REMOTE SENSING OF LATE-SEASON PEST DAMAGE TO COTTON & WILD HOST PLANTS OF TARNISHED PLANT BUG IN THE MISSISSIPPI DELTA

D. L. Sudbrink Jr., F. A. Harris and J. T. Robbins
Mississippi State University
Delta Research & Extension Center
Stoneville, MS
G. L. Snodgrass
USDA-ARS
Southern Insect Management Research Unit
Stoneville, MS
S. J. Thomson
USDA-ARS
Application & Production Technology Research Unit
Stoneville, MS

Abstract

Remote sensing technologies were investigated for use in detection of late-season pest infestations and wild host plants of tarnished plant bug in the Mississippi Delta. Preliminary results indicated that spider mite infestations were discernable from healthy and stressed cotton with aerial videography and spectro-radiometry. Broadleaf wild host plants of tarnished plant bug were distinct from non-host grasses in preliminary imagery and radiometry.

Introduction

In the field, pest management is almost entirely dependent upon labor-intensive systems for monitoring pest infestation, damage, alternate wild host plants, and crop developmental stage. Visual symptoms of crop damage are often observed too late for making pest management decisions. Efficient methods for early detection of pest infestation and damage, and wild host plant detection and measurement are highly desirable.

Several species of pests attack cotton in late season in the Mississippi Delta and frequently cause economic injury. Early detection of spot-infestations of these pests could allow reduced application of controls with variable rate technology on a site-specific basis (Seal 1999).

Tarnished plant bug (TPB), *Lygus lineolaris*, is a key pest of cotton in Mississippi which destroys more than 16,600 bales/year (Williams 1999). During non-cropping periods, TPB feeds and reproduces on a wide variety of broadleaf wild host plants that are the focus of area-wide management strategies targeting their destruction (Weaver-Missick 1999). The ability to detect these wild host plants would assist in the targeting of these management strategies to reduce TPB populations before the cropping season begins.

Geo-referenced remote sensing is a promising technology which can be used in the detection of pests, their damage to crops, and their alternate host plants (Allen et al. 1999). In August of 1999, a two-season study was initiated to investigate the use of remote sensing to detect cotton pests and wild host plants in the Mississippi Delta. Specific objectives of the late-season part of the study were to:

- Evaluate remote sensing capabilities for identifying late-season factors in cotton crop development related to pest populations.
- Evaluate remote sensing capabilities to assist in locating, identifying, and determining area coverage of wild host plants of TPB.

Materials and Methods

Late-Season Arthropod Damage Study

In August 1999, two 0.5-ha cotton fields were marked off at two sites within NASA multi-spectral fly-over zones at Stoneville & Tribbett, MS. One field at each location was treated with aphicide (Furadan) & miticide (Pirate).

Fields were marked in a diamond grid pattern and sample sites were recorded in ArcView using a Trimble GPS unit. Sampling for spider mite, aphid, and whitefly populations was conducted once before & twice after pesticide application in fields at Stoneville (n=128 plants), and Tribbett (n=144 plants). At each sampled site, the 4^{th}, 5^{th}, and 6^{th} unfurled leaves from the top of each plant were collected and taken to the lab, where mites, aphids, and whiteflies were counted per square inch. Geo-spatial population data were graphed for each field. To measure % reflectance of spider mite damage to cotton leaves, spectro-radiometry data were recorded using a Li-Cor LI-1800 spectro-radiometer. Multi-spectral images were recorded weekly during the sampling period. Geo-referenced videography of fields was recorded using a GPS-linked SONY digital8 video-camcorder mounted on an aerial crop-duster platform.

Nematode Study

In late October of 1999, nematode soil samples were taken from the same sample points in the fields listed in the arthropod damage study. At each sample point, a 1-pint soil sample was taken which contained eight 1-inch diameter x 0 to 6-inch depth soil cores/pint. Nematodes were extracted using a soil elutriator and identified to species. Data were graphed geo-spatially. Geo-referenced videography and spectro-radiometry data were recorded for cotton fields with areas suspected of being stressed by nematode infestation.

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Lygus lineolaris (TPB) Late-Season Wild Host Plant Study

From August-October 1999, more than fifty sites were sampled at Stoneville and Tribbett for late-season broadleaf wild host plants of *L. lineolaris* (TPB) or grassy non-hosts. The location of each site was recorded with a GPS unit. At each site, four 0.25m-ring samples were taken to measure plant density and % cover and 25 sweeps were made with a standard insect sweep net to measure TPB populations. Site maps were recorded in ArcView. Li-Cor & ASD spectro-radiometers were used to measure % reflectance of wild host plant canopies).

Results & Discussion

Late-Season Arthropod Damage Study

Aphid populations crashed due to a fungal epizootic at both locations and whitefly populations remained too low to observe damage during the sampling period. Two-spotted spider mite (*Tetranychus urticae*), populations increased in hot dry August weather and were highly visible by the end of the season. Greater mite populations were counted in untreated plots than in those treated with miticide (Figs. 1 & 2) Spider mite damaged "hot spots" had more than three times the number of spider mites than healthy green peripheral plants and more than two times that of stressed cotton (Fig. 3). Spider mite "hot spots" were discernable from healthy and stressed plants through aerial videography (Fig. 4). Reflectance of mite "hot spots" was discernable from healthy and stressed plants with spectro-radiometry (Fig. 5). In California, spider mite infestations have been detected in cotton early in the season with digitized multi-spectral remote sensing imagery (Fitzgerald et al. 1999). Digitized multi-spectral imagery of pest infestations was unavailable at press time, which, when available, will allow us to further analyze these data. An additional full season of data will be collected in 2000 to assess the usefulness of this technology for detecting arthropod infestations.

Nematode Study

At Tribbett, reniform nematodes, *Rotylenchulus reniformis*, were found in high numbers and exceeded Fall economic threshold levels in 90% of the field (mean = 14,963 nematodes/pint or almost three times the Fall economic threshold level of 5000/pint) (Fig. 6). Reniform nematodes at Tribbett were clumped in distribution with a range of 496 to 59,000 nematodes/pint. Very low populations of reniform nematode occurred at at Stoneville which was well below threshold levels (mean = <29 nematodes/pint). Possible nematode stressed weak spots were visible with aerial videography and spectro-radiometry (Figs. 7 & 8).

At Stoneville, population levels of root knot nematodes (RKN), *Meloidogyne incognita*, (mean = 195 nematodes/pint) were below the fall threshold level for light soil (250 nematodes/pint). Populations of RKN were clumped in distribution at Stoneville, with a range of 0 to 2900 nematodes/pint. Very low levels of RKN occurred at Tribbett (mean = <1 nematode/pint). Population levels of lance and spiral nematodes (Hoplolaimidae) were not found above 1 nematode/pint at either location Digitized multi-spectral imagery of potential nematode infestations was unavailable at press time, which, when available, will allow us to further analyze this data. An additional full season of data will be collected in 2000 to assess the usefulness of this technology for detecting nematode infestations.

Lygus lineolaris (TPB) Late-Season Wild Host Plant Study

TPB adults and nymphs were collected from several broadleaf host plants (aster, *Aster* spp.; goldenrod, *Solidago* spp.; giant ragweed, *Ambrosia trifida*; Pennsylvania smartweed, *Polygonum pennsylvanicum*; mare's-tail, C*onyza canadensis*; and redroot pigweed, *Amaranthus retroflexus*). TPB was not collected from non-host grasses (Johnsongrass, *Sorghum halapense*; broomsedge, *Andropogon virginicus*; or bermudagrass, *Cynodon dactylon*). Goldenrod, giant ragweed, aster, smartweed, and Johnsongrass had greatest % cover. Broadleaf host plants were visibly discernable from non-host grasses in preliminary imagery and spectro-radiometry readings (Figs. 9 & 10). Digitized multi-spectral imagery of TPB wild host plants and non-host grasses was unavailable at press time, which, when available, will allow us to further analyze this data. An additional full season of data will be collected in 2000 to assess the usefulness of this technology for detecting wild host plants of TPB.

References

Allen, J. C., D. D. Kopp, C. C. Brewster, and S. J. Fleischer. 1999. 2011: An agricultural odyssey. American Entomologist. 45: 96-104.

Fitzgerald, G. J., S. J. Maas, and W. R. DeTar. 1999. Early detection of spider mites in cotton using multispectral remote sensing, pp. 1022-1024.

In, P. Duggar & J. Richter. Proceedings of the 1999 Beltwide Cotton Conferences. National Cotton Conferences, Orlando, FL.

Seal, M. 1999. Precision insecticide research shows potential input savings. Crop Decisions. October: 14-15.

Thomson, S. J., J. E. Hanks, and G. F. Sassenrath-Cole. 1999. Remote sensing system for agricultural spray planes-Preliminary field observations. ASAE Paper No. 99-1137. St. Joseph, MI. ASAE.

Weaver-Missick, T. 1999. Banishing tarnished plant bugs from cotton. Agricultural Research. 47 (7): 12-14

Williams, M. R. 1999. Cotton insect loss estimates-1998. pp. 807-809. In, P. Duggar & J. Richter. Proceedings of the 1999 Beltwide Cotton Conferences. National Cotton Conferences, Orlando, FL.

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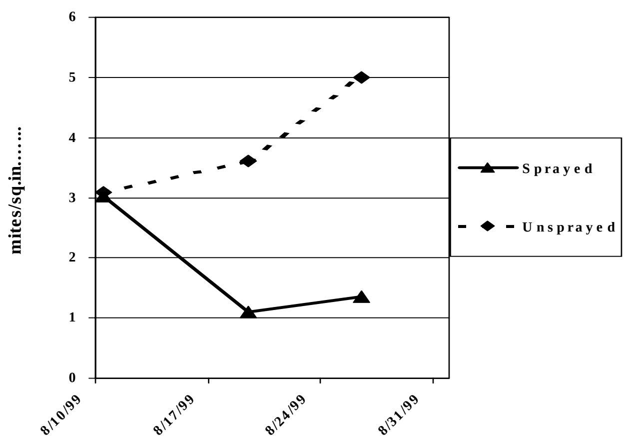

Figure 1. Incidence of spider mites at Tribbett, August, 1999.

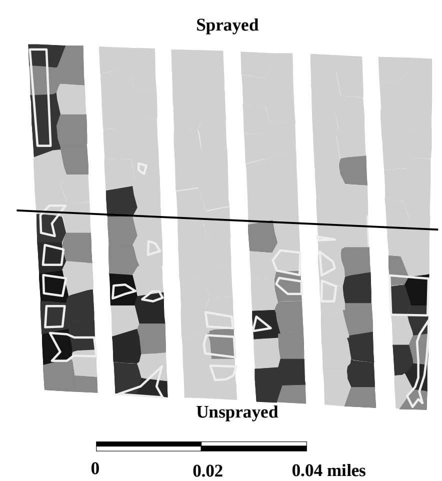

Figure 2. Spider mite infestations at Tribbett, MS, 8/26/99.

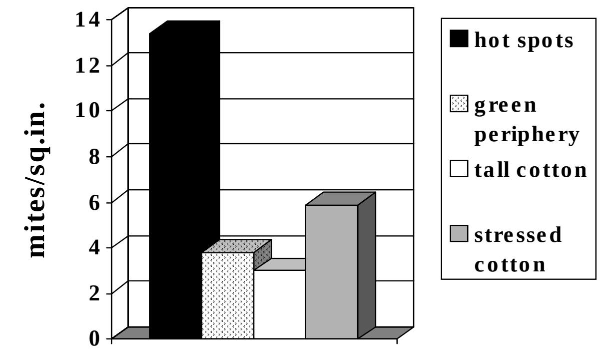

Figure 3. Spider mite infestations in four types of cotton, Stoneville, MS, late August 1999.

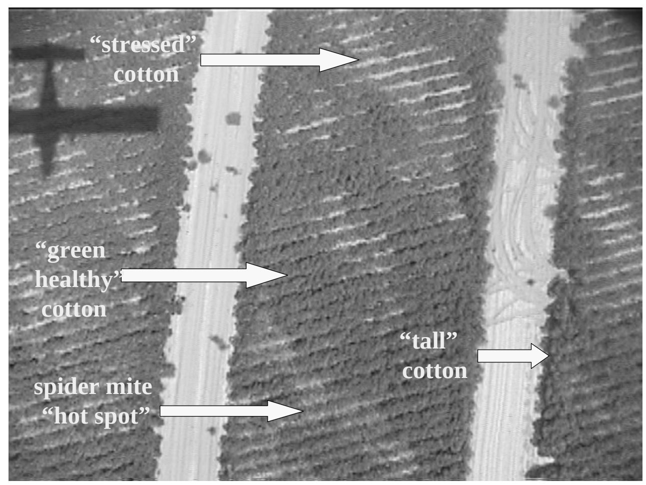

Figure 4. Aerial videography of spider mite infested cotton fields, Stoneville, MS, 8/12/99.

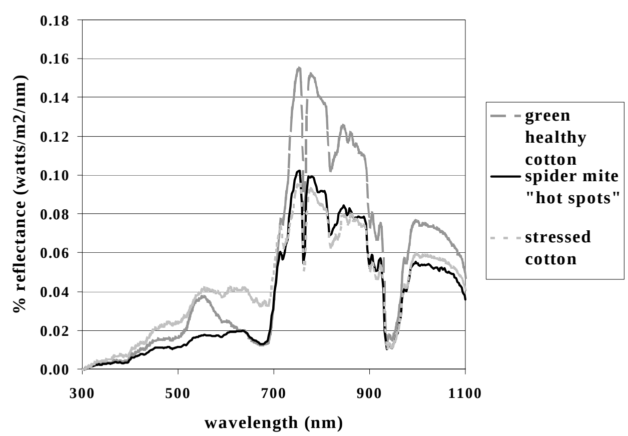

Figure 5. Reflectance spectra for cotton in mite infested fields, Stoneville, MS late August 1999.

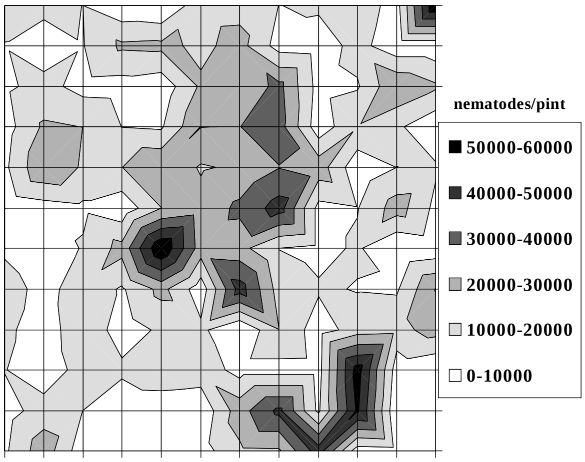

Figure 6. *R. reniformis* populations at Tribbett, MS, 10/26/99.

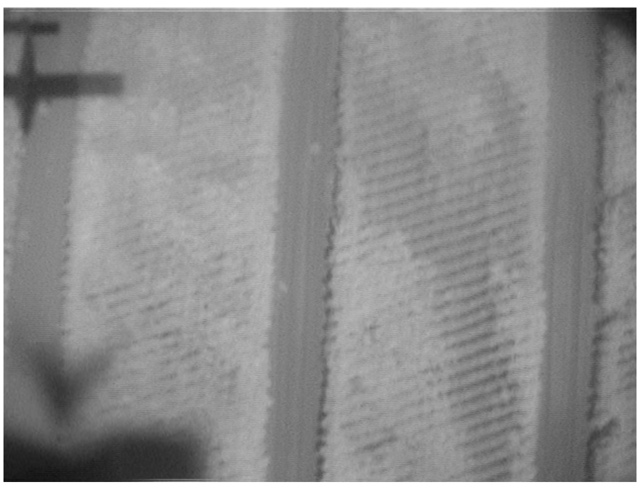

Figure 7. IR-filtered videography of stressed areas in cotton.

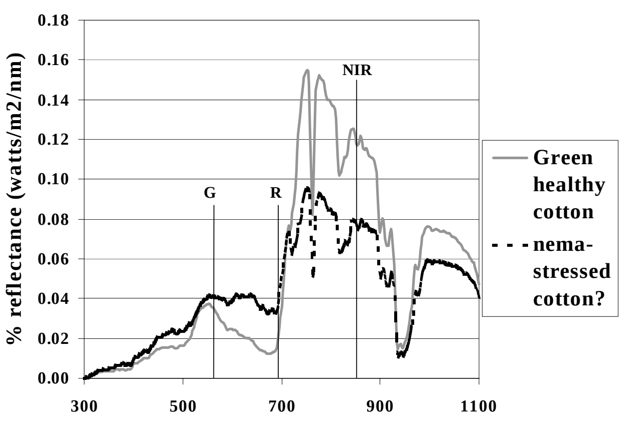

Figure 8. Reflectance spectra for cotton in nematode study field, 8/31/99.

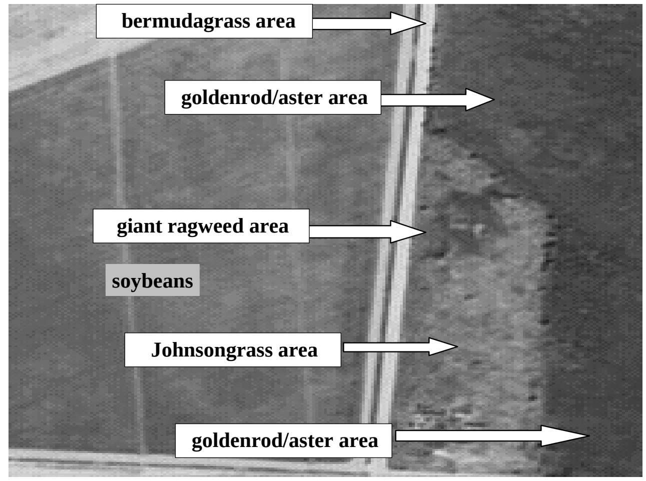

Figure 9. JPEG image of broadleaf hosts of *L. lineolaris* and non-host grasses.

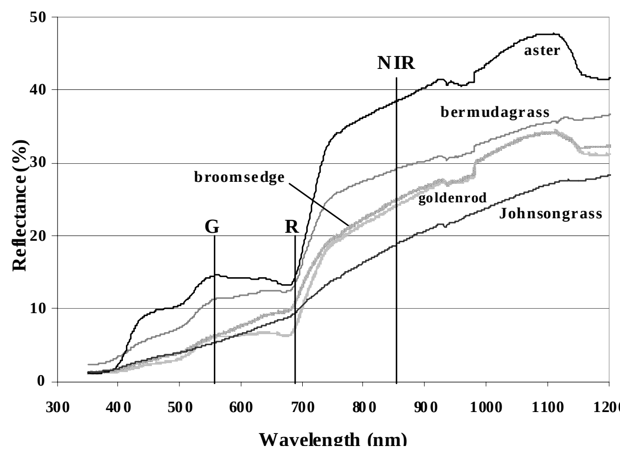

Figure 10. Reflectance spectra of TPB broadleaf hosts and non-host grasses.