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EFFECTS OF OKRA-LEAF COTTON ON BENEFICIAL ARTHROPOD POPULATIONS IN NEW MEXICO

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Abstract

The effects okra-leaf cotton on beneficial arthropods were assessed by comparison of large field plots of acala okra-leaf (W 1218), transgenic Bt (1517-99) and conventional (1517-99) cotton. Microclimatic differences were evaluated by comparing leaf area, surface leaf temperature, relative humidity, and photosynthetically active radiation (PAR). Seasonal populations of beneficials were estimated using sweep-samples. Based on one year's data nabids and the predatory Heteroptera as a group were more common in the okra-leaf variety, while hooded beetles and green lacewings were significantly less common in the Bt than the other varieties.

Introduction

Upland Acala, *Gossypium hirsutum*, and Pima, *G. barabadense*, cottons dominate cotton production under the dry, arid conditions of New Mexico. Varieties grown in the state are the result of complex parentages and breeding improvements that have made them more suitable for the southwestern environment. The search for improved varieties continues and due to the increased implementation of integrated pest management practices, reliance on traditional chemical pest control is decreasing and more environmentally conscious means of control are being sought.

Advances in breeding technology have allowed scientists to identify and manipulate morphological characteristics that are believed to be advantageous to the plant. Some of these morphological traits have been shown to impact resistance against pest feeding and damage. Okra-leaf cotton is currently of interest due to its potential impact on arthropod populations. This characteristic is a distinctive leaf shape which features amplified lobes and greater indentation of the sinus than conventional cotton varieties. It has been found to decrease the total leaf surface area, which may influence the plant's attractiveness to certain pests and beneficial arthropod populations. The okra-leaf trait has been shown to have decreased numbers of silverleaf whitefly, *Bemisea argentifolii*, adults and nymphs than the normal leaf cotton varieties that were also tested (Natwick and Walker 2002), and to be less attractive to the sweet potato whitefly, *B. tabaci* (Chu et al. 2002). Okra-leaf cotton also has been shown to be resistant to cotton and pink bollworms, boll weevil, and mites (Burleigh 1975, Wilson 1986, Pieters and Bird 1977, Wilson 1994). Okra-leaf cotton has the potential to be a valuable tool for host-plant resistance without the selective pressures imposed by Bt.

The okra-leaf type provides an "open-canopy" cotton crop due to decreased leaf surface area. This feature may permit greater air circulation and light penetration to the inner, lower portions of the canopy than that of conventional cotton (Meredith 1984). Due to this increase in air movement and light penetration, temperature within the canopy is also affected and these characteristics may influence arthropods in and around the plant. They may or may not find the crop attractive due to this phenomenon. These variations in the microclimate of the okra-leaf type cotton crop may significantly influence beneficial arthropod populations that reside within it. Therefore, the purpose of this study was to examine the potential impact of the okra-leaf trait on populations of beneficial arthropods and compare this to that of Bt and conventional varieties.

Materials and Methods

Experimental Design

Large field plots (24 rows by 56 ft) of acala okra-leaf (W 1218), transgenic Bt (1517-99) and conventional (1517-99) cotton were planted on the 2nd of May in 2003 at the Leyendecker Plant Sciences Research Center near Las Cruces, NM. Plots were arranged in a randomized complete block design with four replications. Two rows from the center of each plot were machine harvested and weighed to estimate yield.

Leaf Microclimate

Leaf surface area was measured weekly by removing a leaf from the fifth node of 10 randomly selected plants per plot and utilizing a portable leaf area meter (LI-3000A). Surface leaf temperature, relative humidity, and photosynthetically active radiation (PAR) were taken once during the season using LiCor Steady State Porometer (LI-1600). Temperature and humidity levels were monitored season-long using Hobo data loggers. Loggers were placed both within the canopy and above for comparison.

Beneficials

Beneficial populations were estimated using a sweep net. Fifty-sweep samples were taken from one randomly-selected row in each plot each week beginning at bloom and continued until harvest. Samples were taken to the laboratory and frozen until they could be counted.

Results

Leaf Microclimate

Leaf area measurements showed that, as expected, okra-leaf cotton had the smallest leaf area of the three varieties examined (Fig. 1). Preliminary results indicate that the leaf area of the conventional variety was the greatest. Results of the other microclimate readings (Fig. 2) show that PAR was greatest for the okra-leaf plots, while leaf temperature and relative humidity appear similar among varieties.

Beneficials

Among the most common beneficials collected during this study were lady beetles, green lacewings, nabids, *Orius*, *Geocoris*, Collops beetles, and spiders (Fig. 3). Lady beetles, primarily the convergent lady beetle, were the most abundant beneficial collected during this season, but showed no preference for a particular cotton variety. Two groups of beneficials did appear to show a preference for okra-leaf cotton over the other varieties. Nabids and predatory Heteroptera as a group were significantly more abundant in the okra-leaf variety than the Bt or conventional cotton (Fig. 4). Hooded beetles and green lacewings were significantly less abundant in the Bt than in the okra-leaf or conventional varieties. None of the other predators examined appeared to show a preference for a particular cotton variety.

Conclusions

Based on one year's data certain beneficials appear to show a preference for one variety over another. Nabids and the predatory Heteroptera as a group were more common in the okra-leaf variety, while hooded beetles and green lacewings were significantly less common in the Bt than the other varieties. It is difficult to determine the specific reasons behind predator abundance in a crop. Possible reasons include presence of favorable microclimatic conditions, a suitable food source, or both. The smaller leaf area of the okra-leaf variety appeared to increase PAR, resulting in more light within the cotton canopy –this resulted in a different microclimatic environment. It is still unclear what a predator's response to these conditions might be. However, a closer examination of the behavior of beneficials to different light intensities may help answer this question. Although not included in this study, data were taken on populations of the most common pests in this system; this will be examined to see if there is a correlation between pest numbers and beneficial populations.

References

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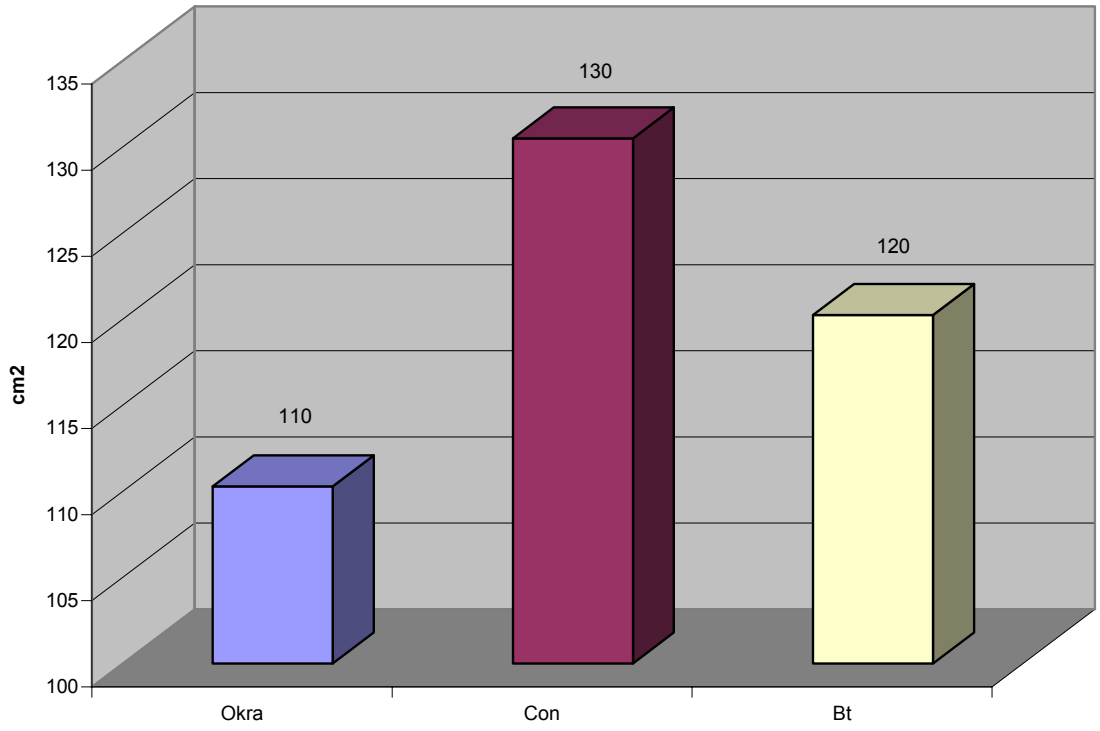

Figure 1. Average leaf area for cotton varieties at Leyendecker Farm, 2003.

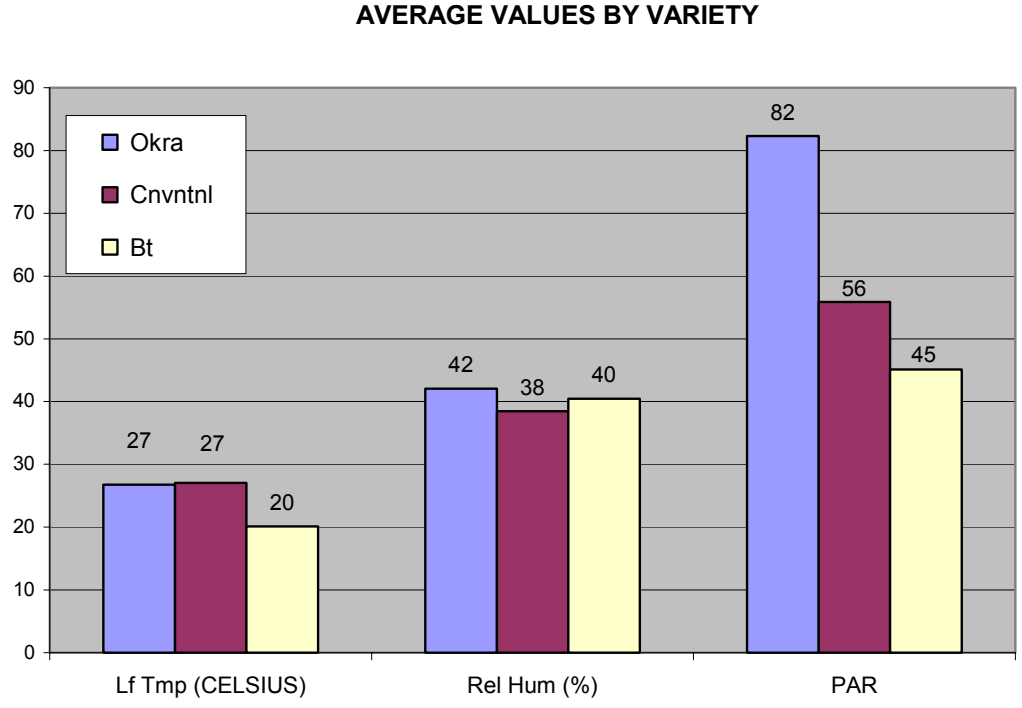

Figure 2. Values for three different plant measurements from cotton plots at Leyendecker Farm, 2003.

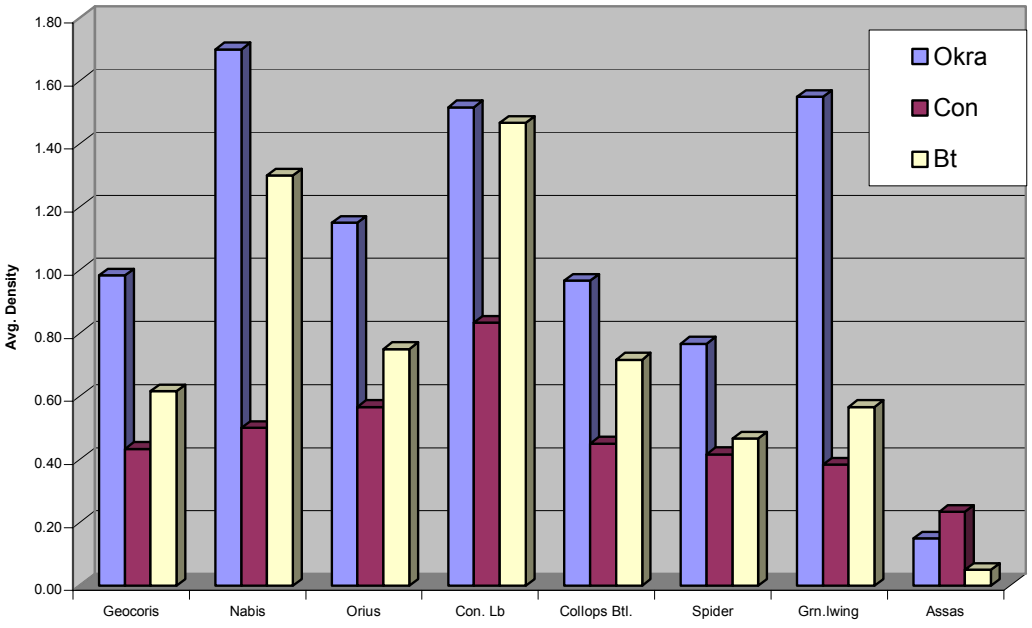

Figure 3. Average density of beneficial arthropods from cotton plots at Leyendecker Farm, 2003.

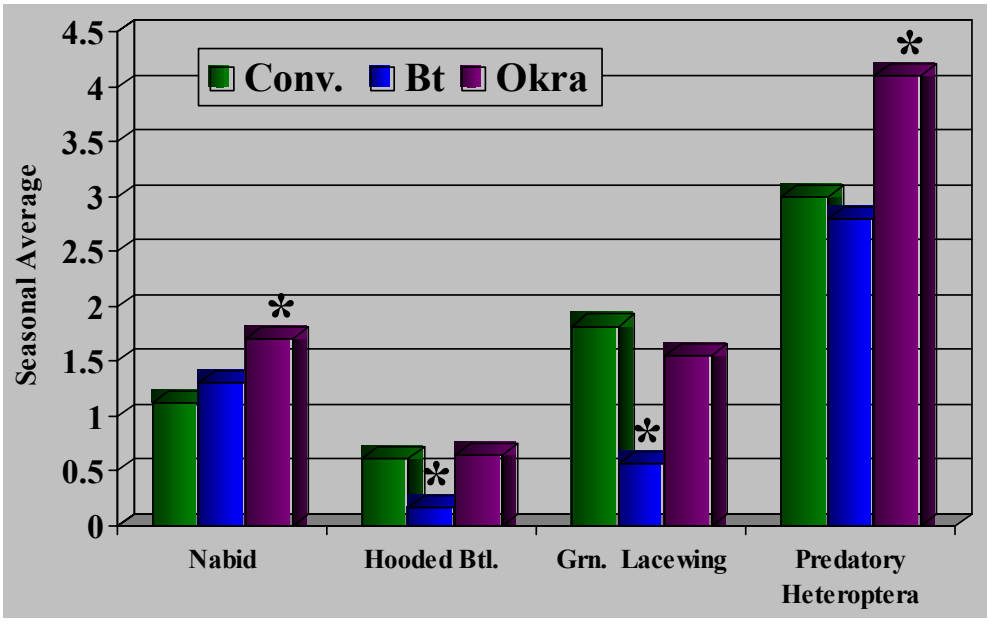

Figure 4. Statistically significant arthropod groups arranged by treatment groups for New Mexico Cotton at Leyendecker Farm, 2003. Bars with an "*" are significant at $\alpha = 0.05$.

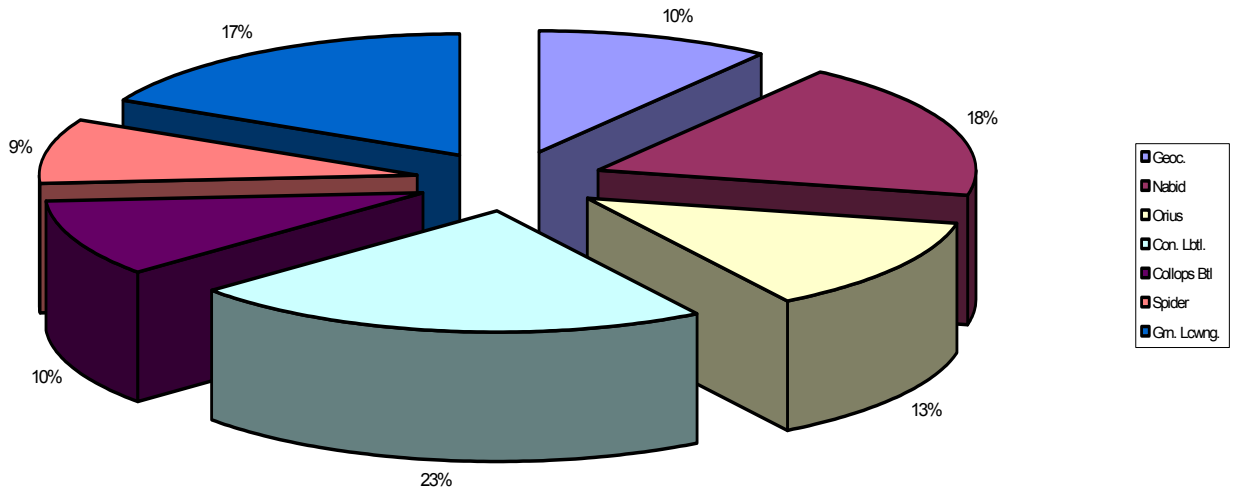

Figure 5. Proportions of Most Abundant Beneficial Arthropods in New Mexico Cotton at Leyendecker Farm, 2003.