# CULTURAL MANAGEMENT OF CUTWORM SPP. IN CONSERVATION TILLAGE SYSTEMS FOR COTTON

**B. R. Leonard[1], P. A. Clay[1], R. L. Hutchinson[1], and J. B. Graves[2]**

## INTRODUCTION

Conservation tillage practices result in a favorable microenvironment for insect populations by increasing host plant density and mediating soil moisture and temperature extremes (Gaylor and Foster, 1987; Stinner, 1990). The primary soil-dwelling cotton insect pests most likely to be affected hy conservation tillage practices include several cutworm spp. The black cutworm, *Agrotis ipsilon* (Hufnagel), granulate cutworm, *Agrotis subterrnea* (F.), and variegated cutworm, *Peridroma saucia* (Hubner), are considered to be occasional insect pests of seedling cotton. These insects indirectly reduce cotton yield by reducing plant stand densities below that which are necessary to produce optimum yields.

As producers implement reduced tillage systems and plant winter cover crops, adult oviposition sites and alternate hosts for cutworm spp. larvae become more available, and the probability of economic infestations of these insects increases. Cutworm spp. larvae are generally already present in conservation tillage production fields at the time cotton is planted. Destruction of the field vegetation that serves as alternate hosts causes these insect pests to move to cotton as an available food source.

Cutworm spp. infestations in cotton can be managed with insecticides, but in many instances, treatments are applied after serious plant stand loss has occurred. In addition, many of the in-furrow insecticides currently recommended to control other early-season insect pests possess little or no efficacy against cutworm spp. A preferred strategy to chemical control of these insect pests in California has been to terminate vegetation in fields at least 3 weeks before planting cotton (Anonymous, 1984). This study was conducted to determine the effects of vegetation management strategies applied at selected preplant intervals on cutworm spp. damage in cotton.

[1]Louisiana State University Agricultural Center, Macon Ridge Research Station, Winnsboro, LA 71295.
[2]Louisiana State University Agricultural Center, Department of Entomology, Baton Rouge, LA 70803.

## METHODS AND MATERIAIS

This study was conducted at the Macon Ridge Branch of the Northeast Research Station located near Winnsboro, Louisiana during *1991 and 1992. A winter* cover crop of hairy vetch, *Vicia sativa* L., was seeded on preformed rows in all plots (25 lb seed/A) in the fall of 1990 and 1991 to increase the prospect of economic cutworm spp. infestations during the following production season. Chembred 219 and Chembred 1135 cotton cultivars were planted in 4-row x 30 ft plots on 40-inch centers at approximately 4.6 seed/row ft. in 1991 and 1992, respectively. Planting dates were 6 May 1991 and 2 May 1992. Aldicarb (Temik 15G, 05 lb ai/A) was used as an in-furrow insecticide in all treatments to control cotton seedling insect pests because of its low efficacy against cutworm spp.

The test design was a randomized complete block with a factorial arrangement of treatment combinations in four replications. The treatments in this study included two vegetation management methods (tillage, herbicide) and four application timings (6, 4, 2, and 1 weeks preplant). Conventional tillage practices consisted of disking each plot twice with a disk harrow at each application interval. A final disking and bedding operation was performed 1 to 2 weeks before planting. The herbicide-treated plots received two applications of paraquat (Gramoxone Extra 25E, 0.47 lb ai/A) with the first being applied at the selected interval and the second treatment following 1 to 2 weeks later. The herbicide was applied with a tractor-mounted boom equipped with a compressed air delivery system calibrated to deliver 20 gallons total spray solution/A through flat fan 8004 nozzles (two/row) at 38 psi. Application timings for the vegetation management method were 19 and 13 March (6 weeks preplant), 2 and 2 April (4 weeks preplant), 17 and 15 April (2 weeks preplant), and 25 and 28 April (1 week preplant) in 1991 and 1992, respectively.

Recommended cultural practices, fertilization, and integrated pest management strategies were used to maintain all plots in a similar manner within each test. All plots receiving the tillage treatment were planted with a conventional planter. To facilitate the no-till planting operation through heavy surface vegetation in the herbicide-treated plots, the planter was modified with ripple coulters mounted in front of each seeding unit. All treatments were mechanically cultivated (1-2X) for weed control. No irrigation was used in these tests.

Treatment efficacy against cutworm infestations was evaluated by measuring plant stand density, plant stand reduction by cutworm spp., estimating intra-row skips (>40 inches) between plants, seedcotton yields, and crop maturity. Plant stand density, plant stand reduction, and intra-row skips were determined by sampling the entire two center rows of each plot. Plant stand reduction from cutworm spp. was calculated by sampling each plot once a week for 4 weeks after seedling emergence and using the cumulative total damaged plants. Plant stand density was measured at 4 weeks after seedling emergence, and the number of intra-row skips was recorded post-harvest. Seedcotton yields were determined by harvesting the center two rows of each plot with a mechanical spindle-type cotton picker on 18 September and 2 October during 1991 and 8 and 28 September during 1992. Crop maturity was determined by calculating the percentage of the total yield collected on the first date of harvest.

Results were subjected to analysis of variance (ANOVA) to determine significant treatment effects. Treatment means were separated with least significant differences (LSD, P = 0.05). These procedures were done using Statistical Analysis Systems (SAS) software modified for personal computers (SAS Institute, 1988).

## RESULTS

Samples of larvae collected from the test areas consisted primarily of black cutworms, although granulate cutworms and variegated cutworms were present in 1991 and 1992. Both methods of vegetation management, tillage and herbicide, adequately controlled the hairy vetch cover crop and significantly affected cutworm spp. infestations. Vegetation management and application timing significantly affected cutworm spp. infestations and influenced plant stand densities, seedcotton yields, and crop maturity (Table 1).

### Plant Stand Density

Plant stand densities in the plots treated with tillage (3.3 and 2.3 plants/ft) were significantly higher compared with that for the herbicide-treated plots (2.4 and 1.6 plants/ft) in 1991 and 1992, respectively. The plots treated 4 and 6 weeks before planting had higher plant stand densities compared with that for the plots treated 1 week preplant during both years (Table 2). A significant interaction between vegetation management and application timing was observed only in 1991. Although plant stand densities were consistently lower in the herbicide-treated plots compared with that for those plots treated with tillage for all application intervals, plant densities in the plots treated with a herbicide 1 and 2 weeks before planting were affected more than the plots treated with tillage at the same application intervals (Fig. 1).

Table 1. Summary of the analysis of variance results testing effects of vegetation management and application timing on plant stand density, percent stand reduction, intra-row skips, seedcotton yields, and crop maturity.

| | 1991 | | | 1992 | | |
|---|---|---|---|---|---|---|
| Variable | Veget. Manag. Method | Appl. Timing | Method x Timing | Veget. Manag. Method | Appl. Timing | Method x Timing |
| Plant stand density | **[1] | ** | ** | ** | ** | NS |
| Stand reduction (%) | ** | ** | ** | ** | ** | • |
| Intra-row skips | ** | ** | ** | ** | * | NS |
| Final yields | NS | NS | NS | * | ** | • |
| 1st harvest (%) | ** | * | NS | * | ** | NS |

[1]NS, no significant effect; * and ** indicates significance at 0.05 and 0.01 levels, respectively.

Table 2. Effects of vegetation management timing nn cotton plant development and cutworm spp. damaged plants (±SE).

| Application Timing[1] | Year 1991 | 1992 |
|---|---|---|
| Plant Stand Density (No./ft) | | |
| Six weeks | 3.3±0.2a[2] | 2.4±0.1a |
| Four weeks | 3.0±0.1ab | 2.0±0.1b |
| Two weeks | 2.7±0.2b | 1.7±0.2bc |
| One week | 2.4±0.3c | 1.6±0.2c |
| LSD | 0.31 | 0.37 |
| Stand Reduction (Percent) | | |
| Six weeks | 0.5±0.3b | 1.2±0.4b |
| Four weeks | 1.4±0.5b | 2.0±0.5b |
| Two weeks | 6.5±2.8a | 4.4±1.4a |
| One week | 10.8±4.6a | 5.0±1.6a |
| LSD | 4.82 | 2.03 |
| Intra-Row Skips (No./Plot) | | |
| Six weeks | 0.1±0.1b | 0.1±0.1b |
| Four weeks | 0.0±0.0b | 0.2±0.1b |
| Two weeks | 0.3±0.2b | 1.0±0.4ab |
| One week | 1.4±0.6a | 1.2±0.5a |
| LSD | 0.61 | 0.89 |
| Seedcotton Yield (lb/A) | | |
| Six weeks | 3776±212a | 1787±74a |
| Four weeks | 3691±240a | 1776±67a |
| Two weeks | 3814±216a | 1669±124a |
| One week | 3582±300a | 1433±106b |
| LSD | 308 | 185 |
| First Harvest (Percent) | | |
| Six weeks | 86.8±2.2a | 81.4±0.9a |
| Four weeks | 86.1±2.2ab | 79.8±1.8ab |
| Two weeks | 85.8±2.3ab | 75.9±1.86b |
| One week | 83.0±2.9b | 69.9±2.8c |
| LSD | 3.26 | 4.52 |

[1]Preplant timing treatments averaged across vegetation managment methods.
[2]Treatment means for each variable followed by a common letter are significantly different (LSD, P=0.05).

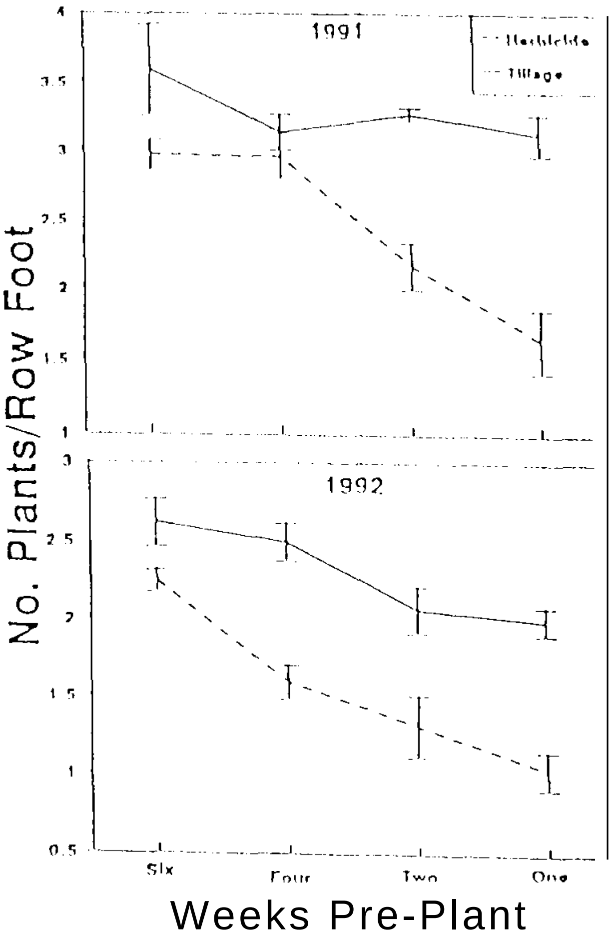


Fig. 1. Effect of vegetation management influenced by application timing on cotton plant stand density (±SE).

Cutworm Spp. Damaged Plants

The plots treated with tillage had lower plant stand reductions compared with that for the herbicide-treated plots, regardless of application timing. Percent stand reduction was significantly lower in the plots treated 4 and 6 weeks before planting compared with that for the plots treated 1 and 2 weeks preplant (Table 2). A significant interaction between factors was also observed for percent stand reduction and intra-skips during 1991 and 1992. Percent stand reductions were higher in the plots treated with the herbicide than in the plots treated with tillage at all application intervals, but plant stand losses increased dramatically in the plots treated with a herbicide 1 and 2 weeks before plant-ing compared with the tillage-treated plots (Fig. 2).

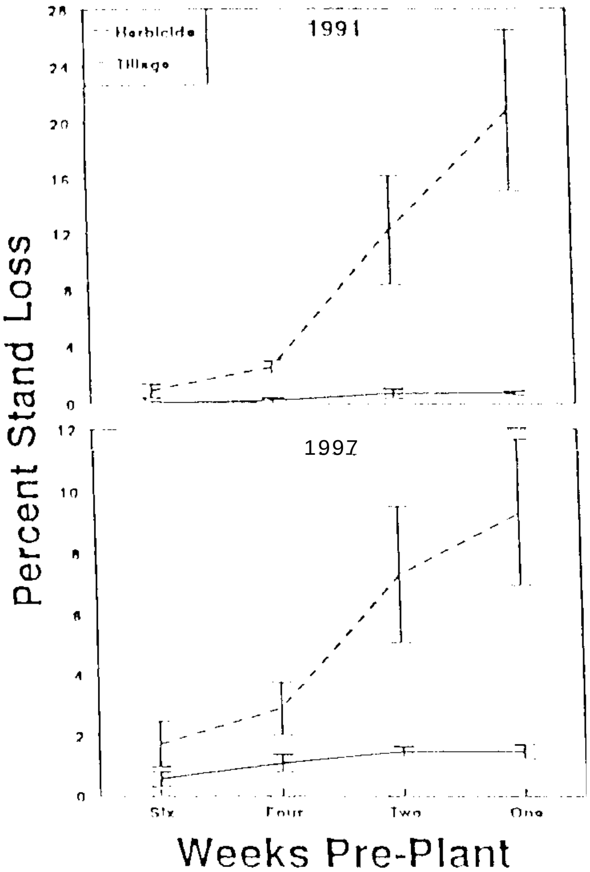


**Fig. 2.** Effect of vegetation management influenced by application timing on percent cotton stand reduction (±SE).

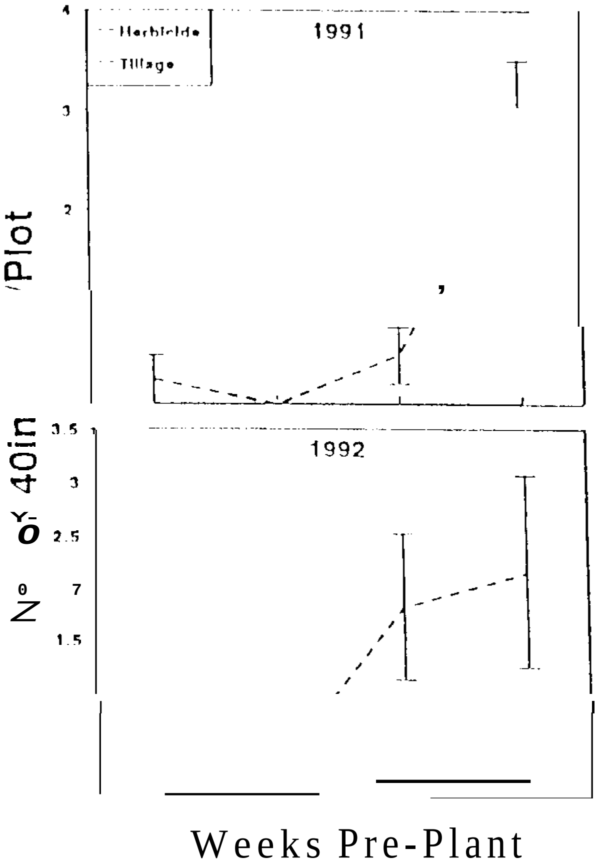


Fig. **3.** Effect of vegetation management influenced by application timing on number of intra-row 40 in. skips between cotton plants **(±SE).**

The plots treated with tillage also had fewer intra-row skips than that in the herbicide-treated plots, regardless of application timing during 1991 and 1992. Lower numbers of intra-row skips were observed in the plots treated 4 and 6 weeks before planting compared with that for the plots treated 1 week preplant during both years (Table 2). A significant interaction between factors was observed for intra-row skips in 1991. Intra-row skips between plants followed the same trend as that for plant stand reduction and serve to further illustrate the potential of cutworm spp. infestations, particularly in those instances where plant stand densities are only marginal for optimum yields (Fig. 3).

Seedcotton Yields and Crop Maturity

Seedcotton yields were not affected in 1991 by vegetation management or application timing. However, in 1992, seedcotton yields were significantly higher in the tillage-treated plots compared with that for the herbicide-treated plots. In 1992, the plots treated 4 and 6 weeks preplant had higher seedcotton yields compared with that for the plots that were treated only 1 week preplant (Table 2). Results for seedcotton yields are more variable than the other parameters, and a significant interaction between vegetation management and application timing was observed only in 1992. Seedcotton yields decreased In the plots treated with herbicides more consistently than in the tillage-treated plots as the application intervals approached the time of planting (Fig. 4).

During both years, the plots treated with tillage had an earlier maturing crop than that for the herbicide-treated plots. Earlier crop maturity was

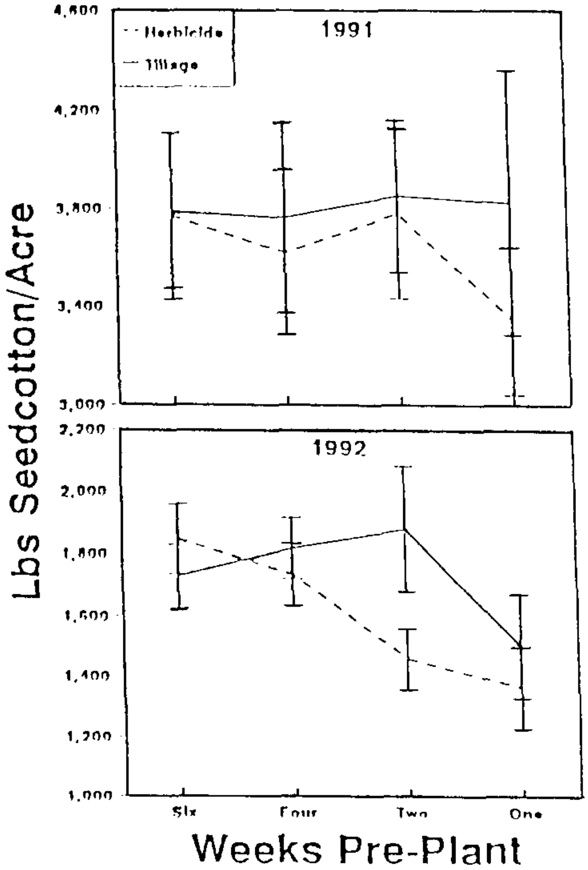


**Fig. 4.** Effect of vegetation management influenced by application timing on seedcotton yields (±SE).

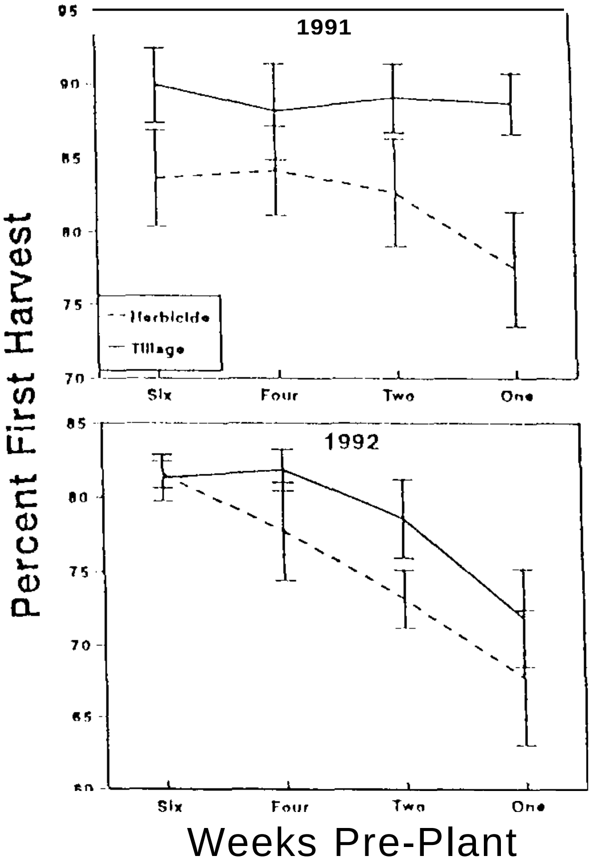


Fig. **5.** Effect of vegetation **management** influenced by application timing **on** crop maturity (±SE).

observed in the plots treated 4 and 6 weeks before planting compared with that for the plots treated 1 week preplant during both years (Table 2). A significant interaction between factors on crop maturity was not observed in either year. However, in response to the reduction in plant stand density and the increase in intra-row skips, crop maturity appeared to be delayed, especially in the herbicide-treated plots (Fig. 5).

## DISCUSSION

Although cutworm spp. remain occasional pests, studies in cotton have illustrated an increase in infestation densities and plant damage associated with conservation tillage production systems (Dumas, 1983; Gaylor et al., 1984). Reduced-tillage practices promote the development of weedy plant species that can serve as oviposition sites for adults and alternate hosts for larval development. In addition, the use of hairy vetch and crimson clover, *Trifolium incarnatum* L., as cultivated winter cover crops in conservation tillage systems fosters the development of economic cutworm spp. infestations (Oliver and Chapin, 1981; Gaylor and Foster, 1987).

Tillage can be an important source of mortality for cotton insect pests, including cutworm spp. (Gaylor and Foster, 1987). The results of this study demonstrate a significant increase in cutworm spp. damage to cotton in plots treated with a herbicide and planted no-till compared with those managed with conventional tillage practices. Optimum stand in conservation tillage systems is generally more difficult to obtain compared with conventional tillage practices because of the additional plant residue that remains on the soil surface. Therefore, the impact of cutworm infestations becomes more important as tillage practices are modified.

Preplant herbicide use strategies are as effective as tillage in managing native vegetation and winter cover crops, but the effects are somewhat delayed compared with the nearly immediate destruction obtained with tillage (Crawford and Collins, 1991; Hutchinson and Shelton, 1991). Depending on the specific herbicide treatment, the target plant species, and environmental conditions, complete desiccation of vegetation may require a few days to several weeks. Any delay in completely terminating vegetation with herbicides could improve the survival of cutworm spp. larvae and increase the probability of economic infestations occurring in seedling cotton. In the present study, two applications of paraquat were required to completely kill the hairy vetch cover crop because of vegetative regrowth. Plant root material probably provided an adequate food source for several days after the final herbicide treatment was applied. At least some of the differences between tillage and herbicide treatments were probably related to incomplete kill of the hairy vetch in the herbicide-treated plots that allowed cutworm spp. larvae to survive until cotton became an available host.

The timing of vegetation management operations had a significant effect on cutworm spp. infestations by removing alternate hosts before cotton seedlings became available. A lapse of 14 days between the destruction of vegetation with tillage and the time of planting corn was sufficient to significantly reduce economic damage from black cutworm (Showers et al. 1985). Recommendations to manage cutworm spp. in California suggest that the destruction of vegetation should occur at least 3 weeks prior to planting cotton (Anonymous, 1984). In addition to decreasing the survival of larvae already present in the field, early preplant destruction of vegetation reduces oviposition by decreasing alternate host attractiveness to cutworm spp. adults.

The information obtained in the present study provide additional evidence showing that cutworm spp. damage to cotton may be increased in conservation tillage systems compared with conventional tillage practices. These results also suggest that cutworm spp. damage to cotton can be suppressed by managing vegetation with tillage or with the herbicide paraquat at least 3 to 4 weeks in advance of planting (4 to 5 weeks before plant emergence). With the proper selection of herbicides, application rates, and treatment timing, it is likely that satisfactory vegetation management in conservation tillage systems can be accomplished. Additional information is needed to develop effective and economical preplant weed control strategies for conservation tillage systems that reduce economic infestations of cutworm spp. in cotton.

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