HOST PREFERENCE SURVEY OF STINK BUGS ON TEXAS HIGH PLAINS COTTON, ALFALFA AND PREVALENT WEEDS

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Abstract

Stink bugs (Hemiptera: Pentatomidae) are normally classified as occasional pests of upland cotton (*Gossypium hirsutum* L.) in the Texas High Plains (THP) region. Understanding where cotton arthropod pest species, such as stink bugs (SB), feed, and possibly more importantly, where these pests reproduce can be useful in creating insect management strategies for the THP and other areas. A study was conducted during the February to November periods of 2004 and 2005 to determine the seasonal abundance and reproduction of SB species on cotton, alfalfa, and over 20 prevalent THP weed species. Over the 2-year study period, a total of 224,509 plant sweeps yielded 5,794 SB adults and 362 nymphs. These specimens were placed into one of two groups: *Green Stink Bugs* (GSB) is comprised of two species, [green SB, *Acrosternum hilare* (Say); southern green SB, *Nezara viridula* (L.)] while the second group, referred to as the *Brown Stink Bugs* (BSB), contains only one species [brown SB, *Euschistus servus* (Say)]. For each of five 2-month sampling periods (Feb/Mar, Apr/May, Jun/Jul, Aug/Sep, Oct/Nov), the plant species which yielded the highest numbers of adult and immature stink bugs are discussed. Based upon selected SB species groupings (GSB and BSB), it does not appear that the compositions of these groupings vary greatly across study year or the north/south geographical gradient. During the first four sampling periods (February-September) the GSB group dominated (ca. 75:25 ratio) the overall SB population, whereas during the Oct/Nov sampling period we observed increasing number of BSB (ca. 50:50 ratio). Knowledge related to stink bugs and their preferred THP 'hosts' will hopefully result in quicker development of management strategies for areas experiencing problems with stink bugs on cotton or other crops.

Introduction

Understanding where pest species feed and reproduce can be useful in creating insect management strategies that utilize cultural control methods, thereby reducing reliance on chemicals which can disrupt natural controls and cause secondary pest outbreaks. In the cotton producing region of the Texas High Plains (THP), stink bugs (SB; Hemiptera: Pentatomidae) are typically categorized as occasional pests of cotton. However, some scientists feel that the pest status of plant bugs, including stink bugs, could possibly be elevated due to recent changes such as the widespread adoption of Bt technology, boll weevil eradication and the increased use of more pest species specific insecticides. In the past, it is possible that occasional pest outbreaks were inadvertently prevented by insecticidal applications directed at key pest species.

Although we did not attempt to quantify host plant abundance in this study, an important factor in evaluating a plant species' overall contribution to increased SB numbers is the abundance of that specific plant in the landscape. A particular plant species that harbors SB and is favorable for SB reproduction may not contribute much to SB population increases on an area wide basis if the plant occurs in small numbers or limited areas.

The primary objective of this study was to gain some baseline data related to the following: 1) determine which plant species (crop or weed) attract the greatest number of adult SB, 2) identify host plants which provide an environment conducive to SB reproduction, and 3) determine SB species complex composition as affected by variables such as year, host, time of year, and geographic location.

Materials and Methods

This stink bug (SB) survey was conducted in three counties representing northern (Hale Co.), central (Lubbock Co.) and southern (Dawson Co.) 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).

Two SB groups will be discussed. The first group, referred to herein as the *Green Stink Bugs* (GSB), is comprised of two species [green SB, *Acrosternum hilare* (Say); southern green SB, *Nezara viridula* (L.)] while the second group, referred to as the *Brown Stink Bugs* (BSB), contains only one species [brown SB, *Euschistus servus* (Say)]. Common plant names for the sampled crops and weeds are used throughout the text and tables but corresponding scientific names can be found in Tables 1 and 2.

A 15-inch heavy-duty insect sweep net served as the SB sampling tool. Weekly sweeps of available THP weeds, cotton and alfalfa (field and roadside) were taken at 3-10 sites in each of the three 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.

Precise locations of each sampling site were determined with a Garmin® hand-held GPS device. Weed hosts sampled were identified to species using *Weeds of the West* (Whitson et al. 2001). Texas AgriLife Research weed scientists and their support personnel assisted with some plant identifications.

Sample processing and stink bug identifications were conducted by one experienced individual in order to maximize sample processing uniformity while at the same time minimizing the possibility of specimen mis-identification.

Results

Survey Overview

A total of 224,509 sweeps were taken during the February to November periods of 2004 and 2005. These sweeps yielded a total of 5,794 adult stink bugs and 362 nymphs (Table 3) which were detected on numerous plant hosts. For each life stage, Table 3 sums the SB totals by county and year. Numbers of SB adults and nymphs per 100 sweeps are shown for cotton and 21 non-cotton plant species sampled during each of the five 2-month (Feb/Mar, Apr/May, Jun/Jul, Aug/Sep, and Oct/Nov) sampling periods in Tables 1 (adults) and 2 (nymphs). The common and scientific names of all plant species sampled are also shown. Although numbers were often small, SB nymphs were found on multiple habitats during four of five sampling periods (Apr/May to Oct/Nov). No evidence of reproduction was observed during the early Feb/Mar survey period. As expected, nymphs were found on the same plants species that harbored the adult stage.

Sampling Period and Habitat Influence on Stink Bug Abundance

February/March. This early season period in the southern THP region is typically characterized by few available plant host species with limited distributions. In this semi-arid 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, including two cool season wild mustards (London rocket, tumble mustard) and curly dock harbored the greatest numbers of SB adults (bolded values; Table 1). Stink bug reproduction as evidenced by the presence of nymphs on host plants was not detected during this Feb/Mar survey period (Table 2).

April/May. Warmer temperatures resulted in an increased number of available hosts during this survey period. Yellow sweetclover, London rocket and curly dock held the largest number of SB adults per 100 sweeps (Table 1). Reproduction, as evidenced by the presence of nymphs, was first observed during this period with the highest counts detected on Russian thistle, London rocket and kochia (Table 2).

June/July. The highest numbers of SB adults were found on lambsquarter, kochia and alfalfa at this time of year. The numbers found on lambsquarter were very high, higher than on any other host by a factor of 20. It should also be noted that though the numbers of stink bugs may not be much larger on any individual plant host (with the exception of lambsquarter) than in the previous two-month period (April/May, Tables 1 and 2), it is likely that the greater number and wider distribution of available hosts (personal observation, S. C. Carroll), including cultivated crops, results in many more stink bugs in the overall regional agroecosystem. Nymphal counts per 100 sweeps were the highest on curly dock, lambsquarter and field bindweed. Cotton became available for sampling but the numbers of adults and nymphs in cotton were small in relation to the numbers detected in most other habitats sampled.

August/September. The number of habitats sampled was similar to the June/July period. The highest numbers of SB adults per 100 sweeps occurred in lambsquarter, smartweed and kochia (Table 1). Horseweed, kochia and smartweed harbored the highest numbers of nymphs (Table 2). Again, the occurrence of adults and nymphs was very low in cotton.

October/November. Smartweed and kochia continued to rank high in harboring both SB adults and nymphs. London rocket, a cool season weed, reappeared and followed smartweed and kochia in the number of adults while ragweed ranked third in SB nymphal counts. Adult SB counts in cotton were slightly higher than the June to September period but remained very low for SB nymphs (Tables 1 and 2).

Species Complex as Affected by:

Host Plant Species. Table 4 shows the percentages of GSB versus BSB for all habitats with the highest number of adults or nymphs in one or more of the two-month survey periods [bolded values; Tables 1 (adults) and 2 (nymphs)]. Table 4 shows most habitats had a higher percentage of GSB relative to BSB. One exception was horseweed in which BSB comprised 56% of the population. Also notable is that the SB population in lambsquarter was dominated by GSB (83%).

Year of Sampling. In both 2004 and 2005, the relative percentages of the green stink bug (GSB) group versus brown stink bugs (BSB) were very similar (Table 5). Each year the population consisted of roughly 70% GSB and 30% BSB. These data suggest that the selected SB species complex categories might not differ greatly from year to year. Since the two green SB species [green SB (*Acrosternum hilare*) and southern green SB (*Nezara viridula*)] were combined into one category (GSB), we do not have information on the yearly species composition breakdown.

Sampling Period. In comparing sampling period means (across county, habitats and years), GSB outnumbered BSB in all sampling periods, though the proportions of BSB rose sharply in the Oct/Nov period to almost equal that of GSB (Table 6).

North/South Gradient. Species compositions (across habitats and years) for Hale, Lubbock and Dawson counties are shown in Table 7. The trends in all counties were very similar with the GSB group typically comprising approximately 70% of the population while the BSB comprised about 30% of the population. The similarity of the trends suggests that our species groups might not differ greatly across the Texas High Plains north/south gradient.

Monthly Complexes (Cotton Only). GSB versus BSB population trends found in cotton during the months of July to October to a degree reflect the trends discussed above in the *Sampling Period* section. Values in Table 8 indicate that the GSB group dominated during the July to September sampling period. The percentage of BSB increased in the late season but was still substantially less than the percentage of GSB in October. It is possible that the late season percentage of BSB would have approached GSB if sampling of cotton could have extended through November.

Table 1. Average number of stink bug adults per 100 sweeps found in cotton and 21 non-cotton plant species during five, 2-month sampling periods (across years) in Hale, Lubbock and Dawson counties, TX, 2004-2005.

		Average Number of Stink Bug Adults / 100 Sweeps [a]				
Common name	**Species name**	**Feb/Mar Adults**	**Apr/May Adults**	**Jun/Jul Adults**	**Aug/Sep Adults**	**Oct/Nov Adults**
Alfalfa	*Medicago sativa* L.	0.82	1.57	**4.93**	0.64	1.79
Black mustard	*Brassica nigra* (L.) Koch		0.17			1.00
Blue mustard	*Chorispora tenella* (Pall.) DC.	0.06	0.09			
Curly dock	*Rumex crispus* L.	**1.65**	**3.53**	1.22		0.33
Field bindweed	*Convolvulus arvensis* L.		0.20	2.67	0.00	
Flixweed	*Descurainia sophia* (L.) Webb. Ex Prantl	0.68	0.85			
Horseweed	*Conyza canadensis* (L.) Cronq.		2.38	2.45	0.90	3.06
Kochia	*Kochia scoparia* (L.) Schrad.		2.46	**5.50**	**2.38**	**8.51**
Lambsquarter	*Chenopodium* spp.		2.00	**102.11**	**9.00**	
London rocket	*Sisymbrium irio* L.	**2.22**	**5.39**			**8.14**
Pigweed	*Amaranthus* spp.			1.00	0.82	1.80
Ragweed	*Ambrosia* spp.		0.00	1.07	0.34	2.50
Redstem filaree	*Erodium cicutarium* (L.) L'Her. Ex Ait.	1.00	3.47			
Russian thistle	*Salsola iberica Sennen*		1.00	2.24	0.82	2.75
Silverleaf nightshade	*Solanum elaeagnifolium* Cav.		0.17	0.75	0.69	2.61
Smartweed	*Polygonum* spp.			0.40	**2.75**	**10.80**
Texas blueweed	*Helianthus ciliaris* DC.		1.63	0.26	0.11	0.48
Tumble mustard	*Sisymbrium altissimum* L.	**2.50**	0.97			
Wild sunflower	*Helianthus annuus* L.		1.00	0.51	0.12	7.00
Woolyleaf bursage	*Ambrosia grayi* (A. Nels.) Shinners		1.38	2.53	0.48	0.50
Yellow sweetclover	*Melilotus officinalis* (L.) Lam.		**9.24**	3.38		
Cotton (Upland)	*Gossypium hirsutum* L.			0.09	0.08	0.36

[a] Within each 2-month survey period, plant species with the three highest SB adult values are highlighted in bold font. Empty cells in any sampling period column indicate that the corresponding habitat was not sampled during that specific sampling period.

Table 2. Average number of stink bug nymphs 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 Stink Bug Nymphs / 100 Sweeps [a]				
Common name	**Species name**	**Feb/Mar**	**Apr/May**	**Jun/Jul**	**Aug/Sep**	**Oct/Nov**
Alfalfa	*Medicago sativa* L.	0.00	0.14	0.18	0.29	0.10
Black mustard	*Brassica nigra* (L.) Koch		0.08			
Blue mustard	*Chorispora tenella* (Pall.) DC.	0.00	0.00			
Curly dock	*Rumex crispus* L.	0.00	0.07	**1.11**		0.00
Field bindweed	*Convolvulus arvensis* L.		0.00	**0.67**	0.00	
Flixweed	*Descurainia sophia* (L.) Webb. Ex Prantl	0.00	0.02			
Horseweed	*Conyza canadensis* (L.) Cronq.		0.38	0.24	**0.70**	0.17
Kochia	*Kochia scoparia* (L.) Schrad.		**0.43**	0.20	**0.53**	**0.49**
Lambsquarter	*Chenopodium* spp.		0.20	**0.89**	0.00	
London rocket	*Sisymbrium irio* L.	0.00	**0.50**			0.00
Pigweed	*Amaranthus* spp.			0.07	0.23	0.37
Ragweed	*Ambrosia* spp.		0.22	0.07	0.19	**0.45**
Redstem filaree	*Erodium cicutarium* (L.) L'Her. Ex Ait.	0.00	0.07			
Russian thistle	*Salsola iberica Sennen*		**0.57**	0.13	0.19	0.15
Silverleaf nightshade	*Solanum elaeagnifolium* Cav.		0.00	0.14	0.14	0.22
Smartweed	*Polygonum* spp.			0.00	**0.40**	**2.10**
Texas blueweed	*Helianthus ciliaris* DC.		0.03	0.03	0.11	0.00
Tumble mustard	*Sisymbrium altissimum* L.	0.00	0.25			
Wild sunflower	*Helianthus annuus* L.		0.19	0.00	0.00	0.00
Woolyleaf bursage	*Ambrosia grayi* (A. Nels.) Shinners		0.00	0.06	0.10	0.08
Yellow sweetclover	*Melilotus officinalis* (L.) Lam.		0.06	0.00		
Cotton (Upland)	*Gossypium hirsutum* L.			0.01	0.01	0.03

[a] Within each 2-month survey period, plant species with the three highest SB nymphal values are highlighted in bold font. Empty cells in any sampling period column indicate that the corresponding habitat was not sampled during that specific sampling period

Table 3. Overview of the total number of sweeps by year/county and total numbers of adult and immature stink bugs recovered from all sampled habitats.

Year	*County*	*Total Sweeps*	*GSB Adults*	*GSB Nymphs*	*BSB Adults*	*BSB Nymphs*
2004	Hale	33,384	566	35	168	39
	Lubbock	33,250	373	6	164	52
	Dawson	38,450	321	8	120	48
2005	Hale	39,750	422	4	165	48
	Lubbock	37,075	2133	6	524	79
	Dawson	42,600	562	8	258	29
	Grand Totals	224,509	4,377	67	1417	295

Table 4. Species composition of stink bugs found on plant species which harbored the three highest numbers [bolded values in Tables 1 (adults) or 2 (nymphs)] of stink bugs in one or more of the 2-month sampling periods. Data are from Hale, Lubbock, and Dawson counties, TX, 2004 and 2005.

	Species Composition (%)	
Host	*Green Stink Bugs*	*Brown Stink Bugs*
Alfalfa	72.75	27.25
Curly dock	61.98	38.02
Field bindweed	75.83	24.17
Horseweed	44.15	55.85
Kochia	66.17	33.83
Lambsquarter	83.04	16.96
London rocket	62.32	37.68
Ragweed	59.92	40.08
Russian thistle	74.03	25.97
Smartweed	63.45	36.55
Tumble mustard	74.17	25.83
Cotton	79.29	20.71

Table 5. By year, percentages of green and brown stink bugs found in sweep net samples taken from **all habitats** sampled in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

	Species Composition (%)	
	2004	2005
Green SB	71.04	68.07
Brown SB	28.96	31.93

Table 6. By two-month sampling period, percentages of stink bugs found in **all habitats** sampled in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

	Species Composition (%)				
County	Feb/Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov
Green SB	71.01	73.16	80.94	72.9	50.68
Brown SB	28.99	26.84	19.06	27.1	49.32

Table 7. By county, percentages of green and brown stink bugs found in sweep net samples taken from **all habitats** sampled in Hale, Lubbock and Dawson counties, TX, 2004 and 2005.

	Species Composition (%)		
	Hale County	Lubbock County	Dawson County
Green SB	68.06	69.49	70.79
Brown SB	31.94	30.51	29.22

Table 8. Monthly percentages of green and brown stink bugs found in sweep net samples taken from **cotton** in Hale, Lubbock and Dawson counties, TX, 2004 and 2005

	Species Composition (%) in Cotton.			
	July	August	September	October
Green SB	85.71	100.00	87.5	69.64
Brown SB	14.29	0.00	12.5	30.36

Conclusions

Ecological knowledge gained from this study of stink bugs and their preferred hosts will be useful in the ultimate goal of developing cotton pest management strategies that rely less on the use of pesticides. During this large study, counts of *Lygus* bugs (Hemiptera: Miridae) and lady beetles (Coleoptera: Coccinelidae) were also collected from the samples. 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 does not harbor a cotton pest species (i.e., stink bugs or *Lygus*), yet allows for the buildup of large lady beetle populations.

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