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TITLE: Survey of Lady Beetles (Coleoptera: Coccinellidae) Found on Texas High Plains Cotton, Alfalfa and Weeds

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Survey of Lady Beetles (Coleoptera: Coccinellidae) Found on
Texas High Plains Cotton, Alfalfa and Weeds

Abstract

Lady beetles (Coleoptera: Coccinellidae) serve as important predators of many arthropods that are pests of upland cotton (*Gossypium hirsutum* L.). Understanding where cotton's beneficial predators such as lady beetles find and feed on their prey, and possibly more importantly, where these beneficial predators successfully reproduce can be useful in creating insect management plans for the Texas High Plains and beyond. A study was conducted during the February to November periods of 2004 and 2005 to determine the seasonal presence and reproduction of lady beetle species on cotton, alfalfa, plus over 20 prevalent Texas High Plains weed species. Over the 2-year study period, a total of 221,209 plant sweeps yielded 27,058 lady beetle adults and 3,936 larvae. The adult specimens represented a total of six different species with the convergent lady beetle, *Hippodamia convergens* Guerin-Meneville, easily representing over 80% of the overall population. For each of the 2-month sampling periods, the plant species which yielded the highest numbers of adult and immature lady beetles are discussed. The species composition of the Texas High Plains lady beetle population did not vary greatly across study year, sampling periods, or a north/south geographical gradient. Slight lower percentages of convergent lady beetles in the complex were detected on some sampled plant species including curly dock, silverleaf nightshade, wild sunflower, and woolyleaf bursage. Knowledge related to lady beetles and their preferred 'hosts' will hopefully be useful in preserving or possibly promoting higher numbers of lady beetles in Texas High Plains cotton fields.

Introduction

Understanding where beneficial arthropod predators feed on their prey and reproduce can be useful in creating cotton (upland, *Gossypium hirsutum* L.) insect management strategies. Preserving predators can allow them to move into adjacent crops and provide natural control of crop pests. Numerous species of lady beetles (Coleoptera: Coccinellidae) are recognized as important predators of many crop pests.

The presence or absence of lady beetles on various 'host plants' is most likely driven by the presence or absence of the prey they are seeking. Plants that attract favored prey arthropods such as aphids will also likely attract large numbers of lady beetles. An important factor in evaluating a plant species' overall contribution to increased beetle numbers is the abundance of that specific plant across the landscape. A particular plant species that harbors lady beetle prey and is favorable for lady beetle reproduction may not contribute much to crop pest control on an area wide basis if the plant occurs in small numbers or limited areas.

The primary objectives of this study were to: 1) determine which plant species (or associated lady beetle prey) attract the greatest number of adult lady beetles, and 2) discover which host plants serve as an environment conducive to lady beetle reproduction, and 3) determine the lady beetle species composition as affected by variables such as year, host, time of year, and geographic location.

Materials and Methods

This lady beetle survey was conducted in three counties representing northern (Hale), central (Lubbock) and southern (Dawson) regions of the southern Texas High Plains. The study was conducted during the periods of February to November of both 2004 and 2005.

Each year's data were subdivided into five 2-month sampling periods (Feb/Mar, Apr/May, Jun/Jul, Aug/Sep, and Oct/Nov).

A 15-inch heavy-duty insect sweep net served as the primary sampling tool (Fig. 1). Weekly sweeps of seasonally available Texas High Plains weeds, cotton and alfalfa (field and roadside) were taken at 3-10 sites in each of the three selected counties. For each sampling date and site, prevalent plant species were sampled by taking a minimum of 100 sweeps in each non-cotton plant species and 150 sweeps in cotton. When cotton was available, cotton and all nearby non-cotton plant species were sampled to allow for grouped comparisons. Samples from the sweep nets were transferred to 1-gal. Ziploc[®] storage bags, and then placed into an ice chest until they could be returned to the laboratory. In the laboratory samples were placed into a standard household freezer until they could be processed (Fig. 2).

Precise locations of each sampling site were determined with a Garmin[®] hand-held GPS device. Sampled weed hosts were identified to species by utilizing a reference book entitled, *Weeds of the West* (Whitson et al. 2001). Texas Agricultural Experiment Station weed scientists and their support personnel also assisted with the plant identifications.

All lady beetle specimens collected were identified to species (Fig. 2) using a predaceous insects guide authored by Frank and Slosser (1996). Sample processing and lady beetle identifications were conducted by one experienced individual in order to maximize sample processing consistency while at the same time minimizing the possibility of specimen mis-identification.

Results

A total of 221,209 plant sweeps were taken during the February to November periods of 2004 and 2005 (Table 1). These sweeps yielded a total of 27,058 adult lady beetles and 3,936 larvae. For each life stage, Table 1 sums the lady beetle totals by county and year.

All lady beetles collected were identified as one of six common Texas High and Rolling Plains lady beetle species including: 1) the convergent lady beetle, *Hippodamia convergens* Guerin-Meneville; 2) twice-stabbed lady beetle, *Chilocorus cacti* (L.); 3) *Scymnus* lady beetle, *Scymnus loweii* Mulsant; 4) Ash-grey lady beetle, *Olla v-nigrum* (Mulsant); 5) seven-spotted lady beetle, *Coccinella septempunctata* (L.); and 6) spotted lady beetle, *Coleomegilla maculata* (DeGeer).

Numbers of lady beetle adults per 100 sweeps are shown for cotton, alfalfa, and 22 weed species sampled during each of the five 2-month (Feb/Mar, Apr/May, Jun/Jul, Aug/Sep, and Oct/Nov) sampling periods (Table 2). Common and scientific names of all plants sampled are shown in this table. Although numbers of lady beetle larvae were sometimes small, they could be found on multiple host plant species during all five 2-month sampling periods (Table 3). As expected, larvae were found on the plants species that also harbored the adult stage.

Lady Beetle Abundance Factors: Sampling Periods and Other Potential Influences

February/March. This early season period in the southern Texas High Plains is typically characterized by few available host plant species and limited distributions of these hosts (Fig. 1). In the southern Texas High Plains region, the diversity and abundance of late winter/early spring weed species is directly related to the amount of moisture received in that same winter and spring. Three habitats: curly dock, alfalfa and redstem filaree harbored the greatest early season numbers of adults per 100 sweeps (Table 2). Likewise, the same habitats also harbored the highest numbers of larvae during this sampling period (Table 3). Again, the selection of 'host plants' by adults is most likely driven by the presence of the lady beetle's prey.

April/May. Adult and larval numbers increased dramatically during this period (Tables 2 and 3). Wild sunflower, horseweed and curly dock held the largest numbers of adults while redstem filaree, flixweed and alfalfa harbored the greatest number of immature lady beetles.

June/July. Lady beetle adult and larval counts per 100 sweeps decreased from those observed in the April/May period, but this drop could possibly be due to a dilution effect caused by beetles dispersing to other land areas occupied by numerous new plant species. Wild sunflower, silverleaf nightshade and lambsquarter were the primary sanctuaries for lady beetle adults (Table 2), while larval abundance was highest in alfalfa, ragweed and lambsquarter (Table 3).

August/September. This sampling period was characterized by decreasing lady beetle adult activity and increasing larval numbers. The highest numbers of adults were observed in ragweed, wild sunflower and alfalfa (Table 2). Alfalfa, cotton and horseweed harbored the highest numbers of larvae (Table 3).

October/November. In this period, adult lady beetle counts continued to decrease and larval counts were similar to those observed in the early season February/March period. Alfalfa, ragweed and curly dock held the highest numbers of adults (Table 2) while relatively low numbers of larvae could be found in samples collected from woolyleaf bursage, alfalfa and cotton (Table 3).

Lady Beetle Species Complex vs. Host Plant Species. Figure 3 clearly illustrates that the convergent lady beetle, *Hippodamia convergens*, was by far the most prevalent lady beetle species on all plant species sampled. With the exception of curly dock, all habitats had 80-96% *H. convergens*. Curly dock had percentages of 70, 12, 10 and 7 for convergent, *Scymnus*, seven-spotted and spotted lady beetles, respectively. *Scymnus* lady beetles accounted for 11+% of the overall populations on silverleaf nightshade, wild sunflower, and woolyleaf bursage.

Year of Sampling. The 2004 and 2005 species compositions were almost identical (Fig. 4). These data suggest that the Texas High Plains species composition may not differ greatly from year to year.

Species Composition vs. Sampling Periods. Species composition trends were similar across all five sampling periods (Fig. 5). Convergent lady beetles were the dominant species with a range of 79-96%, with the observation of 79% occurring in the June-July period. Ash-grey lady beetles numbers were highest (4-6%) during the April to July periods while *Scymnus* lady beetles accounted for 12% of the population during the June/July period.

North/South Gradient. Species compositions (across habitats and years) for Hale, Lubbock and Dawson counties are shown in Fig. 6. The trends in all counties were very similar with convergent lady beetle numbers varying from 85-89% and all other species combined accounting for 11-15% of the overall population. These similar trends suggest that species compositions do not differ greatly across the southern Texas High Plains north/south gradient.

Monthly Species Complexes (Cotton Only). Lady beetle species composition trends found in cotton during the months of July to November did not differ greatly during the five monthly periods (Fig. 7). During July and August, the percentages of *Scymnus* lady beetles were higher than later in the season. Convergent lady beetles again dominated with 84+% in all months and the highest percentages were observed in September and October at 97 and 99%, respectively.

Conclusions

Ecological knowledge gained from this study of lady beetles and their 'preferred hosts' will be useful in the ultimate goal of preserving and possibly promoting higher numbers of lady beetles in High Plains cotton fields. During this study, counts of *Lygus* bugs and stink

bugs, both of which are cotton pests, were also collected. After further study and analyses, cultural weed control management plans can hopefully be produced which will help both in the control of cotton pest insect species and the promotion of higher beneficial insect numbers. For example, a recommendation might be issued to not destroy a specific field perimeter weed species that is not found to harbor crop pest species yet allows for the buildup of large lady beetle populations.

References

- Frank, W.A., and J.E. Slosser. 1996. An illustrated guide to the predaceous insects of the northern Texas Rolling Plains. Texas Agricultural Experiment Station, MP-1718. 24 pp.
- Whitson, T.D., D. Cudney, and R. Parker (eds). 2001. *Weeds of the West*, 9th Ed. Western Society of Weed Science, Grand Teton Lithography, Jackson, Wy. 627 pp.

Table 1. Overview of the total number of sweeps by year/county and total numbers of adult and immature lady beetles recovered from all sampled habitats.

<i>Year</i>	<i>County</i>	<i>Total Sweeps</i>	<i>Lady Beetle Adults</i>	<i>Lady Beetle Larvae</i>
2004	Hale	33,384	2,676	432
	Lubbock	33,250	2,008	685
	Dawson	38,450	7,712	1,187
2005	Hale	38,350	3,847	337
	Lubbock	36,275	3,418	455
	Dawson	41,500	7,397	840
	Grand Totals	221,209	27,058	3,936

Table 2. Average number of lady beetle adults per 100 sweeps found in cotton and 21 non-cotton plant species during five, 2-month sampling periods (across year) in Hale, Lubbock and Dawson counties, TX, 2004-2005.

		Average Number of Lady Beetle Adults / 100 Sweeps^a									
		Feb. / Mar.		Apr. / May		Jun. / Jul.		Aug. / Sept.		Oct. / Nov.	
Common name	Species name	Adults	Rank	Adults	Rank	Adults	Rank	Adults	Rank	Adults	Rank
Alfalfa	<i>Medicago sativa</i> L.	6.4	2	18.1		17.4	4	28.8	3	20.7	1
Black mustard	<i>Brassica nigra</i> (L.) Koch			10.2							
Blue mustard	<i>Chorispora tenella</i> (Pall.) DC.	0.3		1.3							
Curly dock	<i>Rumex crispus</i> L.	12.4	1	37.7	3	8.7				11.7	3
Field bindweed	<i>Convolvulus arvensis</i> L.			1.7		5.7					
Flixweed	<i>Descurainia sophia</i> (L.) Webb. Ex Prantl	2.6	5	4.6							
Horseweed	<i>Conyza canadensis</i> (L.) Cronq.			49.1	2	11.2	5	16.1	4	8.1	4
Kochia	<i>Kochia scoparia</i> (L.) Schrad.			10.5		7.2		1.6		0.8	
Lambsquarters	<i>Chenopodium</i> spp.			7.0		34.5	3				
London rocket	<i>Sisymbrium irio</i> L.	4.5	4	2.6						5.7	5
Pigweed	<i>Amaranthus</i> spp.					3.8		6		3.5	
Ragweed	<i>Ambrosia</i> spp.			3.7		7.2		36.9	1	12.7	2
Redstem filaree	<i>Erodium cicutarium</i> (L.) L'Her. Ex Ait.	5.0	3	28.2	4						
Russian thistle	<i>Salsola iberica</i> Sennen			10.0		3.5		3.6		3.3	
Silverleaf nightshade	<i>Solanum elaeagnifolium</i> Cav.			13.5		36.4	2	5.7		4.7	
Smartweed	<i>Polygonum</i> spp.					0.8		1.9		2.0	
Texas blueweed	<i>Helianthus ciliaris</i> DC.			5.5		5.7		6.9	5	1.5	
Tumble mustard	<i>Sisymbrium altissimum</i> L.			9.2							
Wild sunflower	<i>Helianthus annuus</i> L.			150.1	1	76.2	1	32.7	2		
Woolyleaf bursage	<i>Ambrosia grayi</i> (A. Nels.) Shinnery			9.3		7.4		5.1		1.2	
Yellow sweetclover	<i>Melilotus officinalis</i> (L.) Lam.			28.1	5	5.6					
Cotton (Upland)	<i>Gossypium hirsutum</i> L.					6.1		6.8		3.9	

^a Within each 2-month survey period, plant species with the most lady beetle adults are ranked from 1 to 5 (top three are in bold font). Empty cells in the five "adults" columns indicate that the corresponding habitat was not sampled during that sampling period.

Table 3. Average number of lady beetle larvae per 100 sweeps found in cotton and 21 non-cotton plant species during five, 2-month sampling periods (across year) in Hale, Lubbock and Dawson counties, TX, 2004-2005.

		Average Number of Lady Beetle Larvae / 100 Sweeps^a									
		Feb. / Mar.		Apr. / May		Jun. / Jul.		Aug. / Sept.		Oct. / Nov.	
Common name	Species name	Larvae	Rank	Larvae	Rank	Larvae	Rank	Larvae	Rank	Larvae	Rank
Alfalfa	<i>Medicago sativa</i> L.	0.82	2	4.62	3	1.09	1	11.04	1	0.31	2
Black mustard	<i>Brassica nigra</i> (L.) Koch			1.50	5						
Blue mustard	<i>Chorispora tenella</i> (Pall.) DC.	0.00		0.18							
Curly dock	<i>Rumex crispus</i> L.	1.00	1	0.13		0.11	5			0.00	
Field bindweed	<i>Convolvulus arvensis</i> L.			1.33		0.00					
Flixweed	<i>Descurainia sophia</i> (L.) Webb. Ex Prantl	0.13	4	9.47	2						
Horseweed	<i>Conyza canadensis</i> (L.) Cronq.			0.25		0.00		3.25	3	0.00	
Kochia	<i>Kochia scoparia</i> (L.) Schrad.			0.71		0.00		0.32		0.00	
Lambsquarters	<i>Chenopodium</i> spp.			0.20		0.42	3				
London rocket	<i>Sisymbrium irio</i> L.	0.07	5	2.33	4					0.00	
Pigweed	<i>Amaranthus</i> spp.					0.00		0.61		0.00	
Ragweed	<i>Ambrosia</i> spp.			1.00		0.47	2	0.75		0.05	4
Redstem filaree	<i>Erodium cicutarium</i> (L.) L'Her. Ex Ait.	0.33	3	27.20	1						
Russian thistle	<i>Salsola iberica</i> Sennen			0.71		0.00		0.11		0.00	
Silverleaf nightshade	<i>Solanum elaeagnifolium</i> Cav.			0.50		0.07		1.31	4	0.00	
Smartweed	<i>Polygonum</i> spp.					0.20	4	0.25		0.00	
Texas blueweed	<i>Helianthus ciliaris</i> DC.			0.09		0.03		0.15		0.04	5
Tumble mustard	<i>Sisymbrium altissimum</i> L.			0.88							
Wild sunflower	<i>Helianthus annuus</i> L.			0.44		0.00		0.64			
Woolyleaf bursage	<i>Ambrosia grayi</i> (A. Nels.) Shinnery			0.63		0.00		1.05	5	0.50	1
Yellow sweetclover	<i>Melilotus officinalis</i> (L.) Lam.			0.76		0.00					
Cotton (Upland)	<i>Gossypium hirsutum</i> L.					0.03		5.62	2	0.15	3

^a Within each 2-month survey period, plant species with the most lady beetle larvae are ranked from 1 to 5 (top three are in bold font). Empty cells in the five "larvae" columns indicate that the corresponding habitat was not sampled during the sampling period.

Figure Headings....

Figure 1. Megha Parajulee sweeping London rocket during late winter. At this time of year, actively growing hosts are typically limited in number and distribution.

Figure 2. Damara Lucia processing sweep samples followed by counting and keying lady beetle specimens to species.

Figure 3. Species composition (**percentages**) of the lady beetle adults found on plant species which harbored the highest numbers of lady beetles (adults and larvae). Hale, Lubbock and Dawson counties, 2004 and 2005.

Figure 4. By year, **percentages** of six lady beetle species found in sweep samples taken from all habitats sampled in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

Figure 5. For each of five 2-month sampling periods, **percentages** of six lady beetle species found in dominant habitats sampled per period in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

Figure 6. By county, **percentages** of six lady beetle species found in sweep samples taken from dominant habitats sampled in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

Figure 7. Monthly **percentages** of six lady beetle species found in sweep samples taken from cotton in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

figure 1



figure 2



figure 3

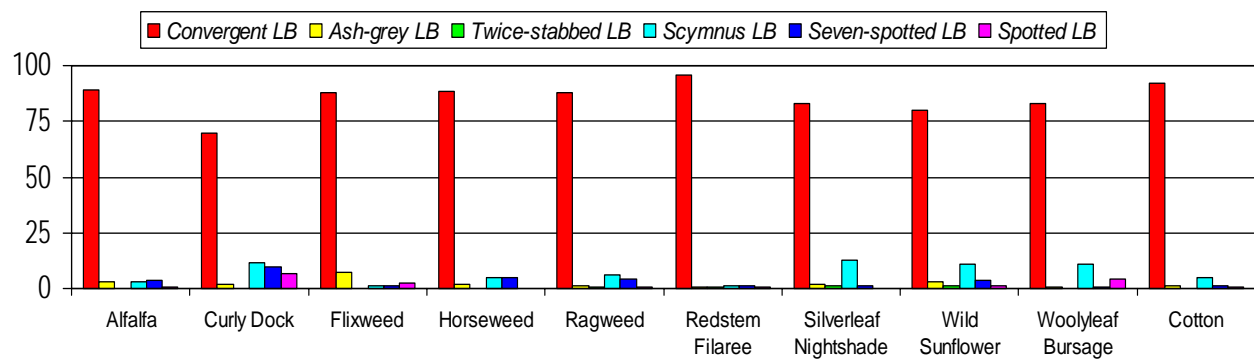


figure 4

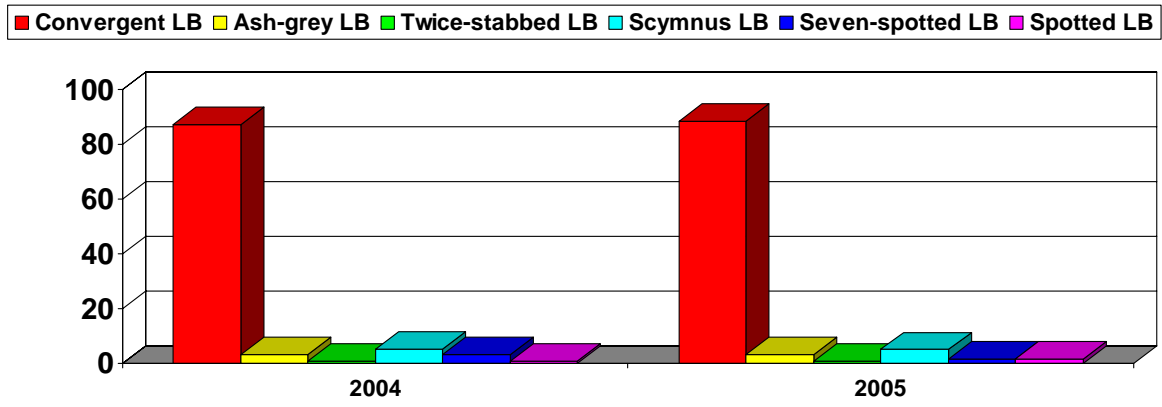


figure 5

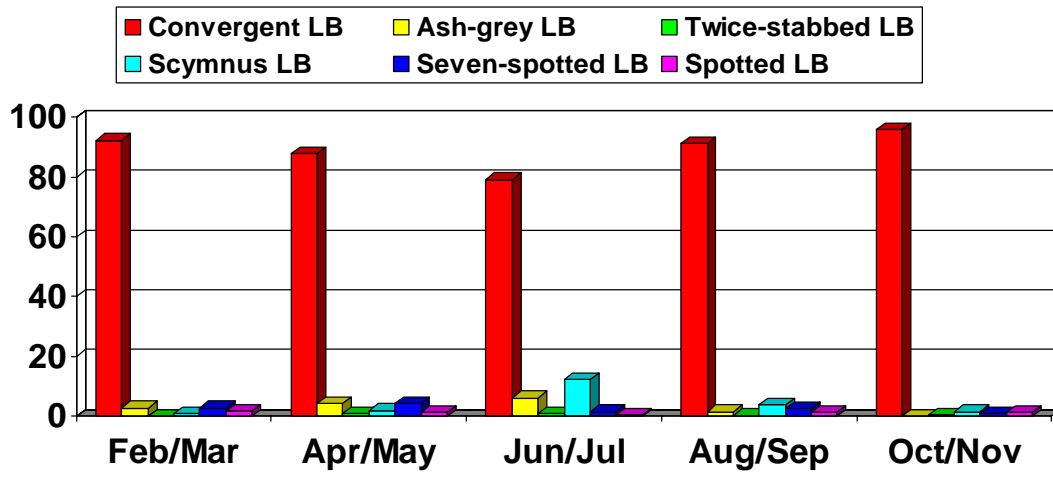


figure 6

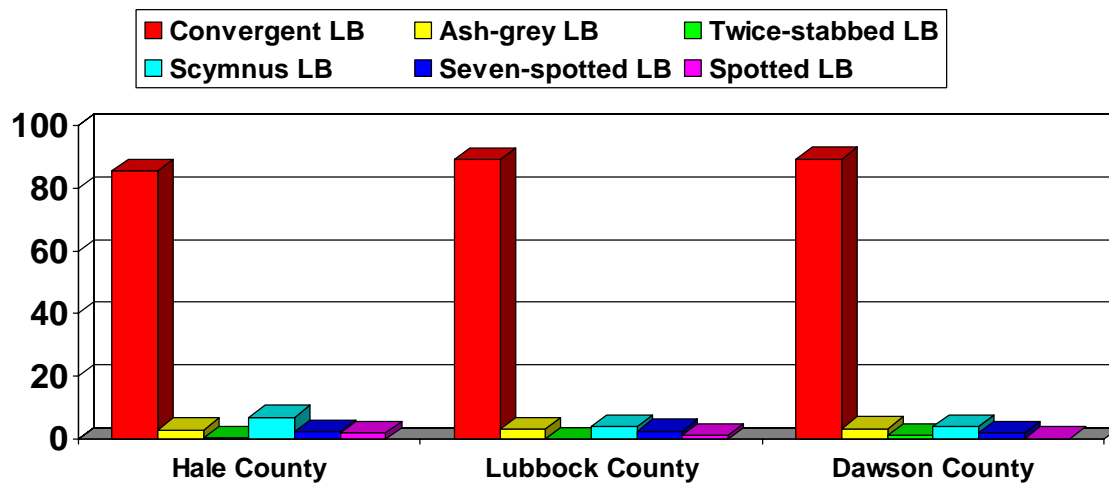


figure 7

