodes above white flower measurement becomes more important as a plant monitoring tool. As the plant develops, flowering will slowly (hopefully) advance toward the plant terminal. The speed of the advance varies, but should be approximately one NAWF per week. As flowering progresses up the plant, terminal growth will also progress, but at a slower rate. Cutout is defined as the point at which fruiting growth will overpower vegetative growth, and this occurs when NAWF reaches 5. The objective of insuring good yields is to keep the plant in a fruiting mode to slow the advance of the flower toward the terminal of the plant. At early bloom, NAWF on most full season picker varieties should range between 8 and 12 and on short season stripper varieties, should equal

7 to 10 nodes. As boll loading progresses, NAWF declines. Rate of decline is important, and plotting NAWF is a valuable management tool. A rapid decline in NAWF indicates the plant is experiencing severe stress. If NAWF was high at first bloom, this decline could be due to boll loading and high demand for nutrients and water. When NAWF does not decline after first bloom, or it increases, the boll load is not developing sufficiently to hold the plant back. This should be an area for concern, and immediate action. Boll loss could have been from lack of adequate moisture, cloudy days, lack of enough heat units, or insect damage. When hot days return and insects are controlled, application of a plant growth regulator will probably be needed to bring the plant back into a fruiting mode. It is important that the subtending leaf (the leaf next to a developing square) receive sunlight to nourish the newly developing fruit. If top growth is rapid enough to shade the subtending leaf on newly developing fruit, they will likely be shed. The plant will then respond with even more active growth due to a lack of fruit. This will only increase shading and fruit loss. This situation is called self perpetuating fruit shed. Only drought stress or a higher than normal application rate of Pix will stop this pattern, and at best, the crop will be delayed, with yield determined by late season conditions and management.