POTENTIAL RELAY STRIP CROPS FOR PREDATOR ENHANCEMENT IN COTTON

M. N. Parajulee and J. E. Slosser
Texas Agricultural Experiment Station
Vernon, TX

Abstract

Predator abundances were quantified in six cover crops to examine their potential as relay strip crops for predator enhancement in cotton in 1995-96 in Munday, TX. Strip crop treatments included 3 fall crops [fall canola, vetch, and wheat], 3 spring crops [spring canola, forage sorghum, and grain sorghum], a relay system comprising canola planted in the fall and grain sorghum in the spring. Cotton planted adjacent to cotton served as a check. Potential of each strip crop for enhancing predator abundance in cotton was evaluated by quantifying the predator abundances in cotton adjacent to each strip crop treatment. Also, the efficacy of each strip crop in suppressing pest populations in cotton was assessed by quantifying the abundances of cotton aphids and bollworms in cotton planted adjacent to each strip crop. Among fall crops, vetch had higher predator numbers than canola or wheat. Spring crops did not differ in their ability to support predators, and they had lower abundances compared with the fall strip crops. Predator abundance in cotton was significantly affected by strip crops, with the highest predator numbers adjacent to grain sorghum, canola-sorghum relay, and vetch. Predator numbers in cotton were not significantly impacted by canola, wheat, or forage sorghum. The canola-sorghum relay system resulted in the lowest aphid abundance in cotton; strip crops did not significantly impact bollworm abundance in cotton.

Introduction

Strip intercropping, growing two or more crops simultaneously in different strips wide enough to permit independent cultivation but narrow enough for the crops to interact agronomically (Vandermeer 1989), has been shown to benefit insect predators through habitat diversification (Burleigh et al. 1973, Bugg et al. 1991, Tonhasca 1993, Alderweireldt 1994). Parajulee et al. (1997) indicated a potential role of strip crops for enhancing predator abundance and reducing aphid numbers in cotton. Although an intercropped system enhances predator abundance, it can also act as a sink for predators by being more attractive than the primary crop itself. Also, a poor choice of strip crops may relay pests to the primary crop together with the predators. An efficient strategy for relaying predators from strip crops to the primary crop without relaying pests requires that the intercrops be colonized by natural enemies before the primary crop is most susceptible to pest damage (Corbett and Plant 1993). Relay intercropping, growing two or more crops simultaneously during part of the life cycle of each (Vandermeer 1989), can have advantages over simple strip intercropping. For example, there is less competition for water and nutrients between the crops in the relay system (Fukai and Trenbath 1993), and relay crops provide a predator reservoir that is in place before the arrival of key pests of the primary crop. Depending on the crops chosen, the location, and the maturity timing of the crops, they may relay insect predators, without relaying pests, from one crop to another as each crop matures and senesces. The objective of this study was to evaluate the efficacy of different cover crops as potential relay strip crops for predator enhancement and pest suppression in cotton. Specific objectives were to (1) compare seasonal abundances of predators in selected strip intercrops and in cotton planted adjacent to each strip crop, and (2) compare cotton aphid and bollworm abundances in cotton, as affected by strip crops.

Materials and Methods

The study was conducted at the Texas Agricultural Experiment Station at Munday, TX during the 1995-96 crop season. Each treatment consisted of 4 rows of strip crop on both sides of an 8-row x 75-ft cotton plot (Fig. 1). Strip crop treatments included three fall crops [fall canola, vetch, and wheat], three spring crops [spring canola, forage sorghum, and grain sorghum], a relay crop system comprising canola planted in the fall (2 outer rows) and grain sorghum in the spring (2 inner rows) [hereafter referred to as C/S-relay], and cotton as a check. Treatments were deployed in a randomized complete block design, with three replications as blocks. Treatment plots were separated from each other by a 25-ft strip of fallow land. Irrigation was applied as needed to ensure sufficient moisture in the soil.

Fall strip crop treatments of wheat, canola, and vetch and canola of the C/S-relay were planted on 11 October 1995. Fall crops were irrigated on 16 October 1995, 14 December 1995, and 8 February 1996. Spring canola was planted on 24 March 1996 and watered once immediately after seeding. Spring strip crop treatments of forage sorghum and grain sorghum and grain sorghum of the C/S-relay were planted on 8 April 1996, with a postseeding irrigation on the same day. All strip crops and cotton plots were irrigated on 14 May and the cotton var. ÔSphinxÕ was planted on 23 May, with a preplanting fertilization of 100-0-0 (N-P-K) lbs/ac.

Predator abundance in strip crops and cotton was monitored weekly throughout the crop season by taking a 15 s D-Vac sample from each treatment plot. Samples were sorted for each predator species, and the number and type of each species were recorded. Predator abundance

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1124-1127 (1997)
National Cotton Council, Memphis TN

in fall strip crops were monitored from 13 March through 10 June, whereas the spring strip crops were sampled from 13 May through 19 July. Predator abundance in cotton was monitored from 17 June through 26 August. Aphid abundance in cotton was estimated during the peak aphid period (7 - 26 August) by counting the number of aphids on 10 upper and 10 lower leaves from plants selected randomly within each treatment plot. Bollworm abundance was estimated by visually inspecting the number of larvae present in 13 row-ft per plot. Separate repeated measures analyses of variance (ANOVA) were performed for the predator abundances in fall crops, spring crops, and cotton and for aphid and bollworm abundances in cotton, with sample weeks as repeated measures (SAS Institute, 1995).

Results and Discussion

The most common predators collected in all crops included lady beetles, big-eyed bugs, soft-winged flower beetles, lacewings, pirate bugs, damsel bugs, assassin bugs, and various species of spiders. Overall, fall strip crops supported higher predator abundance compared with the spring strip crops (Fig. 2). Among the fall crops, vetch supported the highest numbers of total predators, followed by canola and wheat; spring crops were all similar in their ability to harbor predators (Fig. 2). Predator abundance in cotton was significantly affected by the adjacent strip crop, but this effect dissipated as the season progressed (Fig. 3). During the first five weeks of the sampling period, grain sorghum, C/S-relay, and vetch relayed the highest numbers of predators to cotton, while fall crops such as wheat and canola had no significant impact. Wheat and fall canola did not significantly enhance predator abundance in cotton because these crops matured before cotton was ready to support the dispersing predators (Fig. 4). However, vetch continued supporting predators for 4-5 more weeks after the date when wheat and canola matured. Spring strip crops overlapped temporally with cotton which provided continuity for relaying predators from strip crops to cotton (Fig. 5). Thus, predator abundances in cotton adjacent to spring strip crops were higher compared with the check plot, although not significant in all cases. Predator abundance in cotton during the second 6 weeks of the sampling period was not affected by the strip crops (Fig. 3).

The pattern of predator movement into cotton from adjacent crops early in the season (first 5 weeks of the sampling period) appeared to suppress aphid populations in cotton. Aphid numbers were highest in the check plot and lowest in the cotton plot adjacent to C/S-relay treatment (Fig. 6). Wheat, grain sorghum, spring canola, and C/S-relay all reduced aphid numbers in cotton significantly. Fall canola, vetch, and forage sorghum also reduced aphid numbers in cotton, but not significantly. Strip crops did not significantly impact bollworm abundance in cotton (Fig. 7).

Natural enemies are generally less effective in ephemeral, annual crops than in a more permanent system because annual crops must be recolonized each year (Ekbom 1994). In a relay cropping system utilizing winter, spring, and summer crops, plants are in the field long enough that recolonization by predators would not be interrupted in time. The timing of plant maturation and senescence is important to the success of relay intercropping by providing a new source of food to predators in the next crop while the prior intercrop senesces. In our study, fall canola and wheat terminated before the cotton was ready. On the other hand, vetch and all the spring crops acted as a natural enemy reservoir to relay predators to cotton due to their temporal overlap with the cotton. Fall intercrops adjacent to spring intercrops, such as C/S-relay in our study, rather than a sole strip of a fall or a spring crop may aid the establishment of predators in cotton. In a multiple crop relay system, predators arrive earlier and in higher numbers in cotton than they would have had the winter intercrops not been there. Results of this study indicate that relay intercropping is a promising strategy for enhancement of biological control of cotton aphids in agroecosystems that do not employ chemical means of insect control.

References

Alderweireldt, M. 1994. Habitat manipulations increasing spider densities in agroecosystems: possibilities for biological control? Journal of Applied Entomology 118: 10-16.

Bugg, R. L., F. L. Wackers, K. E. Brunson, J. D. Dutcher, and S. C. Phatak. 1991. Cool-season cover crops relay intercropped with cantaloupe: influence on a generalist predator, *Geocoris punctipes* (Hemiptera: Lygaeidae). Journal of Economic Entomology 84: 408-416.

Burleigh, J. G, J. H. Young, and R. D. Morrison. 1973. Strip-cropping's effect on beneficial insects and spiders associated with cotton in Oklahoma. Environmental Entomology 2: 281-285.

Corbett, A., and R. E. Plant. 1993. Role of movement in the response of natural enemies to agroecosystem diversification: a theoretical evaluation. Environmental Entomology 22: 519-531.

Ekbom, B. 1994. Arthropod predators of the pea aphid, *Acyrthosiphon pisum* Harr. (Hom., Aphididae) in peas (*Pisum sativum* L.), clover (*Trifolium pratense* L.) and alfalfa (*Medicago sativa* L.). Journal of Applied Entomology 117: 469-476.

Fukai, S., and B. R. Trenbath. 1993. Processes determining intercrop productivity and yields of component crops. Field Crops Research 34: 247-271.

Parajulee, M. N., R. Montandon, and J. E. Slosser. 1997. Relay intercropping to enhance abundance of insect predators of cotton aphid (*Aphis gossypii* Glover) in Texas cotton. International Journal of Pest Management (*in press*).

SAS Institute. 1995. JMP, Statistics Made Visual, Cary, NC.

Tonhasca, Jr., A. 1993. Effects of agroecosystem diversification on natural enemies of soybean herbivores. Entomologia Experimentalis et Applicata 69: 83-90.

Vandermeer, J. 1989. The ecology of intercropping. Cambridge University Press, pp. 237.

Field Map

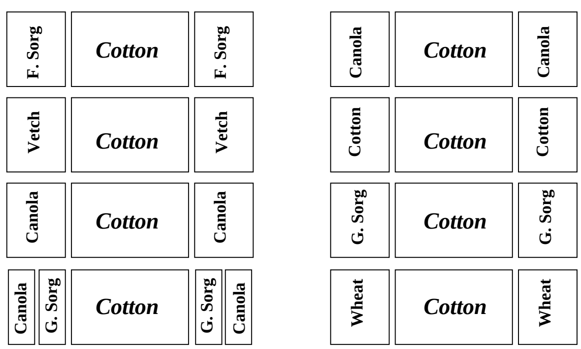

Figure. 1. Field map showing the deployment of eight strip crop treatments adjacent to cotton plots in one of the replications, Munday, TX, 1995-96.

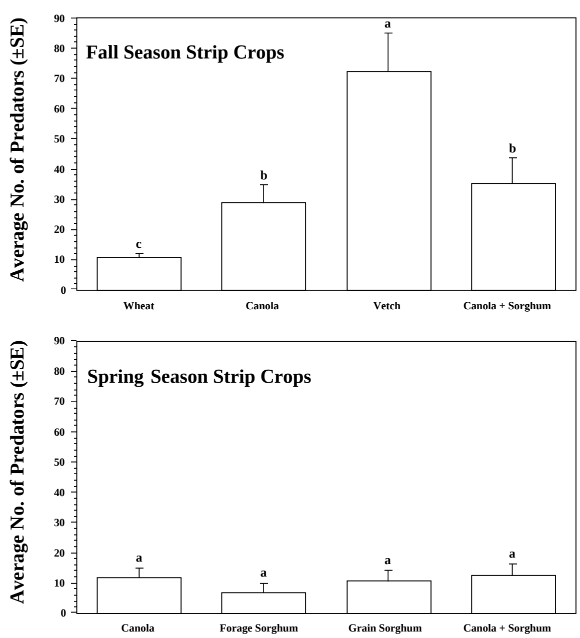

Figure. 2. Predator abundances in fall and spring strip crops, Munday, TX, 1995-96.

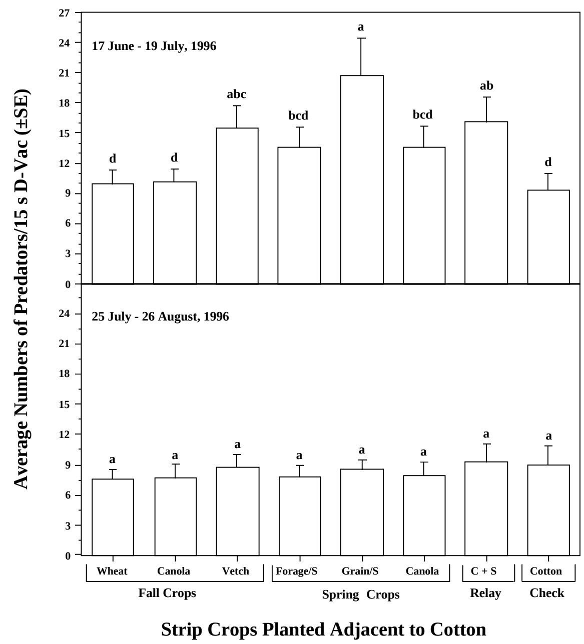

Figure. 3. Predator abundances in cotton, as affected by strip crops during the first five weeks and the second six weeks of the sampling season, Munday, TX, 1995-96.

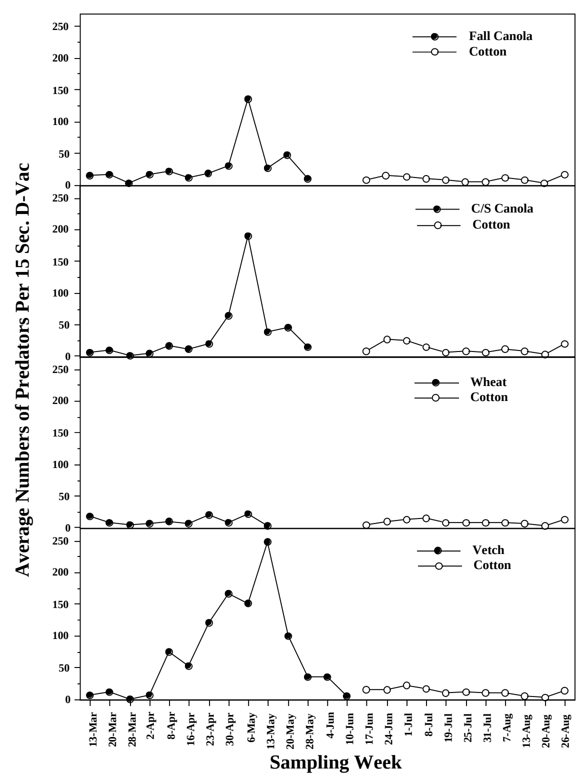

Figure. 4. Predator abundances in fall strip crops and cotton, Munday, TX.

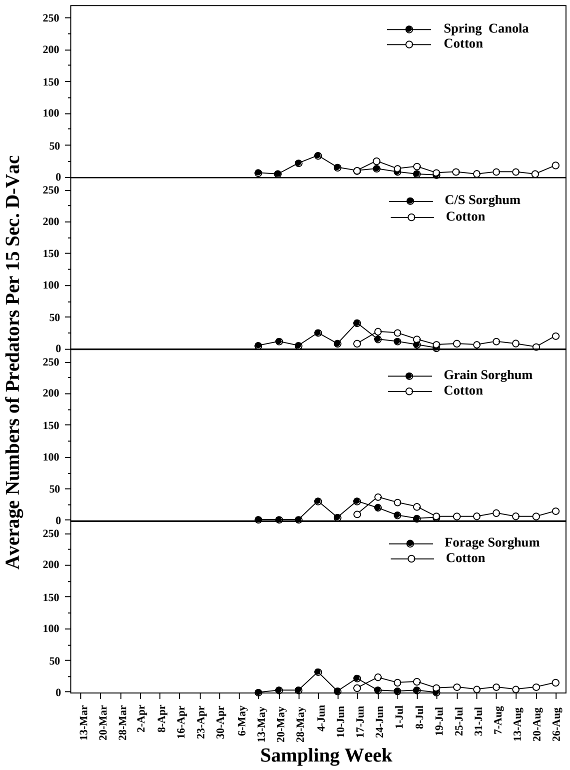

Figure. 5. Predator abundances in spring strip crops and cotton, Munday, TX, 1995-96.

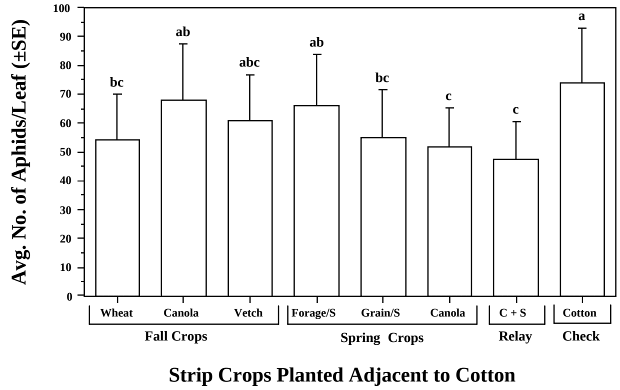

Figure. 6. Aphid abundance in cotton, as affected by strip crops, Munday, TX, 1995-96.

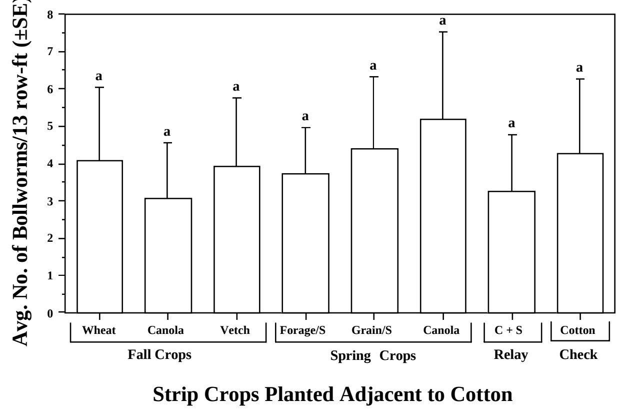

Figure. 7. Bollworm abundance in cotton, as affected by strip crops, Munday, TX, 1995-96.