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# IMPACT OF THE BOLL WEEVIL ERADICATION PROGRAM ON BENEFICIAL INSECTS IN COTTON: IS THERE A CANARY IN THE COAL MINE.

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## Abstract

Densities of predatory insects and spiders were sampled in cotton fields under boll weevil eradication and outside of eradication for two growing seasons in Central Texas to determine if sampling could anticipate an increasing risk of outbreaks of secondary pests, primarily beet armyworm and bollworm/budworms. As expected, densities of most predatory insects and spiders were significantly lower under eradication. An exception was lady beetles which were significantly more abundant under eradication due to the greater density of cotton aphids. Densities of fire ants and immature pirate bugs (*Orius* species) were much lower under eradication relative to densities in fields outside of the eradication program and thus were too sensitive to malathion to be useful indicators. Spiders increased early in the season, but then began to decline as fields were repeatedly treated with malathion. In contrast, spider densities continued to increase throughout the season in fields not under boll weevil eradication. Total spider densities were negatively correlated with densities of beet armyworms and bollworms. Results suggest that spiders may be a useful indicator group for assessing the risk of outbreaks of caterpillar pests in a boll weevil eradication program. Also, spiders are easily and quickly sampled using the beat bucket method and are easily identified in the field.

## Introduction

Although boll weevil eradication has been achieved across much of the cotton producing regions of the U. S., the program is on-going in Texas where some 5.7 million acres (92%) of cotton are currently in some stage of eradication. Several regions of Texas, including the northern Blacklands, the St. Lawrence area of west Texas and the Rio Grande Valley, have not yet begun eradication. As in other states, boll weevil eradication will provide long-term economic and environmental benefits to Texas producers. However, boll weevil eradication does pose a short term risk of secondary pest outbreaks of beet armyworms, aphids, whiteflies and other pests. The risk of secondary pests is believed to be due to the reduction in beneficial insects resulting from the area-wide and multiple applications of malathion applied for boll weevil eradication (Ruberson et al. 1994, Summy et al. 1996, Layton and Long 2001, Stewart et al. 1996).

The Texas Boll Weevil Eradication Program recognizes the potential for outbreaks of secondary pests and reduces the intensity of malathion treatments when beet armyworm, aphids or other secondary pests begin to increase in area fields. It is hoped that by reducing the number of treated acres that populations of beneficial insects will recover and again bring the pest populations under control. However, such remedial efforts may be too late due to the time needed for the recovery of natural enemy populations. We propose that a more effective approach is to monitor populations of key beneficial insects, rather than only pests, and reduce the acreage treated with malathion when beneficial inset populations begin to show a significant decline. Early detection of a negative impact on natural enemies followed by a reduction in acreage treated would potentially limit the reduction in beneficial insect populations such that the risk of secondary pests would be even less than under the current system which monitors only pests. These key natural enemies could serve as the canaries in the coal mines, alerting program managers of a decline in beneficial insect populations and a corresponding increase in the risk of secondary pest outbreaks.

The objective of this study was to compare densities of beneficial insects and spiders in cotton within and outside of a boll weevil eradication zone and determine if the changes in densities of any species or species group could indicate an increasing risk of secondary pests.

## Materials and Methods

Densities of beneficial insects and spiders were recorded in 16 and 24 commercial cotton fields in the Southern Blacklands Boll Weevil Eradication Program during 2002 and 2003, respectively. The eradication program began in this zone with fall diapause spraying during the fall of 2001 and continued with full season spraying during 2002 and 2003. These fields included irrigated cotton in the Brazos Valley and dryland production near Taylor. Eight commercial cotton fields were sampled outside the eradication program during both years. These fields were dryland production in Ellis and Navarro Counties and located ca. 100 miles north of the sample fields in the eradication zone. Cropping patterns in both the eradication and non-eradication areas included corn, cotton and grain sorghum mixed with pasture.

Predatory insects and spiders were sampled in each field weekly for ca. 12 weeks from June through August using the beat bucket method (Knutson et al. 2000). In 2003, 40 beat bucket samples, each representing 4 plants, were collected from each field. Beat bucket samples were preserved in the field in alcohol and sorted in the laboratory. Densities of medium and large larvae of beet armyworm, bollworm/budworm, loopers and others were also determined from the beat bucket samples. Densities of aphids were determined by sampling 20 terminal leaves in each field. The date each field was treated with malathion or other insecticide was recorded.

## Results and Discussion

Pirate bugs (*Orius* species) are often the most common predatory insect collected in cotton in central Texas and are known to prey on eggs of bollworms and beet armyworms. Densities of *Orius* adults were similar in both eradication and non-eradication fields and showed two seasonal peaks. As adults readily fly and reproduce on sorghum, corn and wild hosts, *Orius* may re-populate malathion-treated fields from untreated sorghum and uncultivated areas. However, immature *Orius* were nearly absent from cotton fields under eradication but common in non-eradication fields. Results suggested that *Orius* were not well suited as an indicator species due to their variable numbers as adults or near absence as immatures. Fire ants were also highly susceptible to malathion treatments and were nearly absent from the canopy of cotton fields under eradication. We suspect that malathion repels fire ants from foraging in the cotton canopy. Although fire ants are the most effective predators of beet armyworm eggs (Diaz et al. 2002) in central Texas, the near absence of fire ants from the cotton canopy makes them unsuited as an indicator species.

While the densities of most predatory insects were significantly less in eradication fields, densities of lady beetles was significantly greater under eradication. This increase in lady beetle adults and larvae was in response to the significantly greater densities of cotton aphids in the fields under eradication, relative to the non-eradication fields. Outside of the eradication fields, lady beetle densities were very low as were densities of aphids. Thus, lady beetles did not appear to be a suitable indicator species of a pending increase in aphids, but rather increased in response to aphid numbers despite malathion treatments.

Spiders, including crab spiders, jumping spiders and lynx spiders, were commonly collected in fields inside and outside of the eradication program. In both 2002 and 2003, total spider densities increased during June and July in cotton in and out of the eradication program. In 2002, densities of spiders began to decline during week 8 in the eradication fields, while densities continued to increase in fields outside eradication. Densities of beet armyworms began to increase in week 10 under eradication, but remained low throughout the season outside the eradication zone. In 2003, spider densities increased during weeks 1-5 in both eradication and non-eradication fields, but then declined in fields under eradication. As in 2002, spider densities outside the eradication program continued to increase throughout the season and in early August were about 3 times greater than spider densities in the eradication program.

Results suggest that spiders may be a useful indicator species for assessing the risk of outbreaks of caterpillar pests due to the negative impact of malathion on the predatory arthropods. Spiders increased early in the season, but then began to decline as the fields were repeatedly treated with malathion. Total spider densities were negatively correlated with densities of beet armyworms and bollworms. Also, spiders are easily and quickly sampled using the beat bucket method and are easily identified.

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