YEAR THREE OF INSECT POPULATION DYNAMICS IN A COTTON REFUGIA SYSTEM: PITFALL TRAP SAMPLING

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Abstract

Transects of pitfall traps were used to monitor densities of epigeal carabid beetles and spiders in a 10 ha conventional-tilled Georgia cotton field with permanent refugia strips. Carabid and spider densities were significantly highest in the refugia strips throughout the season. Carabid and spider densities in the 12-row cotton plots on either side of the refugia strips were significantly higher than densities in cotton plots more than 12 rows from the refugia. Overall densities of both groups, even in the most distant cotton plots, remained high throughout the 1996 season, and no pre-plant incorporated or foliar insecticide treatments were applied.

Introduction

This report summarizes year three of an ongoing study reported in the 1995 and 1996 Beltwide Proceedings (Haney et al., 1995; Haney et al., 1996). Our goal in 1996 was to continue evaluating the role that permanent refugia strips play in a cotton field. This season we concentrated on carabid beetles and spiders as indicator species. Both groups are recognized as major predators in widely diverse agro-ecosystems around the world, and both exhibit a wide variety of habitat and feeding preferences, yet there is still much about their contribution to biological control in Georgia cotton that remains unclear.

Materials and Methods

Review of Field History and Layout

Our study field was planted with peanuts in 1994; the entire field was cultivated in early November of 1994 and broadcast seeded with Crimson clover at the rate of 30 kg per ha. In March of 1995 we staked out six refugia strips, each running the entire length of the 415 m field, and each three rows (ca. 3 m) wide. The refugia strips were divided into two groups of three strips each. The first group was separated from the second group by 68 rows. Each refugia strip within a group was separated by 16 rows (four passes of a four-row planter). Seedbeds were formed as normal in the cotton plots, but the designated refugia strips were not cultivated. The original refugia strips, from the south to the north, occupied rows 17-19, 43-45, and 62-64 (Group 1), and 133-135, 152-154 and 171-173 (Group 2). As in 1995, the field is 243 rows from north to south. It was bounded on the north by 20 rows of tobacco., and bounded on the south by a fence, a 10 m wide grassy area and drainage ditch, and a paved road.

1996 Season

Early in 1996 we decided to reduce the number of refugia strips from six to two. Our original intention was to determine more precisely how refugia strips influence beneficial populations in the field. We planned to do this in two ways: *1)* increase the number of pitfall traps transecting the field, and *2*), reduce any possible "overflow" effect from the three closely adjacent refugia strips. We chose to keep the strips occupying rows 62-64 and 152-154, which were furthest from the margins of the field, and also furthest from one another. In March the other four refugia strips were lightly harrowed along with the rest of the field. However, because of dry weather and logistic problems, they were never cultivated or bedded. DPL 90 was planted in mid-May, with an in-furrow application of 2.5 L/ha Treflan. No other pre-plant incorporated or foliar insecticide treatments were applied in 1996.

After planting the field was divided into twenty 12-row strip plots. As in 1995, the plots were designated either "**Full-Influence**," "**Partial-Influence**," or "**Low-Influence**." The "Full-influence" plots were the cotton strips lying immediately adjacent to the undisturbed refugia strips. The "Partial-influence" plots were the cotton strips lying adjacent to the lightly harrowed refugia strips, and the "Low-influence" plots were the cotton plots lying farthest from the refugia strips.

As in 1995, the first transect of traps was placed ca. 100 m from the west end of the field, and the second transect was placed ca. 100 m from the east end of the field, with ca. 200 m separating the two lines. Traps were placed in a middle row of each 12-row cotton plot; construction of the traps was the same as in 1995 (Haney et al., 1996), and each trap site was marked by a 2 m stake tied with red flagging ribbon. The traps were set out on June 4 and checked weekly through August 27, 1996. The contents of each trap were emptied into a shallow, white plastic tray and evaluated right in the field. The cups were also checked for cracks or damage before being refilled with rock salt and fresh water.

Results and Discussion

Refugia Strip Composition and Management

When the refugia strips were originally staked out in March of 1995 they were composed of bare areas of ground interspersed with patches of Crimson clover, a few rosettes of Cranesbill, *Geranium dissectum*, and scattered clumps of Wild mustard, *Brassica kabe*r. The clover began drying up in mid-April, and a succession of other species appeared, but four species became

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dominant, including *B. kaber*, Texas panicum, *Panicum texanum*, Dogfennel, *Eupatorium capillifolium*, and Common ragweed, *Ambrosia artemisiifolia*. In early spring of 1996 patches of Crimson clover again reappeared, followed by a progression of the same dominant species as in 1995. After harrowing in March, the disturbed strips regenerated quickly, but with more *P. texanum* than the undisturbed strips. All of the refugia strips were mowed by the grower to a height of ca. 0.3 m in mid-July. A table of all the plants found in the refugia strips is included in Haney et al., (1996).

Trapping Results

Traps located in the undisturbed refugia strips captured significantly higher numbers of carabids and spiders in both 1995 and 1996 than traps in the Full-, Partial-, and Low-Influence cotton strips (p=< 0.00 in all cases; see **Figures 1** & **2**). Carabid densities in the Partial-Influence strips next to the harrowed refugia were also significantly higher than densities in the Low-Influence strips (p=0.01), but spider densities were not significantly different. All of the -p- values for the 1995-96 between-strip populations of carabids and spiders are summarized in **Table 1**.

1996 populations of carabids and spiders within the undisturbed refugia strips were significantly higher than 1995 populations (p=0.03 for carabids; 0.01 for spiders; see **Figures 1** & **2**). The only other case where 1996 within-strip populations were significantly higher than 1995 populations was with spiders in the Partial-Influence strips (p=0.03). The -p- values for the 1995 vs. 1996 within-strip populations of carabids and spiders are summarized in **Table 2**.

Figure 3 illustrates the distribution of the most commonly captured carabid genera in 1996. As in 1995, a majority of the spiders captured in the pitfall traps were in the genus *Pardosa* (wolf spiders). See Haney et al., (1995) for a list of all the carabid and spider species captured in the pitfall traps.

Summary

We have learned several things during the last three years about the influence of cover crops and refugia on beneficials in cotton fields:

1) In the first year, we found that densities of most of the beneficial insects and spiders we monitored reached significantly higher levels in a conservation-tilled crimson clover field than in a nearby conventional-tilled field (Haney et al., 1995).

2) In the second year, densities of beneficial insects and spiders were again significantly higher in the conservation-tilled crimson clover field than in the conventional-tilled field. In a second study, we found a significant correlation between refugia strips and higher densities of carabids and spiders in adjacent cotton plots (Haney et al., 1996).

3) In the third year, the correlation between refugia strips and higher densities of epigeal carabids and spiders in adjacent cotton plots remained statistically significant.

4) Also, densities of both groups in the undisturbed refugia strips were significantly higher in 1996 than in 1995.

5) We discovered that lightly harrowed refugia strips regenerated quickly and still contributed significantly to carabid densities.

6) 1996 within-strip spider densities were all numerically higher than 1995 densities (**Figure 2**). Although two of the -p-values were not quite statistically significant (**Table 2**), there appears to be a trend developing that reflects a response to alternate habitats and increased stability. In fact, all of our field observations may be partial expressions of the benefits of alternate habitats and increased stability in the cotton agroecosystem.

7) As in 1995, overall density and distribution of beneficials, even in the "Low-Influence" plots furthest from the refugia strips, remained high throughout the 1996 season. No foliar insecticide treatments were applied in 1995; no pre-plant incorporated or foliar insecticide treatments were applied in 1996. Yields average about a bale per acre in both seasons.

In 1997 we will continue studying the effects of refugia strips combined with a cover crop on beneficial populations, and will also attempt to study how different plant mixtures affect densities of cotton beneficials.

Acknowledgments

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References

Haney, P. B., O. J. Stapel, D. J. Waters, W. J. Lewis, S. K. Diffie and J. R. Ruberson. 1995. Dynamics of insect populations in a reduced-tillage, crimson clover/cotton system. Part II: Pitfall surveys. Proc. 1995 Beltwide Cotton Conf. 2:817-821.

Haney, P. B., W. J. Lewis, and S. Phatak. 1996. Continued studies of insect population dynamics in crimson clover and refugia/cotton systems. Part II: Pitfall trap sampling. Proc. 1996 Beltwide Cotton Conf. 2:1115-1119.

Table 1. Summary of -p- Values for 1995-96 Between-Strip Populations of Carabids and Spiders.

	Full- vs. Low	Full- vs. Partial	Partial- vs. Low
1995 Carabids	0.02	0.81	0.01
1996 Carabids	0.01	0.63	0.01
1995 Spiders	0.01	0.16	0.23
1996 Spiders	0.02	0.12	0.33

Table 2. Summary of -p- Values for 1995 vs. 1996 Within-Strip Populations of Carabids and Spiders.

	Refugia vs. Refugia	Full- vs. Full	Partial- vs. Partial	Low vs. Low
Carabids	0.03	0.14	0.28	0.72
Spiders	0.01	0.07	0.03	0.08

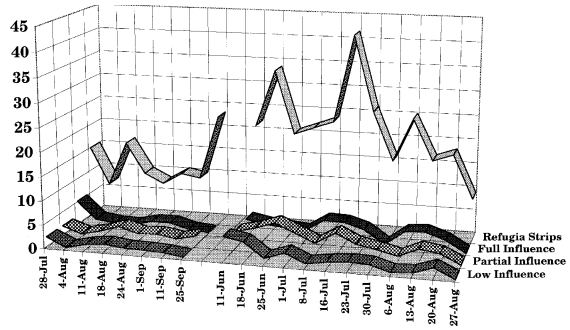

Figure 1 1995-1996 Pitfall Trap Densities - Carabids

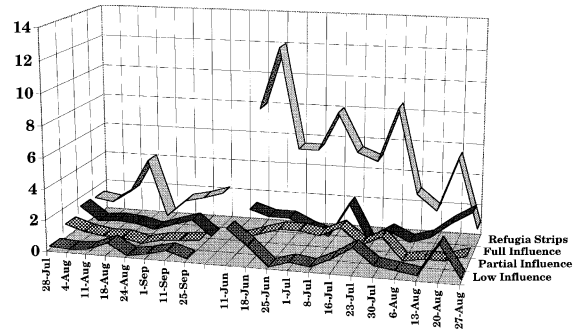

Figure 2. 1995-96 Pitfall Trap Dencities - Spiders

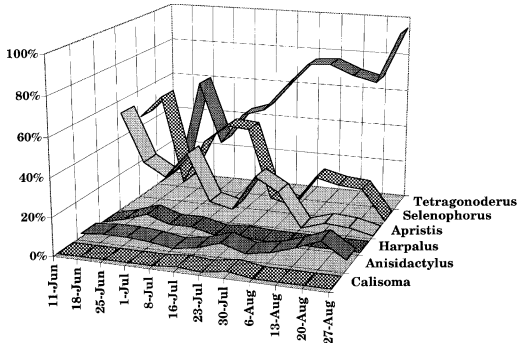

Figure 3 1996 Carabid Species Distribution.