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INTERACTIONS OF WEEDS WITH SELECTED ARTHROPOD GROUPS AND COTTON IN THE LOWER RIO GRANDE VALLEY OF TEXAS

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Abstract

Vegetative diversification of agroecosystems with weeds has shown promise as a technique for enhancing natural enemy populations and suppressing pest induced damage to various crops. This study, using weedy (W) and weed-free (WF) cotton plots in the Lower Rio Grande Valley of Texas in 2000, showed that although some groups of herbivorous arthropod groups supported higher populations of some soil- and foliage-associated natural enemies, boll weevil damage to squares was not reduced. It is conjectured that this was because natural enemy populations were highest in late May and June, after most squares had become bolls and were less vulnerable to boll weevil oviposition than squares, and because the predators encountered are not effective enemies of boll weevils. Numbers of cotton bolls and lint yields were lower in W habitats than in WF habitats because of competition with the weeds.

Introduction

Vegetative diversification in some cropping systems has been associated with the suppression of certain pest arthropods (Altieri et al. 1978, Risch 1979, Letourneau 1986, Showler et al. 1990). Modifications of the polyculture concept include “strip cropping” to accumulate natural enemy populations or for trapping pests, and crop rotation that relies upon vegetative heterogeneity through time (Luckman and Metcalf 1975). In cotton, vegetative diversification has been shown to be effective in the form of strip cropping with alfalfa. Alfalfa retains lygus bug populations, and reservoirs beneficial insects (Stern et al. 1969, Godfrey and Leigh 1994). Safflower, kenaf, and redroot pigweed have also been reported as being possible trap crops for lygus bugs (Stewart and Layton 1996). However, Schultz (1988) found significantly fewer chrysopid eggs on cotton plants intercropped with corn and weeds than in cotton monocultures and suggested that the cause was nocturnal earwig predation of chrysopid eggs. The data described below are results from part of a multi-year study conducted to examine the interactions of indigenous weed growth on pest and beneficial arthropods, and on cotton growth and yield in the Lower Rio Grande Valley of Texas.

Materials and Methods

A 0.8 ha field at the USDA-ARS Kika de la Garza Subtropical Agricultural Research Center in Hidalgo Co., TX, was planted to var. Deltapine-50RR cotton on 6 March 2000. Each plot was 12 rows wide (row width = 1.2 m) by 53.3 m long and was either weedy (W) or weed-free (WF), each replicated six times in a completely randomized design. WF cotton habitats were treated with a post-plant application of Prowl™ (pendimethalin, 924 g a.i./ha), and at the 4-leaf stage of the cotton plants, weeds emerging in the furrows were removed with a rolling cultivator, and weeds on the rows were manually removed on a weekly basis and spot treated with glyphosate two weeks after planting.

Weed biomass in the W plots was measured on 18 April, 1 June, and 7 July 2000 by clipping all weed growth at the soil surface in two randomly thrown 0.5 m^2 quadrats per plot. The weed species were partitioned and dried for 48 h at 60^{o} C, then weighed. Soil surface-associated arthropods were sampled using two pitfall traps (Greenslade 1964) per plot changed once every two weeks from 2 May to 27 June 2000. Arthropods in the groups listed in Table 2 were counted in 70% isopropyl alcohol after the jars’ contents were emptied into counting trays. A dvac machine (Dvac Company, Ventura, CA) was used to collect arthropods from cotton in the W and WF plots and from weed foliage in the W plots by placing the 33 cm diameter nozzle directly onto cotton or weed foliage for five seconds at five random locations within the four central rows of each plot. Dvac sampling was conducted every two weeks from 1 May to 27 June 2000. Dvac collection bags were emptied into jars with 70% isopropyl alcohol and stored until the contents were poured into counting trays, classified into the groups listed in Table 3, and counted. *Solenopsis geminata* (F.) colonies were counted on 3 July by prodding visible ant nests with a rod and identifying the ant species that emerged (O’Keefe et al. 1999).

Boll weevil damage was determined by examining 50 randomly selected squares per plot on 22 and 30 May. Numbers of squares and bolls in a 7.6 m section of row in each plot were counted on 1 May and 19 June, respectively. On 15 May, heights of 25 randomly selected cotton plants in each plot were recorded. The plots received an application of DEF™ at

1,681 g a.i./ha on 7 July. Cotton was hand harvested from two 4 m lengths of row in each plot on 14 July, ginned, and the lint was weighed.

ANOVA was used to detect differences between means for weed biomass, boll weevil injury to cotton squares, and cotton growth and yield. The repeated measures analysis was run to assess the effects of both treatment and time on the numbers of insects collected in the pitfall traps and in the dvac. Whenever treatment effects were significant, treatment means were compared on each date using ANOVA and Tukey's HSD to separate means. Insect numbers were log(x+1)-transformed before repeated measures analyses; however, untransformed means are presented. Pearsons correlations were run on numbers of total prey and total predators collected in pitfall traps, and in dvac samples (Analytical Software 1998).

Results

Weed species were comprised of pigweed, *Amaranthus* spp., common ragweed, *Ambrosia artemisifolia* L., ground cherry, *Physalis heterophylla* Nees, spurge, *Euphorbia* sp., and Texas panicum, *Brachiaria texana* (Buckl.) S.T. Blake (Table 1). Dry weed biomass in the W plots increased from 18 April to 1 June ≈ 4.3 times, and from 18 April to 7 July ≈ 5.6 times. Dicot weeds ranged from ≈ 38% dry biomass on 18 April to ≈ 51% on 1 June.

Prey

The repeated measures analyses revealed that the treatment had a significant effect on the numbers of pitfall collected cicadellids ($P < 0.0001$), herbivorous coleopterans ($P = 0.017$) and hemipterans ($P < 0.0001$), dipterans ($P < 0.0001$), lepidopteran larvae ($P < 0.0001$), and orthopterans ($P = 0.0016$). The effect of time was significant on the numbers of cicadellids ($P = 0.0065$), herbivorous hemipterans ($P = 0.0027$), dipterans ($P < 0.0001$), lepidopteran larvae ($P < 0.0001$), and orthopterans ($P = 0.0016$). A significant interaction was detected between treatment and time effects for numbers of dipterans ($P < 0.0001$). The repeated measures analyses revealed that the treatment had a significant effect on the numbers of dvac collected aphids ($P = 0.0031$), cicadellids ($P < 0.0001$), herbivorous coleopterans ($P < 0.0001$) and hemipterans ($P < 0.0001$), dipterans ($P < 0.0001$) lepidopterous larvae ($P < 0.0001$), thrips ($P < 0.0001$), and whiteflies ($P = 0.0003$). The effects of time were significant on the numbers of aphids ($P < 0.0001$), dipterans ($P < 0.0001$), herbivorous hemipterans ($P < 0.0001$), lepidopteran larvae ($P < 0.0001$), thrips ($P < 0.0001$), and whiteflies ($P = 0.0003$). Significant interactions between treatment and time effects were detected for numbers of herbivorous coleopterans ($P = 0.0044$), lepidopteran larvae ($P = 0.0009$), thrips ($P = 0.0001$), and whiteflies ($P < 0.0001$).

Pitfall collected lepidopteran larvae were more numerous in the W plots on 16 May ($P = 0.0015$), 30 May ($P = 0.0025$), 13 June ($P = 0.0082$), and 27 June ($P = 0.017$) (Table 2). In the dvac samples, lepidopteran larvae were more abundant on W cotton than on WF cotton and weed foliage on 30 May ($P = 0.001$) and on 27 June ($P < 0.0001$) (Table 3). Herbivorous coleopterans were more abundant in W pitfalls on 2 May ($P = 0.0282$), 30 May ($P = 0.0246$), and 13 June ($P = 0.0041$), and foliage-associated herbivorous coleopterans were more numerous on the weeds than on WF cotton on 16 May ($P = 0.0026$) and 13 June ($P = 0.0192$), and they were more abundant on weeds than on cotton plants in either regime on 27 June ($P = 0.021$). Herbivorous hemipterans occurred in higher numbers in W pitfalls on 16 May ($P = 0.0448$), 30 May ($P = 0.0027$), 13 June ($P = 0.0335$), and 27 June ($P = 0.0185$). Dvac collected herbivorous hemipterans were more abundant on the weed foliage than on WF cotton plants on 30 May ($P = 0.003$), 13 June ($P < 0.0001$) and 27 June ($P = 0.0008$), and on 16 May and 27 June populations of herbivorous hemipterans were significantly higher on weed foliage than on cotton plants in the W habitats (P = 0.003 and $P < 0.0001$, respectively). Diptera ns collected in pitfalls were more abundant in W plots on 16 May ($P = 0.0013$), 30 May ($P = 0.035$), and 13 June ($P = 0.0008$). Similarly, dipterans were less numerous in dvac samples taken from WF cotton plants than from weed foliage on 16 May ($P = 0.0096$), and dipterans were less numerous in dvac samples taken from WF cotton plants than from W cotton plants on 30 May ($P = 0.0031$), 13 June ($P = 0.0013$, and 27 June ($P = 0.0041$). Numbers of cicadellids in W pitfall jars were higher than in WF pitfalls on 2, 16, and 30 May, and on 13 and 27 June ($P = 0.069$, 0.0094, 0.0002, 0.0074, and 0.025, respectively). Cicadellids were more abundant on weed foliage than on WF cotton plants on 16 May ($P = 0.0073$), and they were more abundant on weed foliage and W cotton than on WF cotton on 30 May ($P = 0.0085$), 13 June ($P = 0.0012$), and 27 June ($P < 0.0001$). On 30 May, dvac collected whitefly, *Bemisia argentifolii* Bellows and Perring, numbers on W cotton and WF cotton marginally were higher than on weed foliage (3-fold and 2-fold, respectively, $P = 0.0757$), and numbers were higher on WF cotton than on W cotton and weed foliage on 13 June (3 times and 4.5 times, respectively, $P = 0.0499$) and on 27 June (7.5 times and 18 times, respectively, $P = 0.005$). Cotton aphid, *Aphis gossypii* Glover, numbers were greater on WF cotton than on weed foliage on 27 June (5 times, $P = 0.0303$), and, though not statistically different ($P > 0.05$), aphid numbers on WF cotton were 4.5 times higher than on W cotton. Populations of orthopterans collected in the pitfall traps were higher in the W plots than in the WF plots on 13 June ($P = 0.009$), and populations were also numerically, though not statistically, higher on the other four sampling dates. Thrips were more abundant on weed foliage than on W and WF cotton plants on 2 May and 16 May ($P = 0.042$ and $P = 0.0001$, respectively), and on 30 May, thrips on weed foliage were more abundant than on WF cotton ($P = 0.0172$).

Natural Enemies

The repeated measures analyses showed that the treatment had significant effects on the numbers of carabids ($P = 0.00015$), dermapterans ($P < 0.0001$), and *Geocoris* spp. ($P = 0.0004$). The effects of time were significant on the numbers of coccinellids ($P < 0.0001$), dermapterans ($P = 0.0473$), *Orius* spp. ($P < 0.0001$), staphylinids ($P < 0.0001$), wasps ($P = 0.0039$), and spiders ($P < 0.0001$). Significant interaction were detected between treatment and time effects for numbers of carabids ($P = 0.0343$), coccinellids ($P = 0.0003$), and *Geocoris* spp. ($P = 0.0006$). The effects of time were significant on the numbers of *Geocoris* spp. ($P < 0.0001$), nabids ($P < 0.0001$), reduviids ($P = 0.0046$), *Orius* spp. ($P < 0.0001$), neuropterans ($P = 0.0008$), and spiders ($P < 0.0001$). Significant interactions between treatment and time effects were detected for numbers of *Geocoris* spp. ($P = 0.0113$), nabids ($P = 0.0051$), *Orius* spp. ($P = 0.0015$), and reduviids ($P = 0.0306$).

Dermapterans collected in pitfall jars were more numerous in the W habitats than in the WF plots on 2 May ($P = 0.004$), 30 May ($P = 0.0086$), 13 June ($P = 0.019$), and 27 June ($P = 0.0034$) (Table 2). Carabids were more abundant in the W pitfalls on 27 June ($P = 0.0036$). Staphylinid beetles were marginally more numerous in W pitfalls on 13 and 27 June ($P = 0.0677$ and 0.0522, respectively). Dermaptera, Carabidae, and Staphylinidae were not collected in the dvac. *Geocoris* spp. in the pitfalls were higher in the W plots on 27 June ($P = 0.0103$), and they were more numerous in dvac samples taken from W cotton on 13 June ($P = 0.0052$) and on 27 June *Geocoris* spp. numbers on weed foliage and W cotton plants were higher than on WF cotton plants ($P = 0.0002$). *Orius* spp. numbers were $\leq 2.5 \pm 0.5$ in the pitfall traps throughout the sampling dates and no treatment differences were detected. *Orius* spp., however, occurred in higher numbers on weed foliage as compared to WF cotton plants on 2 May ($P = 0.0247$), on 16 May Orius spp. populations were higher on the weed foliage than on W and WF cotton ($P < 0.0001$), on 13 June *Orius* spp. numbers on weed foliage and W cotton plants were greater than on WF cotton plants ($P = 0.0064$), and on 27 June marginally more *Orius* spp. were collected from the weed foliage than from W and WF cotton plants ($P = 0.051$). nabids, also collected low numbers ($\leq 0.5 \pm 0.2$) in the pitfalls, were most abundant in dvac samples taken from weed foliage and W cotton plants than from WF cotton plants on 13 June ($P = 0.0164$) and on 27 June populations on the weed foliage were higher than on the WF cotton plants ($P = 0.0168$). Pitfall collected wasp populations tended to be lower in W plots but the differences were not statistically significant. However, the dvac samples showed that wasps were more numerous on the weed foliage than on the WF cotton plants on 16 May ($P = 0.0085$) and wasps were more abundant on W cotton and weed foliage than on the WF cotton plants on 30 May ($P = 0.0058$), 13 June ($P = 0.0019$), and 27 June ($P = 0.0021$). Pitfall collected neuropterans did not show treatment associated trends but dvac collected neuropterans were more abundant on weed foliage than on cotton plants in either habitat ($P = 0.0392$). Although pitfall collected spiders showed no treatment effects, spiders were more abundant in dvac samples taken from W cotton than on WF cotton and weed foliage on 13 June ($P = 0.0118$), and they were more numerous on the weed foliage than on the WF cotton on 27 June ($P = 0.0217$).

Ants, mostly leafcutters, *Attus* spp., and *S. geminata* (*Solenopsis invicta* Buren were not found) collected in the pitfalls did not show treatment associated trends, and the dvac collected more ants in the WF cotton than on weed foliage on 30 May ($P = 0.0475$). Treatment effects were not detected for pitfall and dvac collected coccinellid populations.

Reduviids and *Collops* beetles were consistently $< 0.5 \pm 0.2$ (except on 13 May when 1.7 ± 0.6 reduviids were collected in the dvac from W cotton plants) and neither type of predator showed treatment-associated trends in the pitfall traps and the dvac samples.

Correlations between numbers of total prey and total natural enemies in the pitfall traps or in the dvac samples were low (≤ 0.64) and not significant.

Cotton Square Damage and Lint Yield

There was no statistically detectable effect of weeds on numbers of squares damaged by boll weevils on both sampling dates in late May (Table 4), but there were 75% fewer bolls ($P \leq 0.0001$) in the W plots than in the WF plots a month later (Table 5), and this was reflected by the 85% lower ($P \leq 0.0001$) lint yield in the W plots.

Discussion

In this study, herbivorous arthropods were considered to be prey, even though predatory arthropods can also be preyed upon by other predators (Vinson and Scarborough 1989). Considering both pitfall and dvac data, lepidopteran larvae, herbivorous Hemiptera and Coleoptera, Diptera, Cicadellidae, Thripidae, and Orthoptera generally occurred in the highest numbers in the W plots as compared to the WF plots, particularly as weed biomass increased later in the season. Association of higher prey populations with increased weed biomass has been reported in other crops (Ali and Reagan 1985, Showler and Reagan 1991). The higher numbers of whiteflies on WF cotton than on weed foliage and W cotton in June reflect the preference of *B. argentifolii* for cotton plants (Reynolds et al. 1975) over weeds. The data suggest that dense weed growth might deter or impede some whiteflies from settling on weeds and cotton plants in weedy areas, as has been reported to occur with other insects in different vegetatively diversified crops (Risch 1979, 1980). It is also possible that the higher numbers of some natural enemy groups in the W plots contributed toward the lower numbers of whiteflies and aphids in those plots, and this has been shown to be the case in the crop systems with different insects (Altieri and Whitcomb 1980, Altieri 1984, Showler and Reagan 1991). The higher aphid populations on WF cotton plants than on weed foliage in late June might have occurred for the same reasons postulated for the whitefly populations trends.

Considering both pitfall and dvac data, natural enemies Dermaptera, *Orius* spp., and Nabidae were more abundant in the W habitats on two to four sampling dates, and to a lesser extent W habitats also appear to have favored carabids, *Geocoris* spp., neuropterans, formicids, and spiders. Coccinellid numbers, highest in the WF pitfall traps, might have been because of a trend for numerically higher populations of cotton aphids collected in the dvac from WF cotton plants. Ant populations were associated to some extent with WF cotton possibly because many ant species prey on aphids or use their honeydew secretions for food (Way 1963). Increased prey availability was associated with trends for greater abundances of 8 of the 14 pitfall collected natural enemy groups.

Significant effects of time on 8 of the 9 groups of prey arthropods most likely occurred because the vegetation food resources that the herbivores prefer, whether it was WF cotton (as in the case of whiteflies) or weed foliage (as in the case of most of the other herbivore groups), increased with time. The significant effect of time on aphids resulted from the aphid population peaks that did not always reflect a direct relationship with increases in cotton plant biomass. Other factors, possibly unrelated to food resource availability and not measured in this study, seem to have been regulating cotton aphid populations. Significant effects of time on 9 of the 14 natural enemy groups probably occurred because the quantity of prey items increased with time. However, correlations between total prey and total natural enemy numbers for the pitfall and dvac samples were not high and many were not significant mostly because of the large variability in samples (caused to some extent by ant populations) and because some prey and predator groups were highest in the W plots while others were highest in the WF plots. Significant interactions between treatment and time effects in relation to prey arthropod groups were detected only for herbivorous coleopterans, lepidopteran larvae, thrips, and whiteflies.

Significant interactions between treatment and time effects in relation to prey and natural enemy groups reflect differing population trends in the W compared to the WF habitats that were observed over time. For example, whitefly numbers increased on the WF cotton over time in contrast to declining whitefly numbers in the W plots, and particularly on the weed foliage.

Despite the trends for some predaceous arthropods to be more abundant in the W plots, the natural enemies failed to reduce boll weevil oviposition injury to squares. The natural enemy populations built to significantly greater levels in W plots in late May and June when weed biomass was highest and when most squares had already become bolls which are less vulnerable to boll weevil oviposition (Hunter 1912, Howard 1921). Also, most natural enemies, with the exception of *S. invicta* in other cotton growing areas in Texas (Sterling et al. 1984), are not considered to be major causes of mortality to boll weevils (Jones and Sterling 1979). Mortality resulting from heat has been identified as being the most important influence on boll weevil populations during the cotton growing season (Lincoln 1978, Parajulee et al. 2001).

The numbers of squares were not significantly different between the W and WF regimes because boll weevil damage was not altered by the treatments and because weed growth in early May was apparently too light to have caused a weed-competition related decline in square production. The fewer bolls counted in the late season when weed competition resulted in lower plant heights was likely induced by thigmomorphogenesis (wind or rubbing against other plants that causes reduction in plant heights) (Jaffe and Forbes 1993) and shading (Zhao and Oosterhuis 2000) by taller weeds (Showler 2001). The lower cotton lint yields in the W plots reflected the lower numbers of bolls. These results agree with studies in Asia that reported that cotton yields were either unaffected or reduced when interplanted with groundnuts, soybeans, greengram, and blackgram (Sanandachari et al. 1980, Musande et al. 1982, Hasnam 1986, Hasnam and Sulistyowati 1989), even though other researchers found more natural enemies in cotton interplanted with corn (Wille 1951, Shalaby et al. 1984), sorghum, and rape (Zhang 1993). However, Waterworth (1994) showed that yields of intercropped cotton and groundnuts grown on alternating ridges 75 cm apart did not improve in low rainfall areas.

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Table 1. Mean weed dry biomass (g/0.5 $m^2 \pm$ SE) in weedy cotton plots, Hidalgo Co., TX, 2000.

Species	**18 April**	**1 June**	**7 July**
Pigweed	8.9 ± 2.1 b	38.5± 10.2 a	35.5 ± 8.6 ab
Common ragweed	0.3 ± 0.1 b	13.1 ± 3.3 a	13.8 ± 4.3 a
Ground cherry	0.2 ± 0.2	1.8 ± 1.1	2.1 ± 1.2
Spurge	0.1 ± 0.02	0.4 ± 0.4	1.2 ± 0.7
Texas panicum	15.4 ± 5.6 b	52.4 ± 6.1 b	86.9 ± 5.4 a
Total weeds	24.8 ± 5.6 b	106.2 ± 17.0 a	140 ± 15a

Means followed by different letters within the same species are significantly different ($P \leq 0.05$). Means not followed by letters are not significantly different.

Table 2. Mean numbers of selected prey and predatory arthropod groups collected in pitfall traps in cotton, Hidalgo Co., TX, 2000.

Arthropod group[a]	Weed Regime[b]	5/2	5/16	5/30	6/13	6/27
Prey						
Lepidoptera	W	0.8	1.7a	2.0a	2.3a	5.0a
larvae	WF	0.2	0.4b	0.4b	0.5b	1.7b
Coleoptera[c]	W	24.8a	13.3	14.5a	16.1a	12.1
	WF	12.6b	13.0	9.9b	8.6b	9.5
Hemiptera[d]	W	8.0	7.3a	13.2a	17.0a	6.6a
	WF	7.6	4.5b	4.8b	6.7b	2.4b
Diptera[c]	W	39.1	150.8a	171.8a	130.6a	14.9
	WF	27.2	40.7b	50.4b	15.2b	10.9
Cicadellidae	W	29.8a	19.3a	23.7a	29.8a	53.8a
	WF	6.8b	3.4b	2.2b	2.7b	2.4b
Orthoptera[f]	W	2.8	3.4	3.2	4.8a	5.7
	WF	0.7	1.2	1.3	1.2b	5.0
Predators						
Dermaptera	W	78.2a	32.2	51.8a	73.9a	150.2a
	WF	5.4b	23.4	21.1b	38.9b	35.5b
Carabidae	W	1.7	4.2	4.7	5.2	8.2a
	WF	2.0	6.4	2.7	2.0	1.2b
Coccinel.	W	4.3	2.8	3.2	1.8	0.4
	WF	8.6	11.6	9.7	3.2	1.3
Staphylin.	W	11.5	12.6	18.5	29.9	83.5
	WF	18.8	14.1	17.7	21.8	55.6
Collops[g]	W	0.7	0.2	0.6	0.4	0.5
	WF	0.6	0.6	0.2	0.1	0
Wasps[h]	W	10.0	25.8	25.1	23.8	12.5
	WF	20.0	22.6	19.4	14.2	10.5
Formicidae[i]	W	70.2	73.8	70.7	56.0	37.1
	WF	59.4	121.1	50.2	75.4	76.3
Geocoris[j]	W	13.0	6.3	5.1	6.5	14.6a
	WF	9.5	4.8	5.2	6.1	2.2b
Orius[k]	W	0.2	2.3	2.3	1.7	0.8
	WF	0.8	2.3	2.5	1.5	0.2
Nabis[l]	W	0	0.2	0.2	0.2	0.4
	WF	0	0.5	0.1	0.1	0.1
Reduviidae	W	0.1	0.1	0.1	0.1	0.2
	WF	0	0.2	0.2	0	0
Neuroptera[m]	W	0.1	0.5	0.6	0.8	0.1
	WF	0.2	0.5	0.6	0.2	0.2
Araneae[n]	W	4.1	3.9	6.2	9.3	29.2
	WF	3.5	3.1	6.1	9.7	20.7

[a] Numbers followed by different letters for each arthropod group within each date are significantly different ($P \leq 0.05$). Numbers not followed by letters are not significantly different.
[b] W, weedy; WF, weed-free.
[c] Mostly Anthicidae, Chrysomelidae, Elateridae, and Tenebrionidae.
[d] Mostly Largidae, Lygaeidae, Miridae, and Pentatomidae,
[e] Mostly Agromyzidae, Calliphoridae, Cecidomyiidae, Chironomidae, Dolichopodidae, Drosophilidae, Muscidae, and Sacrcophagidae.
[f] Mostly Acrididae, Gryllidae, and Blattidae.
[g] Family Melyridae.
[h] Mostly Braconidae, Eupelmidae, Eurytomidae, Ichneumonidae, Pteromalidae. Sphecidae, and Trichogrammatidae.
[i] Mostly *Attus* and *Solenopsis* spp.
[j] Family Lygaeidae.
[k] Family Anthocoridae.
[l] Family Nabidae.
[m] Families Chrysopidae and Hemerobiidae.
[n] Mostly in families Clubionidae, Linyphiidae, Lycosidae, Salticidae, and Thomisidae.

Table 3. Average numbers of selected prey and predatory arthropod groups collected by dvac, Hidalgo Co., TX, 2000.

Arthropod group[a]	Weed Regime[b]	5/2	5/16	5/30	6/13	6/27
Prey						
Lepidoptera	CW	0.3	0.3	1.3a	0.5	6.3a
larvae	CWF	0.2	0.5	0b	0.2	2.5b
	W	0.5	0.7	0.2b	1.3	1.2b
Aleyrodidae	CW	65.0	177.8	181.3	81.0b	77.2b
	CWF	31.5	138.0	121.3	372.8a	579.7a
	W	65.0	194.5	57.7	82.3b	32.2b
Aphididae	CW	18.0	0.8	0.3	0.2	1.3ab
	CWF	34.0	1.5	0	0.8	6.0a
	W	13.7	1.0	0.2	0.2	1.2b
Cicadellidae	CW	7.3	19.3ab	71.7a	177.0a	63.3b
	CWF	1.2	3.7b	6.3b	12.8b	9.3c
	W	11.8	44.8a	55.3a	192.7a	167.2a
Thripidae	CW	6.0b	13.5b	5.3ab	7.2	11.3
	CWF	3.3b	8.2b	1.7b	5.3	13.5
	W	54.0a	41.0a	11.5a	5.3	12.3
Hemiptera[c]	CW	6.0	6.0b	45.3a	92.7a	33.8b
	CWF	1.7	6.3ab	8.5b	14.2b	11.5b
	W	9.3	14.8a	62.5a	117.2a	96.2a
Coleoptera[d]	CW	0	3.7ab	4.2	7.0ab	3.7b
	CWF	0	0.5b	2.0	1.3b	3.2b
	W	0.8	6.7a	3.0	8.8a	11.7a
Diptera[c]	CW	11.3	51.5ab	150.2a	75.7a	171.2a
	CWF	4.8	27.0b	26.0b	30.7b	62.5b
	W	13.7	63.7a	134.5a	79.7a	144.2a
Predators						
Geocoris[f]	CW	2.8	1.7	5.0	22.7a	13.3a
	CWF	0.2	1.0	0.5	2.2b	0.7b
	W	2.2	3.8	3.2	14.5ab	13.3a
Orius[s]	CW	0.7ab	16.5b	21.0	17.2a	1.7
	CWF	0b	10.0b	9.7	2.3b	1.5
	W	4.2a	40.3a	26.8	20.2a	3.5
Nabis[h]	CW	0	0	2.5	7.3a	2.2ab
	CWF	0.2	0.2	0.2	0.8b	0.5b
	W	0.5	0.6	2.2	7.5a	4.8a
Reduviidae	CW	0	0	0	1.7	0
	CWF	0	0	0	0	0
	W	0.2	0	0	0.3	0.3
Coccinel.	CW	0.7	1.0	1.0	3.0	0.7
	CWF	1.7	0.8	0.3	0.2	0.8
	W	0.8	0.3	1.5	1.3	0
Collops[i]	CW	0	0.3	0.3	0.2	0.8
	CWF	0.2	0.2	0	0	0
	W	0.5	0.3	0	0	0
Formicidae[j]	CW	1.3	2.7	1.2ab	1.7	1.2
	CWF	1.3	5.2	5.0a	3.3	3.8
	W	2.3	1.2	0.3b	3.0	0.3
Wasps[k]	CW	8.2	41.8ab	62.3a	76.3a	128.7a
	CWF	11.5	22.8b	18.7b	27.8b	44.2b
	W	13.3	78.2a	57.7a	96.8a	122.8a

Neuroptera[l]	CW	0.2	1.5	1.3	1.0	1.3b
	CWF	0	0.2	0.5	0.5	1.2b
	W	0	2.7	2.3	1.3	3.7a
Araneae[m]	CW	0.8	1.7	2.0	8.3a	4.8ab
	CWF	1.0	0.7	0.7	2.2b	2.0b
	W	0.7	1.8	0.3	3.3b	8.3a

[a] Means followed by different letters in each column and within each date are significantly different ($P \leq 0.05$); means not followed by letters in each column and within each date are not significantly different ($P \geq 0.05$).
[b] CW, cotton in weedy plots; CWF, cotton in weed-free plots; W, weeds in weedy plots.
[c] Mostly Largidae, Lygaeidae, Miridae, and Pentatomidae.
[d] Mostly Anthicidae, Chrysomelidae, and Elateridae.
[e] Mostly Agromyzidae, Calliphoridae, Cecidomyiidae, Chironomidae, Dolichopodidae, Drosophilidae, and Muscidae.
[f] Family Lygaeidae.
[g] Family Anthocoridae.
[h] Family Nabidae.
[i] Family Melyridae.
[j] Mostly *Attus* and *Solenopsis* spp.
[k] Mostly Braconidae, Eulophidae, Eupelmidae, Ichneumonidae, Pteromalidae, Sphecidae, and Trichogrammatidae.
[l] Families Chrysopidae and Hemerobiidae.
[m] Mostly Linyphiidae, Salticidae, and Thomisidae.

Table 4. Mean numbers (± SE) of boll weevil damaged squares out of 50 randomly selected squares per treatment replicate in weedy (W) and weed-free (WF) cotton, Hidalgo Co., TX, 2000.

Treatment[a]	**22 May**	**30 May**
W	10.8 ± 2.0	14.2 ± 2.8
WF	9.2 ± 3.6	14.7 ± 2.7

[a] n=6.

Table 5. Mean numbers[a] of cotton squares and bolls, plant heights, and lint yields in weedy (W) and weed-free (WF) field plots, Hidalgo Co., TX, 2000.

Treatment	**No. squares[b]**	**No. bolls[c]**	**Plant heights (cm)[d]**	**Lint yield (kg/ha)[e]**
W	97.2	78.8 b	26.1 b	48.8 b
WF	101.3	312.5 a	37.8 a	460.7 a

[a] Means followed by different letters with in the same column are significantly different (P < 0.05). Means in each column not followed by letters are not significantly different.
[b] Per 7.6 m row per plot, n = 6, 1 May 2000.
[c] Per 7.6 m row per plot, n = 6, 19 June 2000.
[d] 25 plants per plot, n = 6, 15 May 2000.
[e] Based on hand picked cotton from two 4 m sections of row per plot, n = 6, 14 July, 2000.