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# USE OF COTMAN IN INSECT MANAGEMENT RESEARCH

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## Abstract

COTMAN was used in insect management research projects as another means to measure the effects of differing planting dates, irrigation, row spacing, and tillage systems on cotton growth and development. Differences in plant growth and development can have a profound effect on the development of insect infestations. Planting date, row spacing and tillage practices had a significant effect on both early crop development and physiological cutout. The irrigation methods evaluated had little effect on plant development. Boll damage assessment based on heat unit-delineated maturity provided a boll safe cutoff value of 350 HU for the western tarnished plant bug (*Lygus hesperus* Knight), similar to that found for the tarnished plant bug in the Southeast. COTMAN was found to be a useful tool in evaluating the impact of various crop management practices on plant development and end-of-season management decisions. This information can be related to the development of insect infestations.

## Introduction

COTMAN is an expert system developed by the University of Arkansas to monitor cotton plant development using plant mapping information. COTMAN was designed to be a computer-aided management system, which integrates expert system, database and computer graphics technologies (Zhang et al. 1994). Since 1994 COTMAN has been providing data to producers and researchers alike. COTMAN provides an excellent graphical representation of cotton growth and development as well as end-of-season crop status as it pertains to insecticide termination and application timing of harvest aids. Most of the research studies conducted thus far have been to validate COTMAN in production systems in other states, to refine the decision-making rules, and to add new management components. The insect research studies briefly discussed here utilized COTMAN as another tool to describe changes in cotton growth and development resulting from various crop management practices, which could have an influence on the deployment of insect infestations.

## Materials and Methods

These studies were conducted in 2003 at three sites across the Texas High Plains using the cultivar, Paymaster 2326RR. A timely (May 7, within the optimal planting window) and a late planting date (June 11, insurance planting cutoff date) were compared at the Texas Agricultural Experiment Station farm near Halfway. Two row spacings (15 inches and 30 inches) were also compared in a test at the Halfway site with a May 7 planting date. Conventional tillage (clean till) was compared to conservation tillage (planting into terminated wheat) plots at the AG-CARES farm near Lamesa. Low Energy Precision Application (LEPA) irrigation and Low Elevation Spray Application (LESA) irrigation were compared at the Western Peanut Growers Farm near Denver City at the 75% evapotransporation (ET) target replenishment rate.

Standard COTMAN sampling and data analysis procedures were followed (Cochran et al. 1998) in all studies which included plant density, plant height-to-node ratios, square retention, Nodes Above White Flower (NAWF) and heat unit calculations. Insects were monitored as well but this data will not be presented in this paper. Cutout was determined at NAWF=5, with heat unit calculations initiated at this time. Data are presented as growth curves and compared to the Target Development Curve (TDC). The growth curves include squaring nodes, the apogee at first flower, followed by NAWF.

A damage assessment study was conducted at the Texas Agricultural Experiment Station at Lubbock, using Paymaster 2379RR and evaluating damage caused by the western tarnished plant bug (*Lygus hesperus* Knight) to cotton bolls at heat unit accumulations of 150, 250, 350, 450, and 550. Adult unsexed plant bugs were collected from alfalfa with one adult caged inside each 5” X 6” mesh bag that was fixed around the boll and left for 48 hours. The caging was replicated on 20 bolls per treatment. Heat units were calculated from the time blooms were caged. Bolls were removed at the conclusion of the 48-hour period, and brought into the lab to be evaluated. Outer and inner carpel wall damage and damage observed to seed and lint were recorded.

## Results and Discussion

COTMAN-generated information was able to provide additional insights into plant growth and crop development, which would prove useful in relating changes in crop management practices to changes in insect infestation levels. A comparison of growth curves to the Target Development Curve (TDC) in the planting date study indicated there was pre-bloom stress associated with the timely planting (Figs. 1, 2). This was graphically represented by the right shift of the growth curve and lower apogee at first flower. This delay in crop development and reduction in yield potential was shown to be due to early moisture limitations during a period of increasing fruit load and demand. The late planting delayed fruiting until moisture conditions had improved. Late planting did result in a late cutout, into the period where seasonal rules would have to be followed (due to reduced heat unit availability) for harvest management decisions. This would have decreased actual yield but also made late season insect management more important for protecting late maturing bolls.

COTMAN analysis indicted that cotton grown under the LESA irrigation system encountered early stress as indicated by the flattening of the growth curve prior to first flower (Fig. 3). This was not the case with cotton grown under LEPA irrigation (Fig. 4). A lower apogee for the LESA irrigation treatment indicated lowered yield potential compared to the LEPA irrigation treatment. These differences may be indicative of higher evaporative losses in the LESA system versus the LEPA system resulting in some moisture limitation. While LESA irrigation may provide a better survival environment for insects because of a higher field humidity, LEPA irrigated plants would have more fruit and might be more attractive to insects as well.

There was little difference between growth curves in the row spacing treatments although the 15-inch spacing did speed up cutout, which occurred before seasonal cutout rules would need to be applied (Figs. 5, 6). This represented a faster maturing crop, which would have been vulnerable to late season insect attack for less time than the 30-inch row spacing treatment. Tillage practices had a subtler effect on growth curves with the terminated wheat or conservation tillage system providing a faster start and an earlier cutout (Figs. 7, 8). This faster start may aid in reducing the impact of early thrips infestations.

COTMAN analysis also provided information relevant to late season insect management and harvest management (Table 1). Late planting resulted in a 22 day longer vulnerability period for boll-feeding insects and delayed cutout resulting in insufficient time to accumulate enough heat units for full crop maturity before a plant-killing freeze. The narrow row 15-inch row spacing treatment resulted in an earlier cutout providing a reprieve from the late planting date. The more conventional 30-inch row spacing treatment did not have sufficient time to accumulate the heat units needed for full maturity. Narrow row spacing increases earliness by spreading the yield among more plants that are competing for the same resources resulting in smaller plants that go into cutout sooner. Irrigation methods of LEPA and LESA had no significant impact on heat unit accumulations of 350 or 850. The different tillage systems affected the time of cutout and the abundance of heat units accumulated. However, the terminated wheat in the conservation tillage system did offer early wind protection resulting in a quicker start and finish compared to the conventional tillage system.

The western tarnished plant bug boll damage study revealed that bolls are relatively safe once 350 HU are accumulated past white flower (Fig. 9). This was similar to that observed in earlier studies in the Southeast with the tarnished plant bug. However, bolls continue to exhibit a high level of external boll damage until 450 HU. The lack of correspondence between external and internal damage symptoms means that insect scouts will need to dissect bolls for management decisions.

## Acknowledgements

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Table 1. Comparison of heat unit accumulations for insect-safe bolls and crop maturity between several management scenarios.

| Management Scenarios | | Date of Cutout (NAWF = 5) | Days to 350 HU | Days to 850 HU |
|---|---|---|---|---|
| Timely Planted | May 7 | 7/29 | 18 | 64 |
| Late Planted | June 11 | 8/27 | 40 | ✞ |
| Row Spacing | 15” | 8/1 | 18 | 74 |
| | 30” | 8/10 | 24 | ✞ |
| Irrigation Method | LEPA | 8/13 | 21 | 51 |
| | LESA | 8/15 | 21 | 54 |
| Tillage System | Conservation | 7/27 | 16 | 46 |
| | Conventional | 8/7 | 17 | 60 |

✞ = Unable to reach 850 HU before first freeze

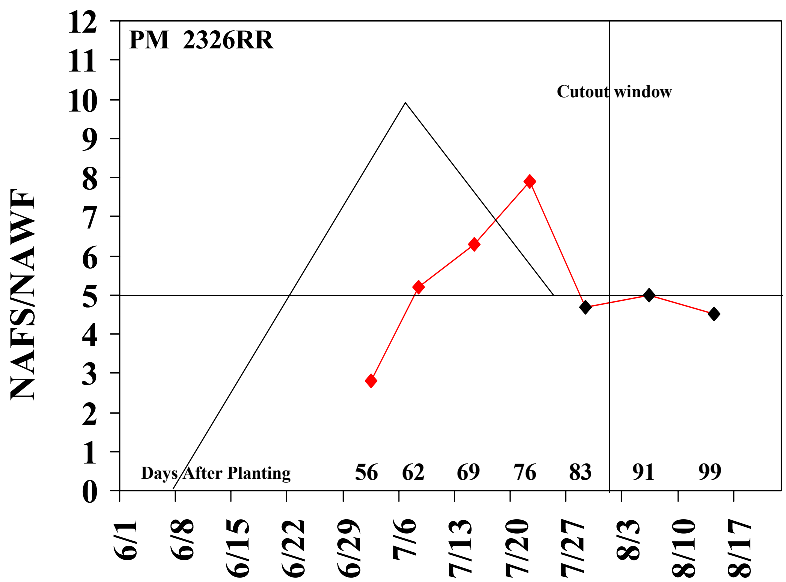


Figure 1. COTMAN growth curve for timely planted cotton. Halfway, TX

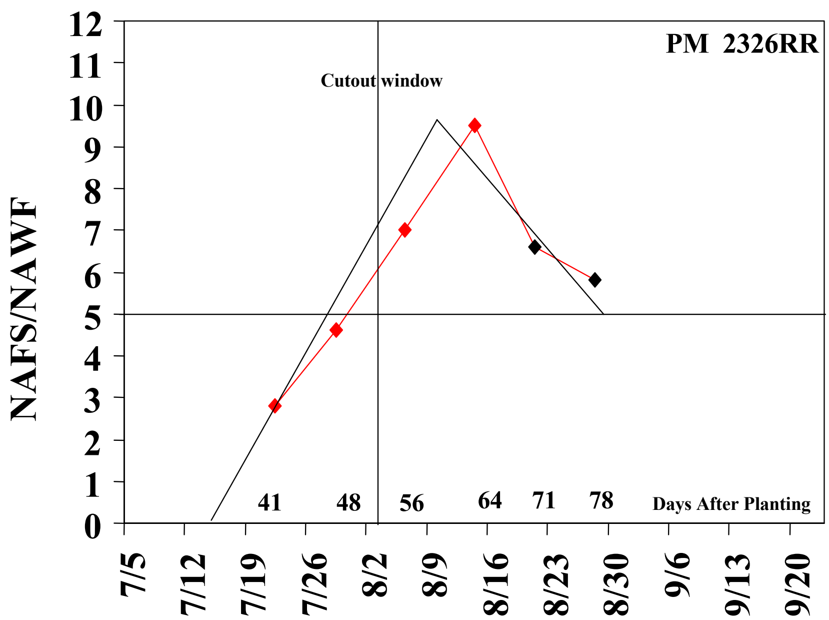


Figure 2. COTMAN growth curve for late-planted cotton. Halfway, TX.

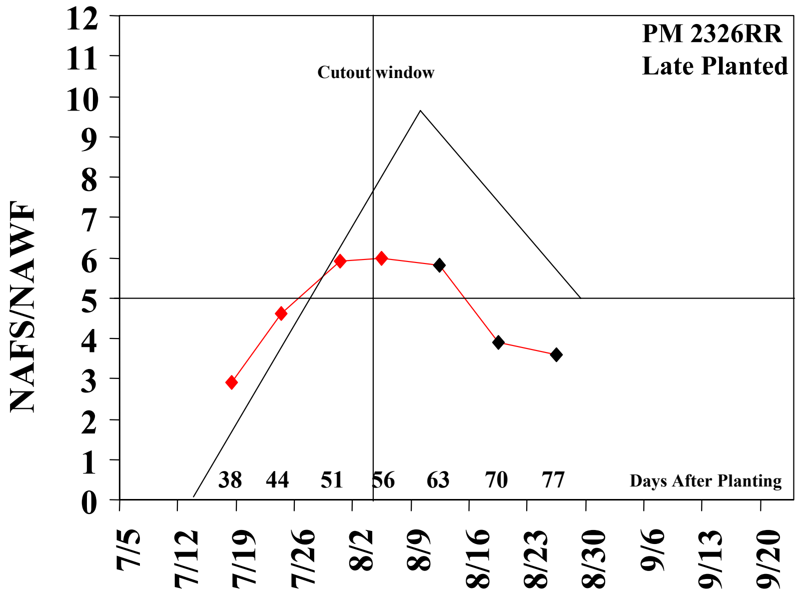


Figure 3. COTMAN growth curve under LESA irrigation, Denver City, TX.

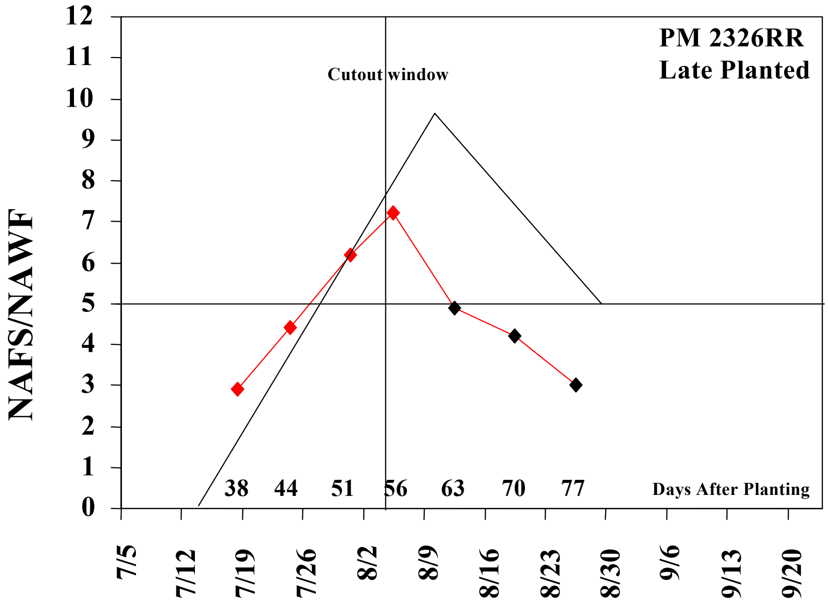


Figure 4. COTMAN growth curve under LEPA irrigation. Denver City, TX

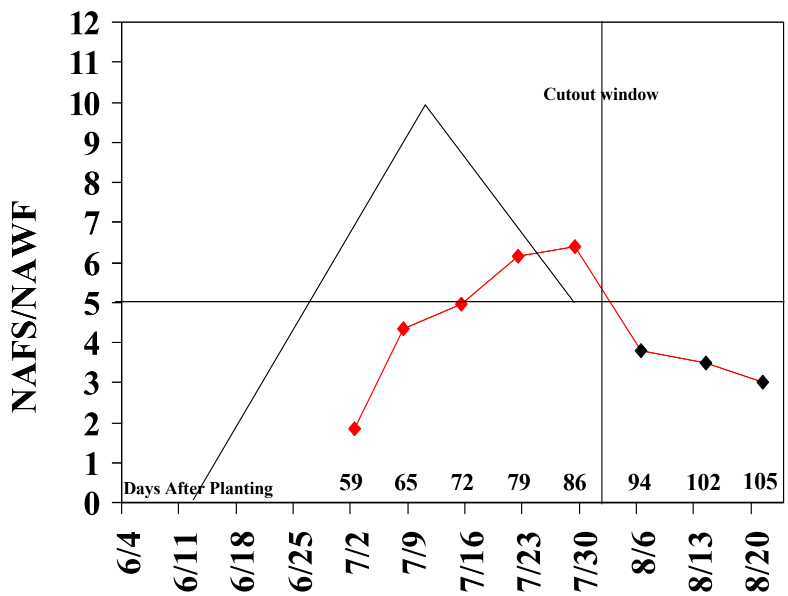


Figure 5. COTMAN growth curve under a 15-inch row spacing. Halfway, TX.

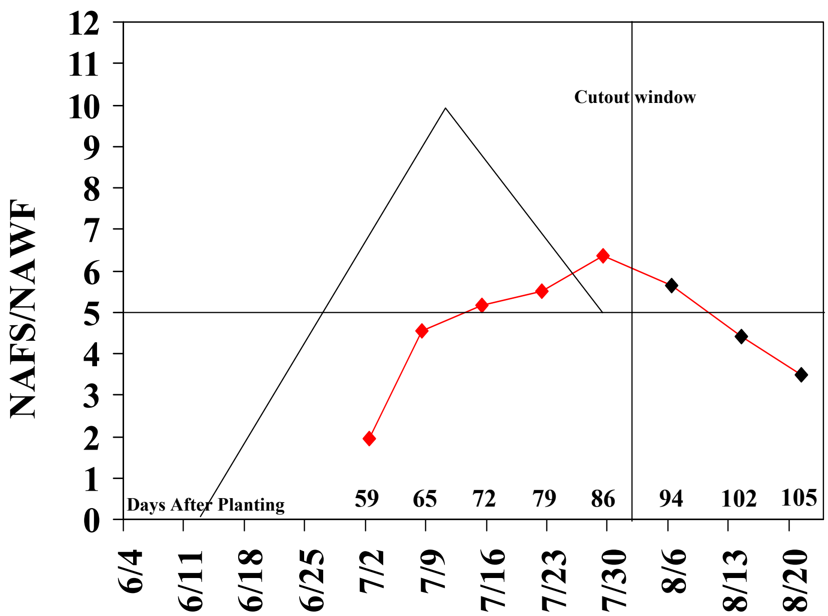


Figure 6. COTMAN growth curve under a 30-inch row spacing. Halfway, TX.

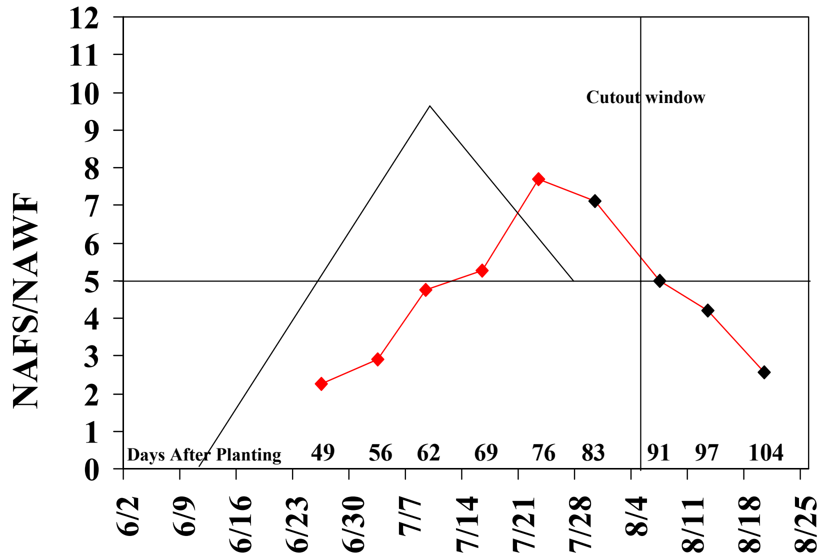


Figure 7. COTMAN growth curve in a conventional tillage system. Lamesa, TX.

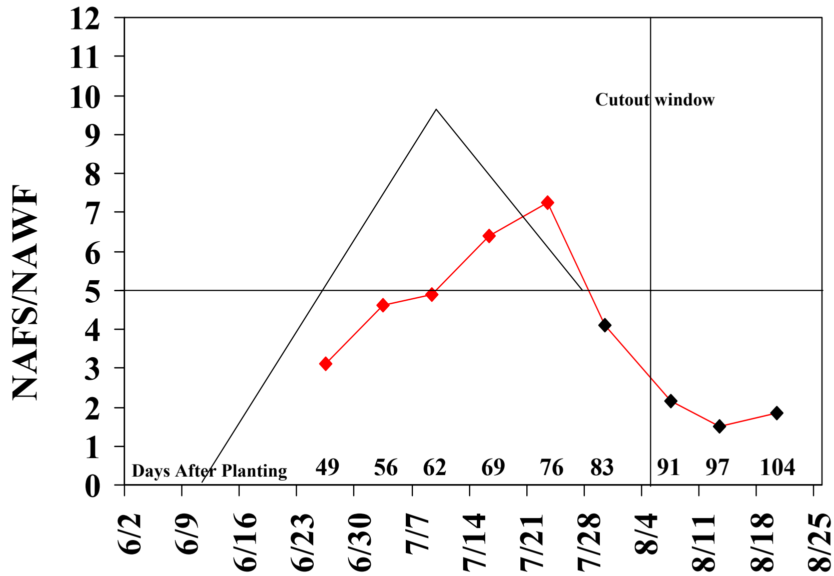


Figure 8. COTMAN growth curve in a conservation tillage system. Lamesa, TX.

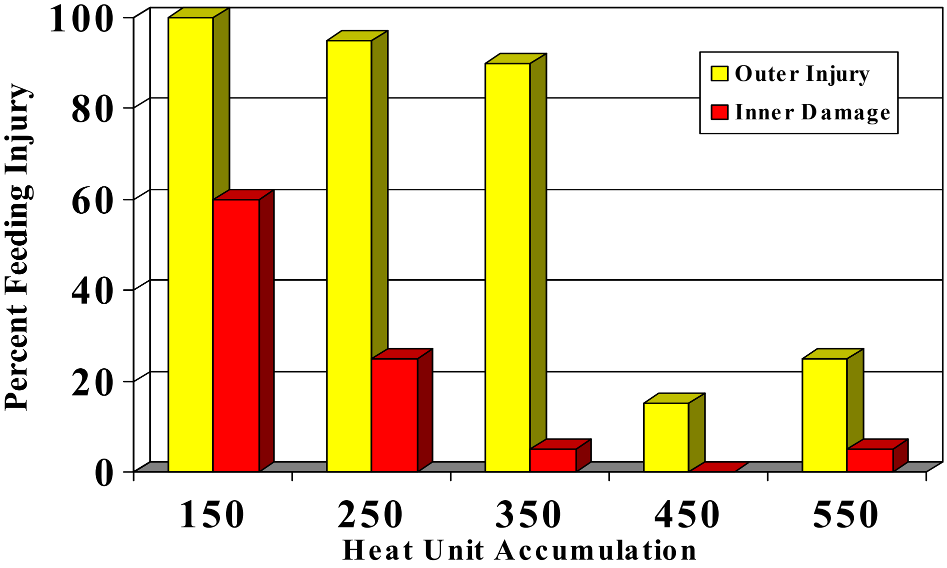


Figure 9. Boll damage from western tarnished plant bug feeding in relation to boll maturity as measured by heat units.