# LYGUS SURVEY IN THE TEXAS HIGH PLAINS: SPECIES COMPOSITION AND HOST-PLANT SEQUENCING Stanley C. Carroll, Megha N. Parajulee and Mark D. Arnold Texas Agricultural Experiment Station

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#### <u>Abstract</u>

An on-going survey for Lygus bugs was conducted in the Texas High Plains in 2004. Cotton and 21 potential noncotton hosts were surveyed using a heavy-duty sweep net (100-150 sweeps/habitat/site) in three counties representing northern (Hale), central (Lubbock), and southern (Dawson) areas of this intensive cotton-growing region. Numerically dominant wild hosts found in roadside ditches and in and around cultivated fields were surveyed throughout the study period. Sampling was conducted on a weekly basis beginning in early February for wild hosts and in early July for cotton. As of November 2004, totals of 87,134 and 17,950 sweeps were taken in non-cotton hosts and cotton, respectively. A total of 19,148 adult Lygus and 7,628 nymphs have been captured to date. An overall sex ratio of 50.7:49.3 (M/F) was found for the Lygus adults. Wild mustards and alfalfa harbored the highest numbers of Lygus in the early and late season periods. Some important mid-season wild hosts included alfalfa, pigweed, ragweed, Russian thistle, smartweed and yellow sweetclover. The similar host-plant preference ratings between adults and nymphs suggest a strong positive correlation between adult population levels and the amount of reproduction within individual host-plant species. Lygus numbers in cotton were uniformly low relative to many non-cotton hosts, indicating that cotton is not a preferred feeding or breeding host. To date in 2004, the overall species complex observed in non-cotton hosts consisted of 96.5, 1.8, and 1.7% L. hesperus Knight, L. elisus Van Duzee, and L. lineolaris (Palisot de Beauvois), respectively, while in cotton the complex consisted of 91.8% L. hesperus with only two specimens each of L. elisus and L. lineolaris retrieved from cotton samples. With the exception of pigweed and ragweed, all other preferred host-plants and cotton showed L. hesperus percentages ranging from 90.3 to 100%. This comprehensive survey supports reports in the literature that Lygus are strongly polyphagous, based on the detection of Lygus throughout the season on available non-cotton hosts. This ability to utilize a succession of common non-cotton hosts allows Lygus to build large populations in wild hosts and invade cotton if conditions are favorable. Sampling is still continuing though 2005.

#### **Introduction**

Yield losses in Texas High Plains cotton caused by *Lygus* bugs have become more of a concern in the last five years as the pest has risen from minor to economic status. These concerns have largely been based on reports from IPM agents and crop consultants who have observed first-hand the reduced fruit set and fruit damage when *Lygus* are present. Reports suggest that insecticide applications are being recommended even for extremely low *Lygus* numbers. This new situation increases the need for additional knowledge to allow for the development of cultural controls for *Lygus* bugs, which will decrease the need for insecticides while preserving arthropod predators and parasitoids.

In order to address these concerns, a *Lygus* survey of three Texas High Plains counties was initiated in early 2004. The primary objective of this study was to gain information about cotton and non-cotton host-plant sequencing throughout the year to use in the development of cultural controls to minimize *Lygus* movement into cotton. A secondary objective was to determine the composition of the *Lygus* species complex across a north/south Texas High Plains gradient and across multiple preferred hosts as identified by the host-plant sequencing objective. The study is still in progress and will be conducted through the end of 2005. Therefore, any results and conclusions presented here should be regarded as preliminary.

#### **Materials and Methods**

For this report, the three-county *Lygus* host-plant survey was conducted weekly during the period of February to November of 2004. Texas counties surveyed were Hale, Lubbock and Dawson roughly representing northern (Hale), central (Lubbock) and southern (Dawson) cotton producing areas of the Texas High Plains.

During each of 31 weekly surveys, multiple sites (3-9) were sampled in each county. At each site, all available plant

hosts were sampled by sweeping the plants with a 15-inch diameter heavy-duty sweep net. A minimum of 100 sweeps were taken in each potential non-cotton host and 150 sweeps were taken in cotton. When cotton was available, cotton and non-cotton hosts in close proximity were sampled at the same time to allow paired comparisons. Sweep samples were placed in ZipLoc<sup>®</sup> 1-gal. plastic bags and cooled in ice chests, then stored in freezers until the samples could be processed.

The exact location of each sample site was determined using GPS devices. Some locations were sampled repeatedly through the season and new sites were added as new potential hosts appeared. Site changes also occurred due to the seasonal disappearance of some hosts or the removal or destruction of hosts due to human activities such as roadside mowing, crop harvest (i.e., alfalfa cuttings), field perimeter disking, and herbicide applications.

All non-cotton weed hosts sampled were identified using *Weeds of the West* (Whitson et al. 2001) and occasional assistance was obtained from weed science research personnel with the Texas Agricultural Experiment Station, Lubbock.

Male *Lygus* bugs collected in this study were all identified to species following the field keys developed by Mueller et al. (2003). The identifications were performed by one trained individual to standardize the process and to minimize errors. A manuscript by Armstrong and Camelo (2003) also relates to the Texas High Plains *Lygus* species complex.

#### **Results**

During the study period, a total of 105,084 sweeps were taken from cotton (17,950) and 21 potential non-cotton (87,134) host-plant species. By county, numbers of sweeps totaled 33,384, 33,250 and 38,450 for Hale, Lubbock and Dawson counties, respectively. These totals represented 315, 315 and 363 individual host-plant sweep samples (100-150 sweeps/sample) taken during the 31 weekly surveys of Hale, Lubbock and Dawson counties, respectively. Hosts having the highest number of individual samples included alfalfa (195), cotton (120), Russian thistle (100), pigweed (86), and kochia (79). Due to their widespread distribution and extended presence in the field, these four non-cotton hosts plus cotton accounted for 63,900 sweeps or 61% of the total sweeps taken in the 2004 study year.

The above-mentioned sweeps captured a total of 19,148 adult *Lygus* and 7,628 nymphs. Totals of 9,713 males and 9,435 females indicate that the sampled *Lygus* population has approximately a 50:50 sex ratio.

# **Host-Plant Sequencing and Preference**

For simplicity, *Lygus* counts from all habitats, sites and weekly surveys were grouped into five 2-month "survey periods" covering February-November, 2004 (Tables 1 and 2). Tables 1 and 2 identify sampled hosts by common and scientific names. For each sampled host, Table 1 shows the average number of *Lygus* adults per 100 sweeps for each of the five 2-month sample periods. Table 2 shows the average number of *Lygus* nymphs per 100 sweeps for the same survey periods and hosts. Empty cells within Tables 1 and 2 indicate that a specific host was not present (or limited availability) and therefore, not sampled during that survey period.

In the February/March survey period, only adult *Lygus* were found suggesting that significant reproduction had not begun by late March (Tables 1 and 2). This period was also characterized by the availability of a very limited number of host-plant species. Wild mustards including London rocket and flixweed were the most prevalent hosts and also harbored the greatest numbers of *Lygus*. Lower numbers of *Lygus* were detected in alfalfa but it should be noted that alfalfa plants are extremely small during this part of the season making sweep sampling less efficient in capturing *Lygus* that may be present.

During the April/May period, a much larger diversity of host-plant species was available. As with the February/March period, numbers of *Lygus* adults were highest in London rocket and flixweed. Numbers in these two hosts were much lower than in the previous period but similar to alfalfa and four new hosts with 20+Lygus per 100 sweeps (Table 1). This possibly reflects a general movement to these other hosts as they became available. The first nymphs were found in wild mustards (London rocket, flixweed, and tumble mustard) on 8 April 2004 in Dawson County. By mid-April, nymphs could be found in other hosts and counties, but numbers were generally highest in wild mustards and in alfalfa. The highest numbers of *Lygus* nymphs were found in London rocket and flixweed, probably due to colonization by adults detected in the previous period (Tables 1 and 2). It appears that London rocket and flixweed are two of the primary breeding hosts that produce the *Lygus* that can attack cotton during squaring.

As the June/July period began, most wild mustards had completed their brief life cycle and were senesced, and other plants took their place as preferred hosts. Within this group of hosts, preference rankings for adults and nymphs were very similar (Tables 1 and 2) with the largest numbers of *Lygus* adults and nymphs detected in alfalfa. Other preferred hosts were smartweed, yellow sweetclover, pigweed, and Russian thistle. The similar host-plant preference ratings between adults and nymphs suggest a strong positive correlation between adult population levels and the amount of reproduction within individual host-plant species.

Four of the five preferred hosts (all but yellow sweetclover, which was unavailable and so not sampled) during June and July remained the preferred hosts during August and September for both adult and immature *Lygus* (Tables 1 and 2). Numbers of nymphs increased over the previous period in alfalfa, smartweed and Russian thistle, indicating that these plants may be important mid- to late season breeding hosts.

An unseasonably high amount of rainfall in August and September caused a late season flush of London rocket, which flourished as fall temperatures cooled during the October/November survey period. *Lygus* adults were detected in large numbers (232.8 per 100 sweeps, Table 1) in this late season London rocket. Next highest numbers were detected in Russian thistle, pigweed, alfalfa and kochia, in that order. Overall, numbers of *Lygus* nymphs decreased in this period with counts all below five nymphs per 100 sweeps (Table 2).

Alfalfa was the only sampled host that harbored *Lygus* adults in all five survey periods. Mid-winter observations during January 2004 indicated that *Lygus* adults can also be found in plant litter collected from alfalfa fields. It should also be noted that *Lygus* numbers in cotton were uniformly low relative to many non-cotton hosts, indicating that cotton may not be a preferred feeding or breeding host when other non-cotton hosts are available.

### Lygus Seasonal Abundance

Across all sampled hosts, the greatest average numbers of *Lygus* adults per 100 sweeps were generally captured during the early and late season (Table 3). During these early and late periods, one explanation for higher *Lygus* numbers might be that adults present may be concentrated on the few available hosts with somewhat limited distribution as compared to mid-season weed-host abundance. Nymphs were primarily detected during the period of April to September (Table 4) indicating active colonization during warm months when host availability was highest.

### Lygus Species Complex

*Lygus* species found in plants surveyed included *L. hesperus, L. elisus*, and *L. lineolaris*. A total of 9,713 *Lygus* males were identified to species resulting in totals of 9,375, 176 and 162 for *L. hesperus, L. elisus* and *L. lineolaris*, respectively. *L. hesperus* was the dominant species regardless of sampling period or county, in all cases comprising more than 84% of the *Lygus* population (Tables 5 and 6). *L. elisus* comprised from zero to 10.6 % of the *Lygus* captured, with the highest percentages in the June/July period (Table 5) and in Lubbock County (Table 6). *L. lineolaris* comprised from zero to 7.3% of the *Lygus* captured with an increasing percentage as the season progressed, and the highest percentage in Dawson County.

Table 7 gives the *Lygus* species composition found on cotton and preferred feeding and breeding hosts. Hosts listed received a preference rating of 1-3 (for adults and/or nymphs) in one or more of the survey periods (Tables 1 and 2). *L. hesperus* was by far the predominant species on these hosts (67.2 to 100%, Figure 7). With the exception of pigweed (67.2%) and ragweed (76.6%), all hosts including cotton were found to have greater than 90% *L. hesperus*. *L. elisus* percentages were highest in pigweed (20.0%) and Russian thistle (8.1%) while *L. lineolaris* percentages were highest in ragweed (12.8%) and smartweed (7.9%).

## **Cultural Controls**

During the early and late season periods, *Lygus* adults were found on only a few hosts, each with limited distribution as compared to mid-season host species numbers and distributions. In areas with a history of *Lygus* problems, the control of wild mustards (primarily London rocket and flixweed) during the early and late season may present an opportunity to reduce *Lygus* numbers by reducing early season *Lygus* breeding habitats. The significance of alfalfa as a feeding and overwintering habitat for *Lygus* during the winter and early spring needs to be investigated further. Control strategies will be refined as the study progresses and additional data become available for evaluation.

Table 1. Average number of *Lygus* adults per 100 sweeps found in cotton and 21 potential non-cotton plant hosts during five 2-month sampling periods in Hale, Lubbock and Dawson counties, TX, 2004.

	<u>Average Number of Lygus Adults / 100 Sweeps</u> <sup>a</sup>				
Common name / Species name	Feb/Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov
Alfalfa	14.0 (3)	20.7.(5)	37 5 (1)	17.0 (2)	37.6 (1)
Medicago sativa L.	14.9 (3)	20.7 (5)	37.5(1)	17.0 (2)	37.0 (4)
Black mustard		15.8			
Brassica nigra (L.) Koch		15.0			
Blue mustard		1.0			
Chorispora tenella (Pall.) DC.	_				
Curly dock		20.0	1.7		
Rumex crispus L.	_				
Field bindweed		4.0			
Convolvulus arvensis L.	_				
Flixweed	120.6 (2)	24.3 (2)			
Descurainia sophia (L.) Webb. Ex Prantl					
Horseweed			0.0		
Conyza canadensis (L.) Cronq.	_				
Kochia		2.2	0.2	5.3	37.1 (5)
Kochia scoparia (L.) Schrad.	_				
Lambsquarters		5.5	2.8		
Chenopodium spp.	_			 	
London rocket	214.5 (1)	26.6 (1)			232.8 (1)
Sisymbrium irio L.	_	 		 	
Amenanthus and			<b>6.0</b> (4)	11.9 (3)	52.5 (3)
Amaranthus spp.	-	<u> </u>			
Ambrogia ann		0.8	0.0	3.0	7.0
Amorosia spp. Redstem filoree	_				
Frodium cicutarium (L) L'Her Ex Ait		21.7 (4)			
Russian thistle					
Salsola ibarica Sennen		5.0	4.1 (5)	11.0 (5)	<b>68.9</b> (2)
Silverleaf nightshade	_				
Solanum elaeagnifolium Cay		3.5	2.3	0.4	2.0
Smartweed					
Polygonum spp.			14.0 (2)	29.3 (1)	
Texas blueweed		1.2	0.2	2.0	
Helianthus ciliaris DC.		1.3	0.3	3.0	2.2
Tumble mustard		20.0			
Sisymbrium altissimum L.		20.0			
Wild or common sunflower		0.7	0.7	1.0	7.0
Helianthus annuus L.		9.1	0.7	1.0	7.0
Woolyleaf bursage		68	0.0	11.6 (4)	17
Ambrosia grayi (A. Nels.) Shinners		0.0	0.9	11.0 (4)	1./
Yellow sweetclover		23 4 (3)	10.8 (3)		
Melilotus officinalis (L.) Lam.	_	23.4 (3)	10.0 (3)		
Cotton (upland)			04	0.7	0.6
Gossypium hirsutum L.			0.4	0.7	0.0

<sup>a</sup> Within each 2-month survey period, host plants with the greatest numbers of Lygus are ranked (1-5) and highlighted in **bold** font.

Table 2. Average number of *Lygus* nymphs per 100 sweeps found in cotton and 21 potential non-cotton plant hosts during five 2-month sampling periods in Hale, Lubbock and Dawson counties, TX, 2004.

Common name / Species name	Feb/Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov
Alfalfa		<u> </u>		<u> </u>	
Medicago sativa L.	0.0	15.7 (4)	21.1 (1)	43.9 (1)	0.6
Black mustard				·	
Brassica nigra (L.) Koch		26.0 (3)			
Blue mustard		0.1			
Chorispora tenella (Pall.) DC.		0.1			
Curly dock		4.0	0.2		
Rumex crispus L.		4.0	0.2		
Field bindweed		0.1			
Convolvulus arvensis L.		0.1			
Flixweed	0.0	46 9 (2)			
Descurainia sophia (L.) Webb. Ex Prantl	0.0	40.7 (2)			
Horseweed			0.0		
Conyza canadensis (L.) Cronq.			0.0		
Kochia		0.3	0.1	1.1	0.9
Kochia scoparia (L.) Schrad.					
Lambsquarters		0.8	0.3		
Chenopodium spp.					
London rocket	0.0	58.2 (1)			2.8 (3)
Sisymbrium irio L.					
Pigweed			7.5 (3)	1.3 (5)	1.8 (4)
Amaranthus spp.					
Ragweed		0.1	0.0	0.3	4.2 (1)
Ambrosia spp.					
		1.3			
<i>Erodium cicutarium</i> (L.) L'Her. EX Ait.					
Russian unsue		2.2	3.6 (4)	7.7 (3)	4.1 (2)
Salsola iberica Sennen		<u> </u>		<u> </u>	
Solarum alagganifolium Cou		0.0	0.6	0.0	0.0
Solutium elueugnijolium Cav.					
Polygonum spp			13.5 (2)	19.3 (2)	
Texas blueweed					
Helianthus ciliaris DC		0.7	0.2	2.5 (4)	0.0
Tumble mustard	-	<u> </u>		<u> </u>	
Sisymbrium altissimum L		15.0 (5)		0.8	
Wild or common sunflower					
Helianthus annuus L		0.3	0.0	0.0	1.0 (5)
Woolyleaf bursage		0.0	0.0		
Ambrosia gravi (A. Nels.) Shinners		0.0	0.0		0.0
Yellow sweetclover	1	2.5	2.5.(5)		
Melilotus officinalis (L.) Lam.		2.6	2.5 (5)		
Cotton (upland)	0.0		0.5	0.1	0.0
Gossypium hirsutum L.	0.0		0.5	0.1	0.0

Average Number of Lygus Nymphs / 100 Sweeps <sup>a</sup>

<sup>a</sup> Within each 2-month survey period, host plants with the greatest numbers of Lygus are ranked (1-5) and highlighted in **bold** font.

Table 3. Average number of Lygus adults per 100 sweeps found in all habitats sampled in Hale, Lubbock and Dawson counties, TX during each of five 2-month sampling periods of 2004.

	Average Mulliber of Lygus Mullis / 100 Bweeps				
County	Feb/Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov
Hale County	66.5	14.7	12.5	10.8	84.4
Lubbock County	146.9	14.0	8.4	14.5	43.6
Dawson County	65.8	37.3	0.9	1.0	2.8

Average Number of *Lygus* Adults / 100 Sweeps

Table 4. Average number of Lygus nymphs per 100 sweeps found in all habitats sampled in Hale, Lubbock and Dawson counties, TX during each of five 2-month sampling periods of 2004.

	Average Number of Lygus Nymphs / 100 Sweeps				
County	Feb/Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov
Hale County	0.0	15.6	6.2	17.3	2.1
Lubbock County	0.0	9.1	7.0	6.5	1.4
Dawson County	0.0	21.8	0.2	0.3	0.7

Table 5. Species composition of male Lygus bugs collected from three Texas High Plains counties during five 2month sampling periods of 2004. Sweep samples were taken from both cotton and 21 non-cotton hosts.

	Species Composition (%)				
Species	Feb/Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov
Lygus hesperus	99.9	97.4	88.2	84.2	91.8
Lygus elisus	0.0	2.1	10.6	8.7	0.9
Lygus lineolaris	0.1	0.5	1.2	7.1	7.3

Table 6. Species composition of male Lygus bugs found in a survey of cotton and 21 non-cotton hosts in three Texas High Plains counties, 2004.

	<u>Species Composition (%)</u>				
Species	Hale County	Lubbock County	Dawson County		
Lygus hesperus	93.3	91.2	92.1		
Lygus elisus	4.8	6.6	0.7		
Lygus lineolaris	2.0	2.2	7.2		

1760

Table 7. Species composition of male *Lygus* bugs found on non-cotton hosts in which the highest *Lygus* numbers were detected in one or more of the five 2-month survey periods as shown in Tables 1 and 2 (host-plant preference ratings of 1-3), and on cotton.

	Species Composition (%)				
Host	Lygus hesperus	Lygus elisus	Lygus lineolaris		
Alfalfa	97.2	0.2	2.6		
Black mustard	100.0	0.0	0.0		
Flixweed	98.1	1.8	0.1		
London rocket	97.8	0.4	1.8		
Pigweed	67.2	20.0	12.8		
Ragweed	76.6	1.0	22.4		
Russian thistle	90.3	8.1	1.7		
Smartweed	92.1	0.0	7.9		
Yellow sweetclover	97.0	3.1	0.0		
Cotton	90.9	4.6	4.6		

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