EFFECTS OF EARLY SEASON WILD HOST PLANTS AND HERBICIDES ON TARNISHED PLANT BUG POPULATIONS

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Abstract

Tarnished plant bug (TPB), *Lygus lineolaris*, feeds and reproduces on a variety of early season wild host plants before the cotton cropping season begins. These host plants have been the focus of area-wide management programs that use burn-down herbicides to reduce the hosts thus reducing crop infestation by TPB. Populations of TPB can be reduced by as much as five times less than in untreated areas. Plot experiments were conducted to determine effects of plant species (broadleaf hosts and non-host grasses) and burn-down herbicide applications (treated or untreated) on TPB populations. TPB numbers were significantly greater in broadleaves vs. grasses. Among broadleaf hosts, radish had the highest TPB numbers followed by crimson clover, vetch, and winter pea. Burn-down herbicide applications to vetch and vetch/ryegrass treatment plots prevented TPB population increases, while untreated vetch and vetch/ryegrass plots had significant increases of TPB. Untreated plots had 5-fold more TPB than burn-down herbicide treated plots (which is similar to results from area-wide management studies). Remotely sensed imagery of plots revealed NDVI values and G-NDVI values of broadleaves that were lower than grasses. Remote sensing may be useful for early-season host detection, but more needs to be known about host phenology, plant stand mixture, and texture.

Introduction

Tarnished plant bug (TPB), *Lygus lineolaris*, is a key pest of cotton in the Mississippi Delta and frequently causes substantial economic injury. TPB has been reported to feed on more than 300 species of wild and cultivated host plants (Young 1986). In the Mississippi Delta, TPB feeds and reproduces on more than 150 species of wild broadleaf host plants during non-cropping periods (Snodgrass et al. 1984). These early-season wild host plants can produce generations of TPB that eventually infest cotton fields thus making these plants the focus of area-wide management strategies targeting their destruction (Snodgrass et al. 2000 and Weaver-Missick 1999). Part of this management strategy involves destruction of early season wild host plants with burn-down herbicides. One of the assumptions of this management technique is that TPB is primarily attracted to broadleaf hosts so that vegetation management could be focussed on destruction of broadleaves. Field testing of this assumption could provide an understanding of host preference useful to vegetation management. The ability to detect wild host plant areas geo-spatially could allow for the site-specific application of vegetation management strategies to reduce TPB populations before the cropping season begins. Geo-referenced remote sensing is a promising technology that can be used in detection of pests and their alternate host plants on a site-specific basis (Allen et al. 1999). Remote sensing has been used in late season to distinguish broadleaf hosts of TPB from grasses and may be useful for early season hosts as well (Sudbrink et al. 2000). In February of 2000, a study was initiated to determine preference of selected wild hosts of TPB and effects of burn down herbicides on host preference, as well as the feasibility of using remote sensing to detect these wild host plants. Specific objectives for the study were to (1) investigate TPB population dynamics on selected wild broadleaf and grass species, (2) evaluate the effects of burn-down herbicides on host preference in TPB, and (3) evaluate remote sensing capabilities for identifying wild host plants of TPB.

Materials and Methods

Wild Host Species Study, 2000

In the fall of 1999, a RCB test was planted at Stoneville with four broadleaf host species and four grass species in 16mX16m plots with four reps (n=32 plots) (Fig. 1). Broadleaf plant species included: radish (*Raphanus sativus*), crimson clover (*Trifolium incarnatum*), winter pea (*Pisum sativum*), and hairy vetch (*Vicia villosa*). Grasses included: ryegrass (*Lolium multiflorum*), rye (*Secale cereale*), wheat (*Triticum aestivum*), oats (*Avena sativa*). Sampling for TPB was conducted with a standard 38cm insect sweep net (25 sweeps/plot, for a total of 100sweeps/treatment/date) late February to mid-May. Plant density and % cover were estimated using a 0.25m sampling ring (five rings/plot, for a total of five square meters/treatment). Remotely sensed data were acquired aerially with an RDACS sensor on 2/25/00 and data were analyzed with ArcView and ENVI software.

Wild Host/Burn-Down Study, 2001

In the fall of 2000, a factorial test was planted at Stoneville with vetch, crimson clover, ryegrass, a vetch/ryegrass mix, and a clover/ryegrass mix, in 16mX16m plots with four reps (n=40 plots) (Fig. 4). Sampling for TPB was conducted with a standard 38cm insect sweep net (25 sweeps/plot, for a total of 100sweeps/treatment/date) from late February through late April. Plant density and % cover were estimated using a 0.25m sampling ring (five rings/plot, for a total of five square meters/treatment). Remotely sensed data were acquired aerially with an RDACS sensor on 4/6/01 and data were analyzed with ArcView and ENVI software. Once TPB populations were established in broadleaf plots, a burn-down application of 2,4-D herbicide was sprayed on half of the plots and the other half were left unsprayed.

Results and Discussion

Wild Host Species Study, 2000

TPB first occurred in the broadleaf host plots in late February, but populations did not increase significantly until late March. The increase continued until reaching a peak in early May when some hosts had senesced. Broadleaf host plots had higher TPB numbers than grass plots (Fig. 2) reflecting the preference of TPB for broadleaves. Highest TPB numbers were collected from radish plots, followed by crimson clover, vetch, winter pea, and the grass species (Fig. 2). Ryegrass plots had significant numbers of TPB upon anthesis (4/14/00).

Remote Sensing, 2000

Multi-spectral imagery of the plot study was acquired on 2/25/00 which was near the date required to make burn-down herbicide decisions for 2000. A Normalized Difference Vegetation Index (NDVI) was calculated using the red and near infra-red bands: NDVI= (NIR-R)/(NIR+R). Broadleaf NDVI values were lower than those of grasses (Fig. 3). Among broadleaves, winter pea had the highest NDVI value followed by radish, crimson clover, and vetch. NDVI values did not differ among grass species. Separability of broadleaf NDVI values from grasses may be useful for site specific vegetation management decisions, but it may also be an indicator of phenological state rather than species.

Wild Host Burn-Down Study 2001

TPB first occurred in some plots in mid-March, but populations did not start to significantly increase until early April due to an unusually cold winter. Cold weather also prevented crimson clover from establishing good stands. Before burn-down herbicide was applied, TPB numbers were significantly greater in all of the vetch and vetch/ryegrass plots than in other plots (Fig. 5). Burn-down herbicide significantly reduced the %-cover of vetch and crimson clover in treated plots while there was no change in untreated Splots (Fig. 6). After burn-down, TPB numbers increased significantly in untreated vetch and vetch/ryegrass plots and were significantly higher than in treated plots (Fig 5). Plots with ryegrass had significant numbers of TPB upon anthesis (4/11/01). Overall, there was a 5-fold difference in the number of TPB in burn-down plots vs. untreated plots (Fig. 7) which reflects similar results in larger scale, area-wide TPB host plant burn-down studies (Snodgrass et al. 2000).

Remote Sensing, 2001

Multi-spectral imagery of the plot study was acquired on 4/6/01 (the date that plant bug populations increase to treatable levels). A Green Normalized Difference Vegetation Index (G-NDVI) was calculated using the green and near infra-red bands: G-NDVI= (NIR-G)/(NIR+G). G-NDVI values for vetch and crimson clover were lower than those of ryegrass (Fig. 8). Mixed plantings of vetch and ryegrass had G-NDVI values that were between those of ryegrass and vetch. Separability of broadleaf G-NDVI values from ryegrass may be useful for site specific vegetation management decisions, but it may be difficult to detect vetch in mixed stands.

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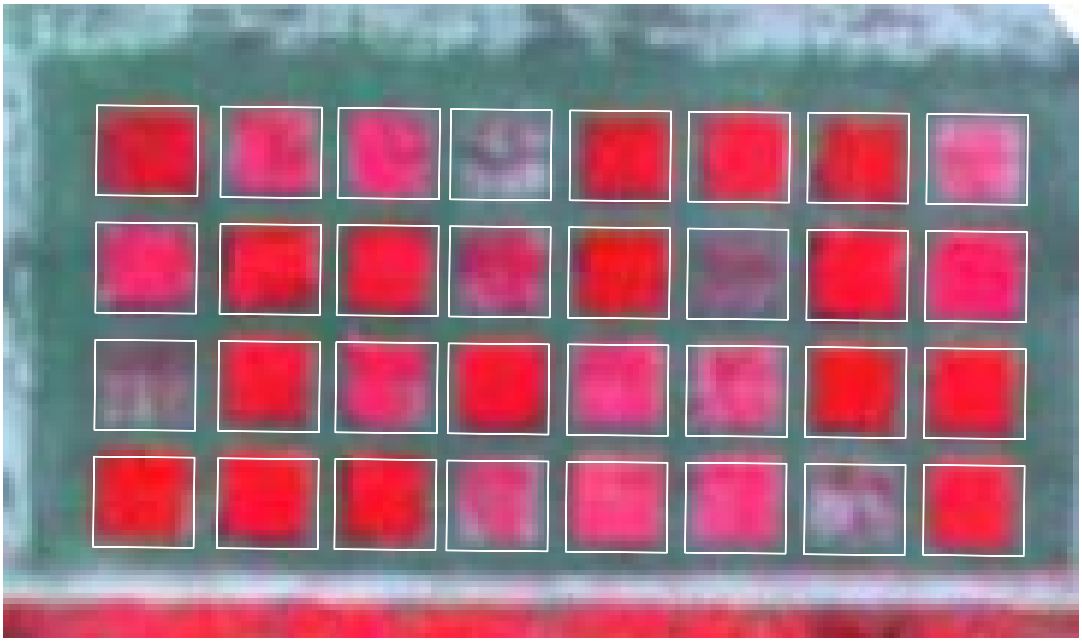

Figure 1. Multi-spectral image of wild host plant experiment, Field 11, Stoneville, MS 2/25/00.

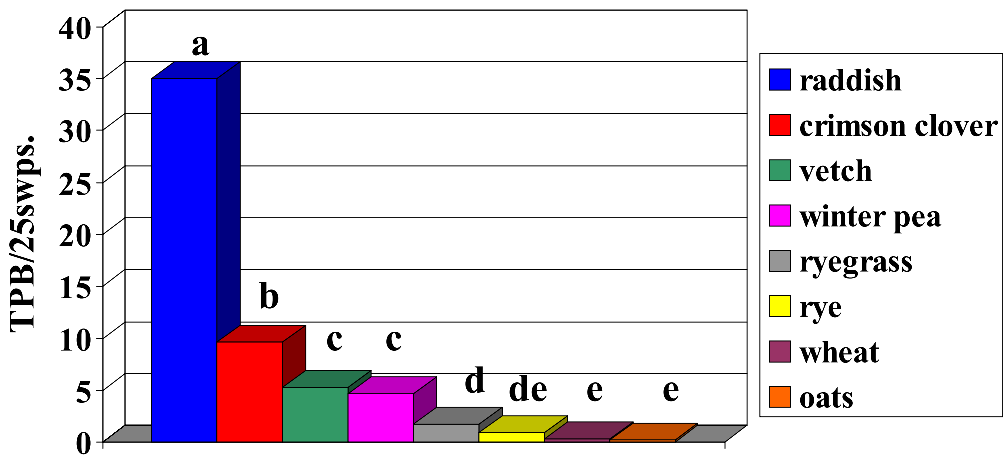

Figure 2. Season average of tarnished plant bugs (TPB), collected from wild host plant species, Field 11, Stoneville, MS, Feb.-May, 2000.

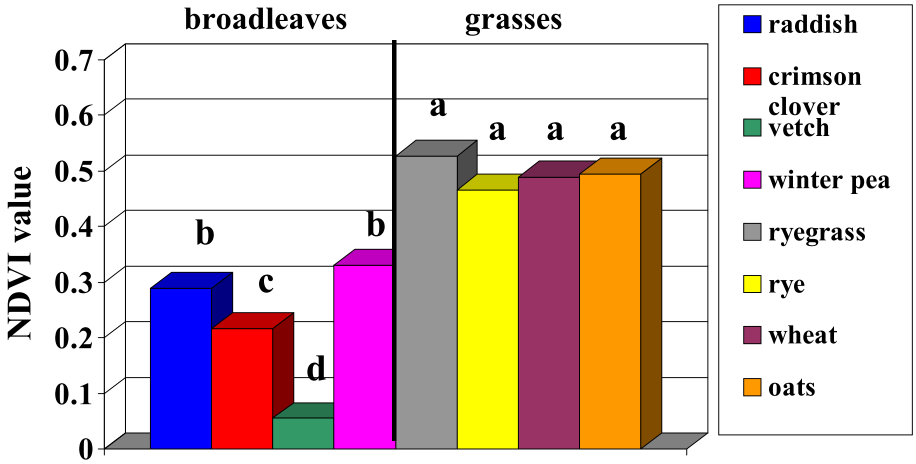

Figure 3. NDVI values from remotely sensed imagery of wild host plant species, Field 11, Stoneville, MS, 2/25/00.

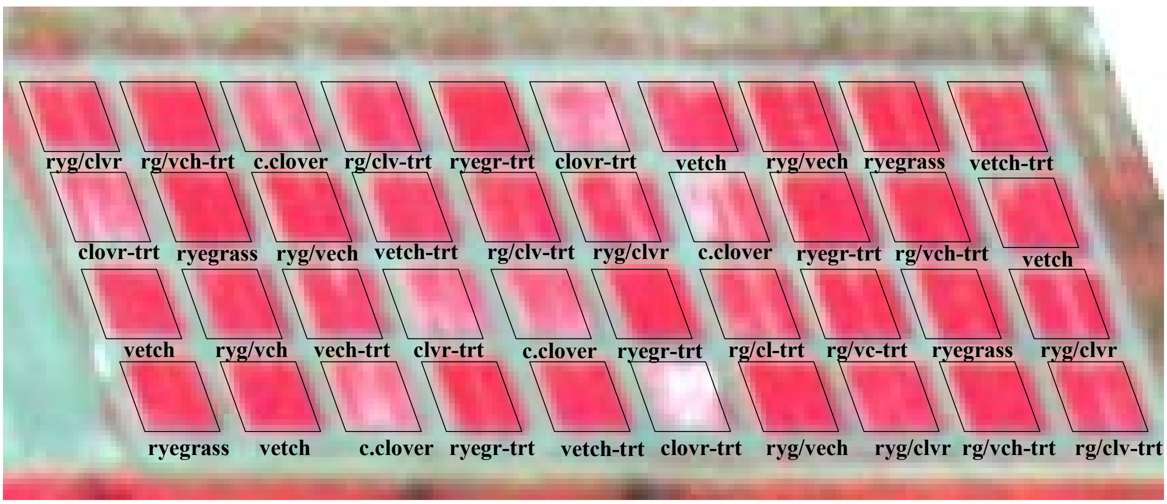

Figure 4. Multi-spectral image of wild host plant experiment, Field 11, Stoneville, MS 4/6/01 (pre-burn-down).

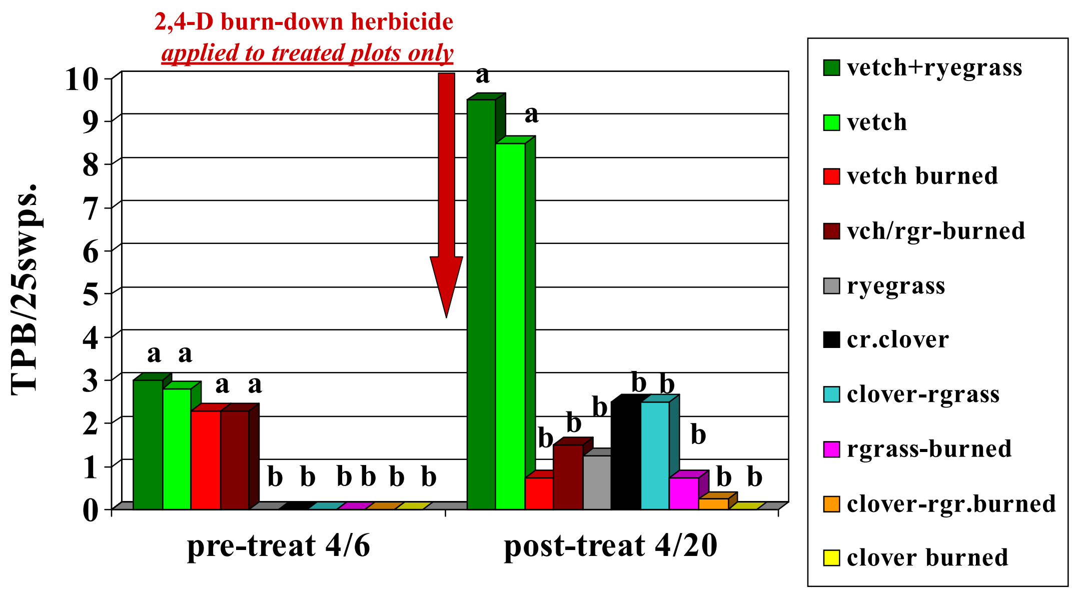

Figure 5. Number of TPB on wild host plants before and after burn-down herbicide treatment, Stoneville, MS, April, 2001.

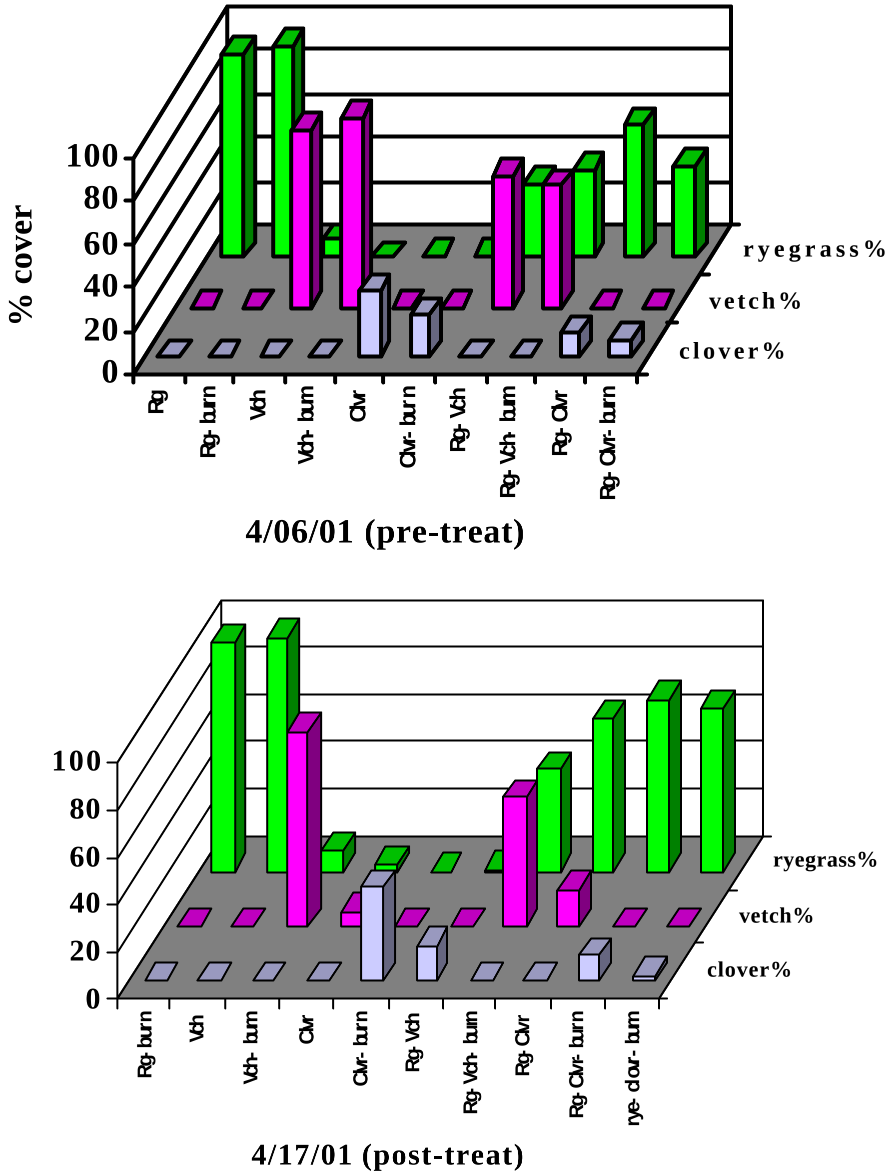

Figure 6. Percent cover values for ryegrass, vetch and crimson clover, for each burn down treatment, before (4/6/01), and after (4/17/01) burn-down herbicide treatment, Field 11, Stoneville, MS, April, 2001.

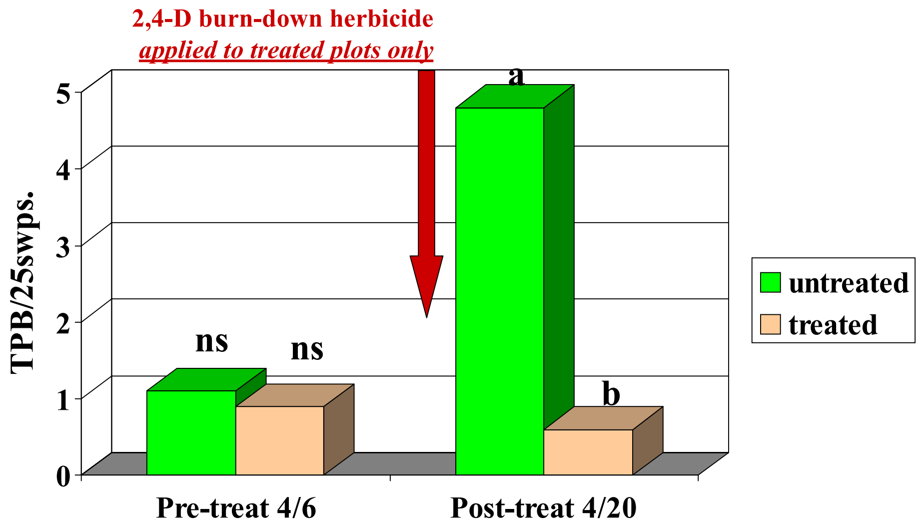

Figure 7. Number of TPB collected from treated and untreated plots, before and after burn-down herbicide treatment, Field 11, Stoneville, MS, April 2001.

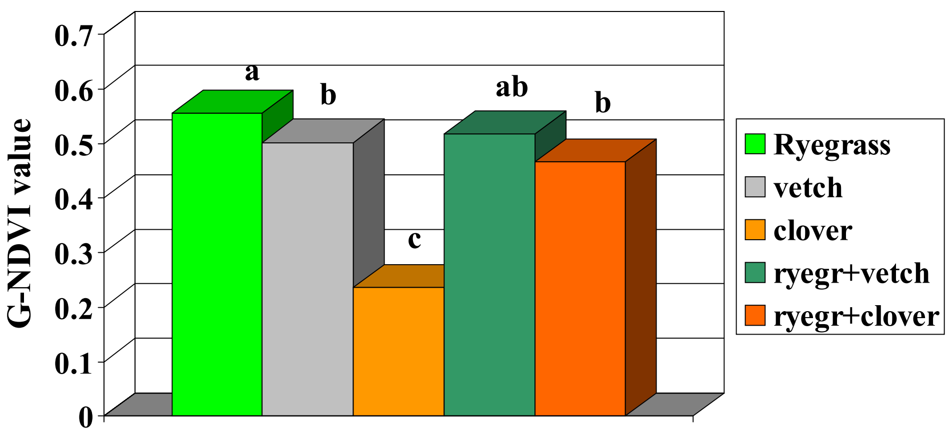

Figure 8. Green-NDVI values from remotely sensed imagery of wild host species, Field 11, Stoneville, MS 4/06/01 (pre-treat).