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GROWTH AND FRUITING OF COTTON RELATIVE TO COTMAN

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Abstract

The Cotton Management program (COTMAN) is a crop monitoring system which records changes in the fruiting dynamics of the plant as well as certain plant growth parameters, and is aimed at characterizing plant development. The central aspect of the COTMAN program is the recording and interpreting of the growth and development patterns compared to a standard target curve. Understanding this development pattern and identifying differences from normal allow detection of stress and poor management, allowing time to remedy the situation. COTMAN has two major components, SQUARE MAN and BOLLMAN. The first component, SQUAREMAN follows the pace of squaring node development, and also includes square shedding and plant growth measurements in the reports that help identify stress and suggest solutions. BOLLMAN follows the squaring nodes (nodes-above white flower) after flowering and is aimed at improving end-of-season decisions related to insecticide termination, defoliation and harvest date. Overall, research on COTMAN and field testing over the past fifteen years has shown that COTMAN is a sensitive and reliable crop monitoring program, which when used properly with suitable attention to the fundamentals of the program, can improve crop management efficiency and reduce input costs.

Plant Monitoring: The Foundation of the COTMAN Program

Recording and interpreting the growth and development patterns of the cotton plant is the *foundation* for the COTMAN crop monitoring program (Danforth and O'Leary, 1998). In non-stressed conditions, the first square should appear about 35 days after planting. A new main-stem node will be added about every 2.7 days until first flower at about 60 days after planting (Figure 1). After first flower, production of new main-stem nodes slows so that nodes about white flower equals five at about 80 days after planting.

Crop Growth and the Target Development Curve

The COTMAN "Target Development Curve" shows crop growth status compared to a standard curve (Figure 2) based on cotton growth and development (Oosterhuis et al., 1996). Research has shown that whole canopy crop photosynthesis follows this target curve closely (Figure 3).

Plotting crop growth and interpretation of the growth curves relative to the target development curve can help with early identification of stress (Bourland et al., 1997). In a field study, Teague et al. (1999) showed using COTMAN that water-stressed plants ceased effective flowering before plants developed adequate structure for optimum yield.

Cutout: A Critical Date in COTMAN

Cutout is based on identification of the *Last Effective Boll Population*, i.e., the latest-developing bolls that will contribute to yield (Oosterhuis et al., 1999).

Physiological Cutout occurs on date that Nodes Above White Flower (NAWF) = 5. After NAWF=5, boll retention dramatically decreases and the number of flowers required to make a pound of seedcotton increases greatly (Figure 5) (Bourland et al., 1992).

Seasonal Cutout occurs when physiological development is limited by late-season weather restrictions (Zhang et al., 1994). Analysis of historical weather identifies location-specific dates when probability is low that bolls set higher on the plant will have sufficient heat units to mature (Figure 6).

End of season management uses the physiological or seasonal cutout date to start counting heat units (D60's). At 350 heat units, the crop is safe from fruit-feeding insects. At 850 heat units it is safe to defoliate.

Questions and Answers

Does critical NAWF vary with environment, i.e. longer growing season? NAWF is a plant-based measurement that reflects the carrying capacity of the plant as determined by plant structure, health, fruit retention, nutrition and growing conditions. NAWF=as signal of physiological cutout has been validated in multiple, contrasting environments. The only time that NAWF<5 becomes a better signal of cutout is when cotton has experienced severe plant stress.

Does critical NAWF vary with pest situation, i.e. is it different for Bt cotton and in boll weevil eradication zones? Improved fruit retention associated with less pest pressure does not affect critical NAWF, but may cause cutout occur earlier. Prior to boll weevil eradication and Bt cotton, NAWF=5 was validated in areas with no boll weevils and with minor bollworm/budworm infestations.

Should physiological cutout coincide with seasonal cutout to obtain maximum yields, i.e. is yield lost if plants cutout prior to seasonal cutout date? This approach may pay off occasionally, but the risks of disaster associated with late-season weather are always increased with delayed production. Certainly, if all fields were pushed to the latest possible cutout date, then harvest could not be completed by the target date. Numerous studies have proven that cotton plants have enough fruiting sites to make ample yield in a short-season approach.

Has the importance of short-season cotton production been lessened by improved production techniques and equipment, i.e. is early maturity still necessary for maximum returns? Short-season concepts of producing cotton have appeared and disappeared in regular intervals over the past century. Each time, the return to using short-season concepts to grow cotton has provided increased yields with lower production costs.

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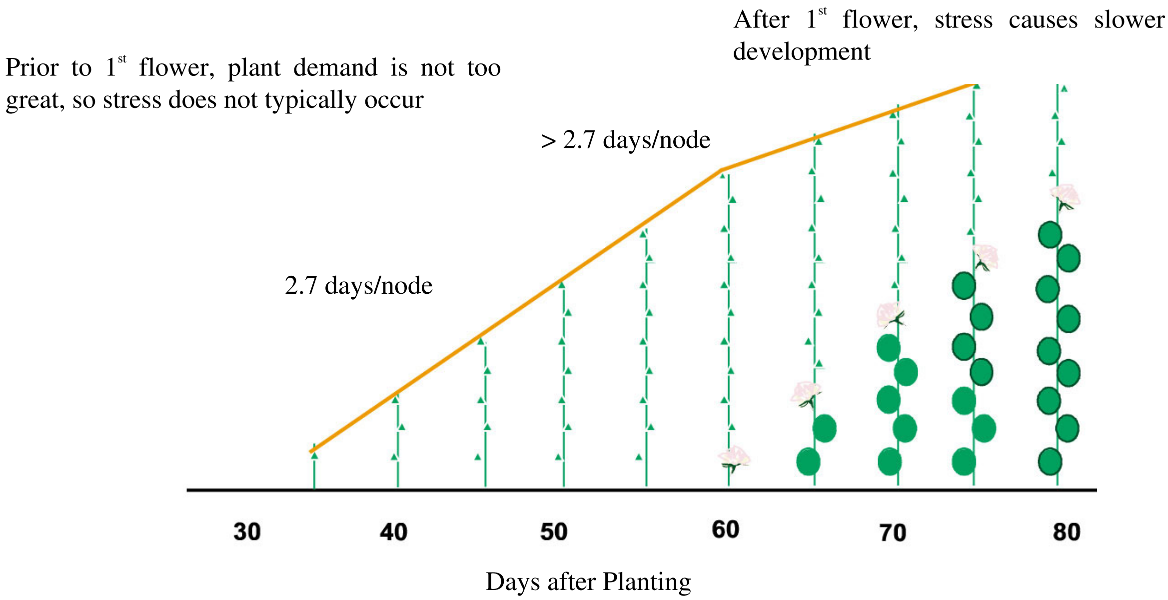

Figure 1. The pace of crop development with days after planting is shown by the development of squaring nodes on the main-stem up to flowering, and then by squaring nodes above the developing boll load after flowering.

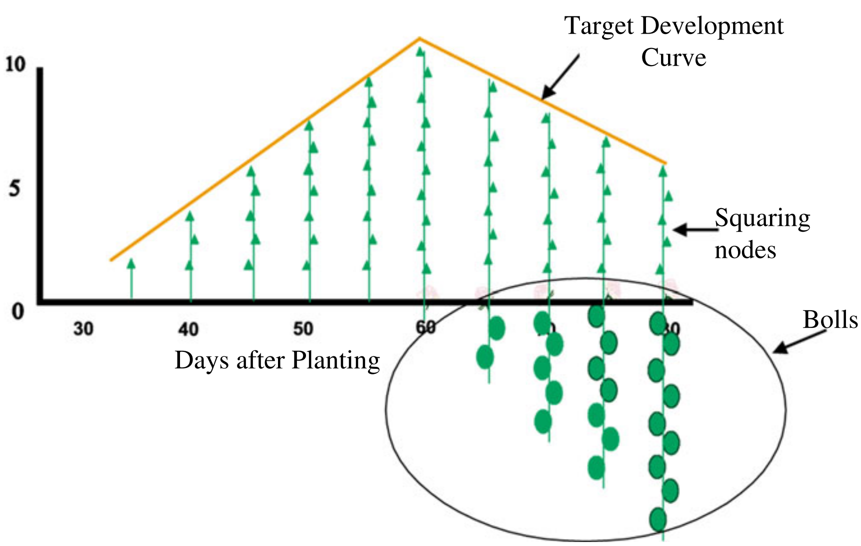

Figure 2. The "Target Development Curve" showing the standard pace of squaring node and boll development.

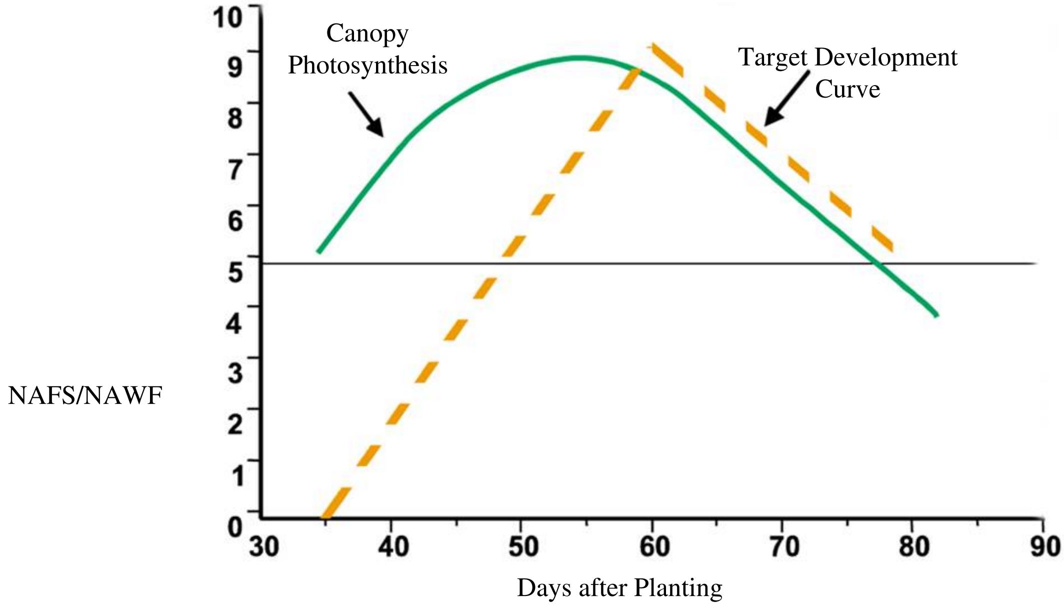

Figure 3. The COTMAN "Target Development Curve" shows crop growth status compared to a standard curve based on cotton growth and development. Whole canopy crop photosynthesis follows this target curve closely.

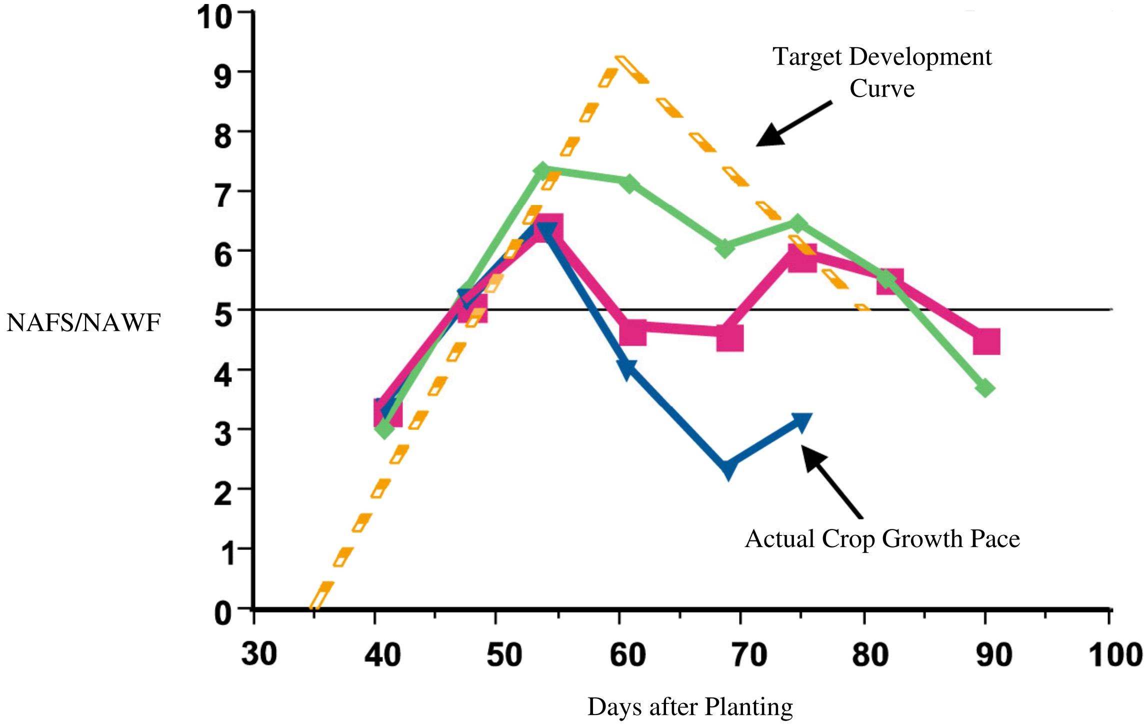

Figure 4. Plotting crop growth curves relative to the target development curve can help with early identification of stress. Various irrigation treatments are shown and these can be compared with the Target Development Curve to interpret when the treatment is experiencing stress, and allowing for timely management to counteract the stress. The lower blue curve showed that these water-stressed plants ceased effective flowering before plants developed adequate structure for optimum yield (From Teague et al., 1999).

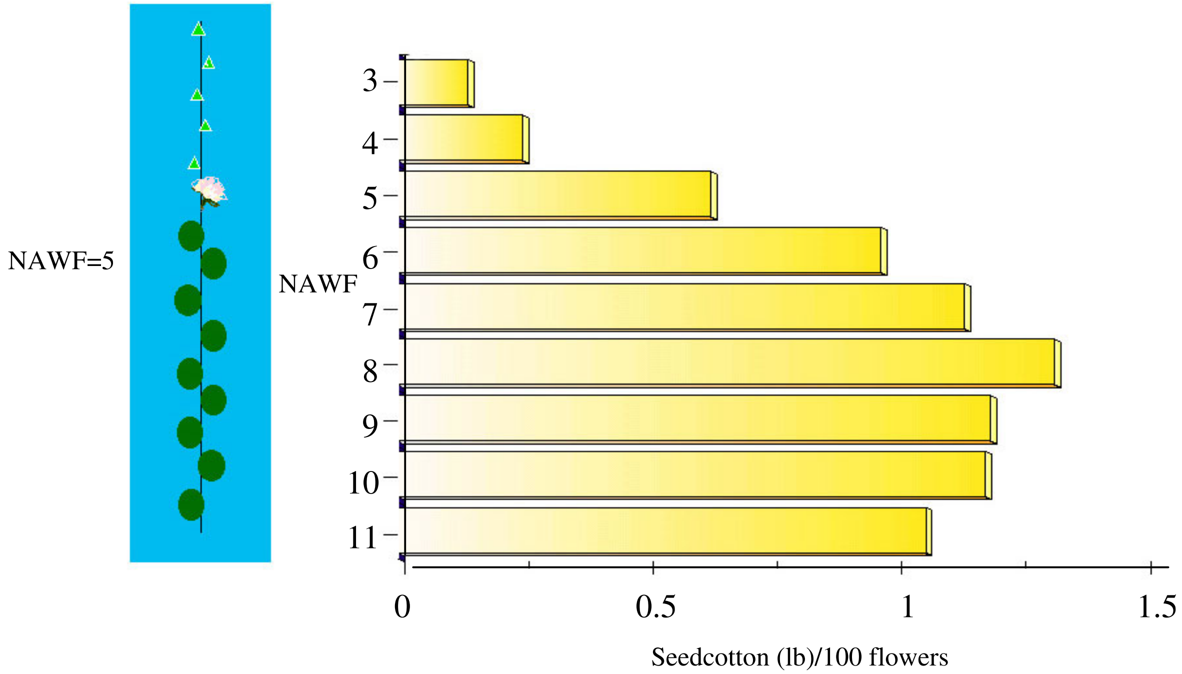

Figure 5. Physiological cutout occurs when the number of Nodes Above White Flower (NAWF) = 5. After NAWF=5, boll retention dramatically decreases and the number of flowers required to make a pound of seedcotton increases greatly.

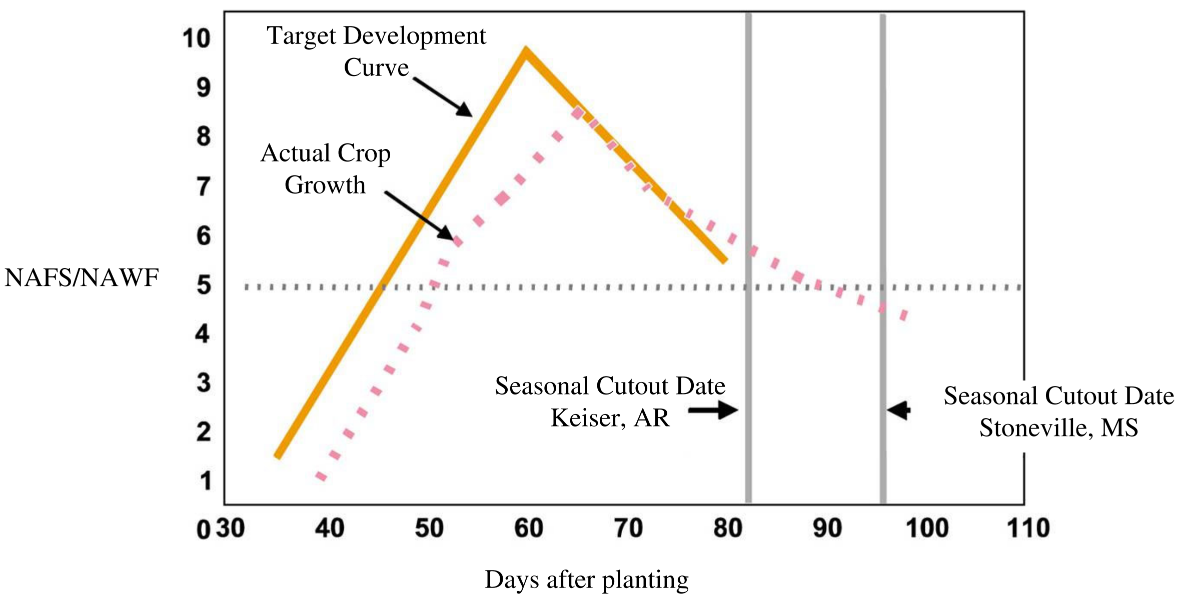

Figure 6. A hypothetical crop growth curve compared to the Target Development Curve. In the above example crop growth would result in "seasonal cutout" at Keiser, but "physiological cutout" in the more southerly Stoneville location.