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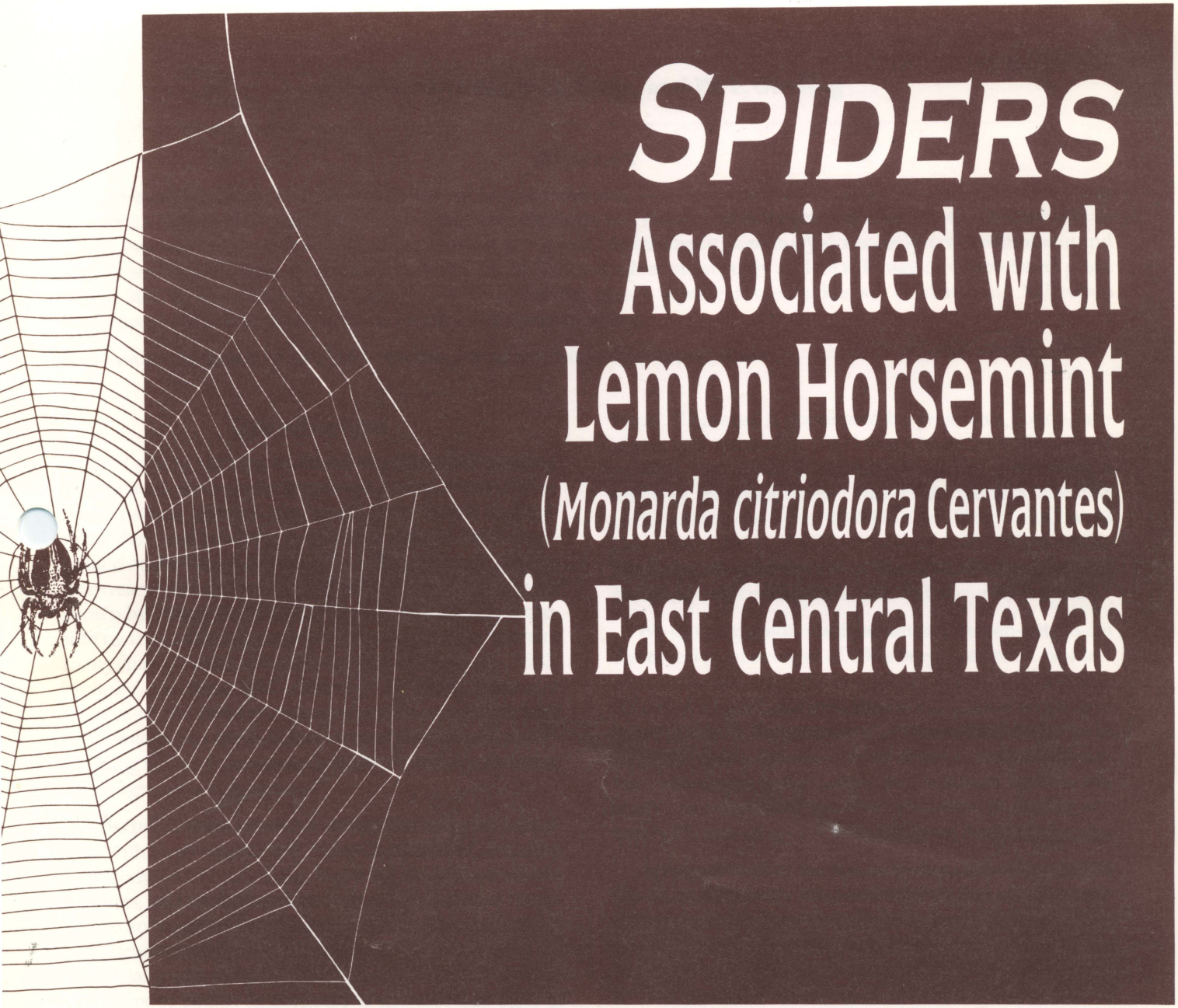

SPIDERS Associated with Lemon Horsemint (*Monarda citriodora* Cervantes) in East Central Texas

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Spiders Associated with Lemon Horsemint (*Monarda citriodora* Cervantes) in East Central Texas

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Abstract

Spider predators were studied on flowering lemon horsemint, *Monarda citriodora* Cervantes, Lamiaceae, at two Texas locations to assess their potential as agroecosystem colonizers and natural control agents of insect pests. *Oxyopes salticus* Hentz, *Peucetia viridans* (Hentz), *Misumenops celer* (Hentz), and *Metaphidippus galathea* (Walckenaer) were predominant and are known (1) to disperse via air currents (ballooning), (2) to colonize cotton fields, and (3) to forage on cotton insect pests. About 90% of the spider individuals found on horsemint plants represent species known to attack and kill cotton fleahoppers, *Pseudatomoscelis seriatus* (Reuter), a key pest of cotton.

Keywords: horsemint, wild plants, spiders, predators, cotton fleahopper, Texas

Introduction

Wild plants growing in minimally disturbed noncrop land may be ecologically important as a reservoir of beneficial natural enemies (i.e., predaceous insects and spiders) that continuously re-colonize annual field crops (Altieri and Whitcomb 1979, 1980). Migration of spiders from reservoir habitats into adjacent agroecosystems was shown by Bishop and Riechert (1990) with a mark-recapture method. Wild plants also serve as alternate hosts for many insect pests (Stadelbacher and Lockley 1983, Nyffeler and Benz 1987, Breene et al. 1988). Faunistic surveys of the natural enemy complex associated with some wild plants are therefore an important step in understanding the mechanisms and effects of predator dispersal in the agricultural landscape.

This publication reports on the spider complex associated with lemon horsemint, *Monarda citriodora* Cervantes, Lamiaceae, in Central Texas. Growing along roadsides, in pastures, and on the borders of crop fields, lemon horsemint is an important wild host plant of the cotton fleahopper, *Pseudatomoscelis seriatus* (Reuter). The potential of the beneficial spider complex as cotton field colonizers and as predators of cotton fleahoppers is discussed in light of their dispersal capacities and prey-size selection.

Materials and Methods

We conducted this study in 1988 at two locations in Snook (near College Station), Burleson County, Central Texas. This area is dominated by grassland, cotton, sorghum, and corn fields. Site 1 was a horsemint-dominated pasture, and at site 2, horsemint patches grew along a highway. Sampling at site 1 was conducted on 8 June 1988 (1450 to 1850) and 9 June 1988 (1510 to 1810); at site 2 on 13 June 1988 (1400 to 1720) and 14 June 1988 (1620 to 1920). The horsemint plants were in bloom on all four dates, and sampling was conducted under warm, sunny weather.

We sampled spiders with a standard sweep-net (38-cm diameter) at an average of 400 sweeps per hour. Spiders were removed from the sweep-net, killed, preserved in 70% ethyl alcohol, and identified under a dissecting microscope (Table 1). Immature spiders were identified as far as possible. *Spider Genera of North America* (Roth 1985) contains references to the taxonomic literature used in this study. We deposited voucher specimens in the Department of Entomology collection at Texas A&M University.

An assessment of the age/size structure of the spiders found on horsemint provided information on their colonizing capability because ballooning is a function of spider body length (Dean and Sterling 1985). Spider size may also be critical in determining which species can be classified as a "key predator" (Sterling et al. 1989). The size class distribution was assessed by assigning each collected spider (Table 1) to one of five size classes according to length (1 to 2, 2 to 3, 3 to 4, 4 to 5, > 5 mm; Table 2). The length was measured from the anterior margin of the carapace to the apex of the abdomen, excluding the spinnerets.

Ecological characterization of these spiders is based on data from previous studies in Texas (Dean et al. 1982, 1987, 1988; Dean and Sterling 1987, 1990; Breene et al. 1988, 1989b; Nyffeler et al. 1992a, b).

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Table 1. Spiders found on horsemint (*Monarda citriodora*) at two locations in Central Texas, 1988, and characterized as follows: ballooning[a] - colonizers of cotton fields[b] - predators of the cotton fleahopper.[c]

Family and Species	Site 1	Site 2	Total	Characterization*
Dictynidae				
Dictyna segregata Gertsch and Mulaik	5	1	6 (0.3%)	a,b,c
Theridiidae				
Achaearanea sp.	1	1	2 (0.1%)	
Theridion sp.	3	3	6 (0.3%)	
Linyphiidae				
Ceraticelus sp. A	1	1	2 (0.1%)	
Ceraticelus sp. B	10	5	15 (0.7%)	
Eperigone eschatologica Crosby	3	0	3 (0.1%)	a,b
Erigone autumnalis Emerton	1	0	1 (<0.1%)	a,b
Grammonota texana (Banks)	5	44	49 (2.3%)	a,b,c
Other	18	10	28 (1.3%)	
Tetragnathidae				
Tetragnatha laboriosa Hentz	6	2	8 (0.4%)	a,b,c
Araneidae				
Acanthepeira stellata (Walckenaer)	0	2	2 (0.1%)	a,b,c
Araneus sp.	1	1	2 (0.1%)	
Argiope sp.	0	1	1 (<0.1%)	
Cyclosa turbinata (Walckenaer)	1	1	2 (0.1%)	a,b,c
Eustala sp.	4	2	6 (0.3%)	
Gea heptagon (Hentz)	2	0	2 (0.1%)	a,b,c
Neoscona arabesca (Walckenaer)	4	9	13 (0.6%)	a,b,c
Other	0	1	1 (<0.1%)	
Lycosidae				
Pardosa sp.	12	1	13 (0.6%)	
Oxyopidae				
Oxyopes salticus Hentz	451	128	579 (27.7%)	a,b,c
Peucetia viridans (Hentz)	51	79	130 (6.2%)	a,b,c
Gnaphosidae				
Micaria sp.	1	0	1 (<0.1%)	
Clubionidae				
Clubiona abboti L. Koch	1	2	3 (0.1%)	a,b
Anyphaenidae				
Aysha sp.	8	28	36 (1.7%)	
Thomisidae				
Misumenoides formosipes (Walckenaer)	2	1	3 (0.1%)	b
Misumenops celer (Hentz) adults	112	53	165 (7.9%)	a,b,c
Misumenops dubius (Keyserling) adults	6	9	15 (0.7%)	b
Misumenops spp. immatures	387	301	688 (32.9%)	
Xysticus auctificus Keyserling	7	16	23 (1.1%)	b
Philodromidae				
Ebo sp.	11	0	11 (0.5%)	
Philodromus pratariae (Scheffer)	1	0	1 (<0.1%)	a,b,c
Thanatus formicinus (Clerck)	0	1	1 (<0.1%)	b
Tibellus duttoni (Hentz)	12	11	23 (1.1%)	b,c

Table 1. cont.

Family and Species	Site 1	Site 2	Total	Characterization*
Salticidae				
Eris aurantia (Lucas)	0	1	1 (<0.1%)	
Habronattus coecatus (Hentz)	11	1	12 (0.6%)	a,b,c
Hentzia palmarum (Hentz)	0	1	1 (<0.1%)	a,b,c
Metaphidippus galathea (Walckenaer)	77	116	193 (9.2%)	a,b,c
Phidippus audax (Hentz)	11	14	25 (1.2%)	a,b,c
Phidippus clarus Keyserling	1	0	1 (<0.1%)	b
Phidippus pius Scheffer	1	0	1 (<0.1%)	
Sarinda hentzi (Banks)	8	0	8 (0.4%)	a,b
Zygoballus nervosus (G. and E. Peckham)	5	1	6 (0.3%)	a,b
Zygoballus rufipes G. and E. Peckham	2	0	2 (0.1%)	a,b,c
TOTAL SPIDERS	1,243	848	2,091 (100%)	

* Based on the following literature:
[a] Dean and Sterling (1990).
[b] Dean et al. (1982, 1988), Dean and Sterling (1987), Breene et al. (1989b).
[c] Dean et al. (1987), Breene et al. (1988, 1989b), Nyffeler et al. (1992b).

Results and Discussion

Spider Assemblages on Horsemint Plants

Table 1 presents a species list (representing 13 families) of spiders associated with flowering horsemint plants. The taxonomic composition of the spider assemblages at two sites was similar. Three families of nonweb-building spiders (foraging without a web) predominated: lynx spiders (Oxyopidae), crab spiders (Thomisidae), and jumping spiders (Salticidae). The lynx spiders *Oxyopes salticus* Hentz and *Peucetia viridans* (Hentz), the crab spider *Misumenops celer* (Hentz), and the jumping spider *Metaphidippus galathea* (Walckenaer) constituted > 75% of the total number of spider individuals collected at each site (Table 1). These four species typically inhabit wild plants in Texas (Dean and Eger 1986; Dean et al. 1987, 1988; Breene et al. 1988), and they are also prominent agroecosystem spider species (Johnson et al. 1986, Dean and Sterling 1987, Nyffeler et al. 1987a). All identifiable spider species listed in Table 1 have been reported in U.S. field crops (Young and Edwards 1990).

We observed a consistent trend of a sex ratio biased toward females (Table 2) and a statistically significant deviation ($p < 0.01$, chi-square test for 2 x 2 contingency table; pooled data for each site) from a theoretical sex ratio of 1 female:1 male. For a hypothetical explanation of the biased sex ratio, see Huhta (1965). The sex ratio is of ecological importance because the heavier females have higher energy requirements compared with the males (sexual dimorphism; Muniappan and Chada 1970, Horner 1972, Nyffeler et al. 1987b). Immature stages (> 80% of total spider individuals) having high dispersal capacity (see section on "Horsemint Plants as a Reservoir for Spider Colonization of Cotton Fields") outnumbered the adults (Table 2).

Horsemint Plants as a Reservoir for Spider Colonization of Cotton Fields

In the cotton agroecosystem, growers periodically destroy the vegetation at the end of the growing season. The system therefore becomes an "ecological desert" (except for soil arthropods) during winter and must be re-colonized by predators each spring (Dean and Sterling 1992). Ballooning appears to be the primary mode by which spiders colonize cultivated fields (Bishop and Riechert 1990). In Texas, Dean and Sterling (1992) measured spider ballooning by means of a Johnson-Taylor suction trap and compared these counts with counts of spiders in a local insecticide-free (8-ha) cotton field. Levels of ballooning activity were high early in the season and declined with the progressing season. Spider numbers on cotton plants increased inversely, suggesting that spiders ballooning early in the season into the cotton field tend to remain there (Dean and Sterling 1992).

Spiders associated with horsemint plants had an early-season age/size structure (> 70% of all collected individuals were ≤ 4 mm in body length, including many immature spiders, Table 2) favorable to dispersal by ballooning (see Dean and Sterling 1985, 1990; Bishop 1990). More than 90% of the spider individuals and identifiable taxa found on the horsemint plants belong to species known to be cotton field colonizers (Table 1).

Spiders as Predators of Insect Pests

The species of spiders found on horsemint (Table 1) are known to be polyphagous insectivores (Muniappan and Chada 1970, Horner 1972, Dean et al. 1987, Nyffeler et al. 1986, 1987a, b, 1989, 1990, 1992a).

Table 1 includes six species, (*O. salticus*, *M. celer*, *Phidippus audax* [Hentz], *Misumenoides formosipes* [Walckenaer], *Acanthepeira stellata* [Walckenaer], and *Tetragnatha laboriosa* [Hentz]), that may qualify as "key predators" of some cotton insect pests (Sterling et al. 1989). According to Sterling et al. (1989), the age structure of predator and prey is critical in determining which species of spiders can be classified as a key predator; most predators of the small stages of insect pests are also small (i.e., immature spiders).

The assemblage of spiders sampled from horsemint plants (Table 2) can be expected to be effective as predators on pests having small body size. The cotton fleahopper, *Pseudatomoscelis seriatus* (Hemiptera: Miridae), a major cotton pest in Texas that uses horsemint as an early-season host, varies between 1.1 and 2.9 mm in length (third instar to adult, Table 3) and ideally fits the prey-size range of the spiders on horsemint (see Nyffeler et al. 1992b). Spiders ranging from 1.2 to 7.4 mm in length are known to attack

Table 2. Size class distribution (%) of the spiders associated with *Monarda citriodora* at two locations in Central Texas, June 1988. Data are on the four dominant species and on all spiders combined (n = number of collected spiders, imm = immatures, ad = adults, *m* = males, *f* = females).

Size class (mm)	*Oxyopes salticus*[a]	*Peucetia viridans*[b]	*Metaphidippus galathea*[c]	*Misumenops* spp.[d]	All spiders[e]
			Site 1		
	(n = 451)	(n = 51)	(n = 77)	(n = 505)	(n = 1,243)
1-2	75.2	0.0	18.2	29.5	45.9
2-3	20.4	0.0	20.8	36.8	26.5
3-4	0.4	2.0	37.7	15.2	10.5
4-5	2.2	9.8	22.1	10.1	8.4
>5	1.8	88.2	1.3	8.3	8.7
Total	100	100	100	100	100
			Site 2		
	(n = 128)	(n = 79)	(n = 116)	(n = 363)	(n = 848)
1-2	42.2	0.0	6.9	28.6	27.7
2-3	32.0	0.0	18.1	53.7	35.1
3-4	14.1	0.0	30.2	3.3	9.8
4-5	3.1	3.8	28.4	5.0	8.6
>5	8.6	96.2	16.4	9.4	18.8
Total	100	100	100	100	100

[a] 435 imm, 3 ad *m*, 13 ad *f* (site 1); 113 imm, 0 ad *m*, 15 ad *f* (site 2).
[b] 51 imm, 0 ad *m*, 0 ad *f* (site 1); 79 imm, 0 ad *m*, 0 ad *f* (site 2).
[c] 49 imm, 14 ad *m*, 14 ad *f* (site 1); 53 imm, 27 ad *m*, 36 ad *f* (site 2).
[d] Mostly *Misumenops celer*; 387 imm, 56 ad *m*, 62 ad *f* (site 1); 301 imm, 21 ad *m*, 41 ad *f* (site 2).
[e] 1,050 imm, 86 ad *m*, 107 ad *f* (site 1); 687 imm, 53 ad *m*, 108 ad *f* (site 2).

Table 3. Body length (mm) of spiders (and prey) known to have successfully attacked and killed cotton fleahoppers. Data are from 108-hours visual observation in a cotton field near College Station, Central Texas (summer 1988, Nyffeler et al. 1992b, unpublished data) (imm = immatures, ad = adults). See Nyffeler et al. (1987a, b) for methods information.

Predator species (and stage)	Life stage (instar) of fleahopper prey	Body length of predator $\bar{x} \pm$ SE (range)	Body length of prey $\bar{x} \pm$ SE (range)
O. salticus (imm, ad)	imm (3rd/5th), ad	4.0 ± 0.3 (2.6-5.7)	2.3 ± 0.1 (1.1-2.9)
P. viridans (imm)	ad	6.9 ± 0.3 (6.4-7.4)	2.5 ± 0.2 (2.2-2.9)
P. audax (imm)	ad	3.7	[a]
M. galathea (imm)	imm (3rd)	3.5	1.6
Misumenops spp. (imm)	ad	3.0	2.6
C. turbinata (imm, ad)	ad	2.4 ± 0.2 (1.9-2.8)	2.2 ± 0.1 (1.8-2.6)
N. arabesca (imm)	ad	2.8 (2.6-2.9)	2.2 (1.9-2.4)
D. segregata (imm, ad)	ad	1.8 ± 0.2 (1.2-2.2)	2.2 ± 0.2 (1.7-2.4)
All species combined	—	3.5 ± 0.3 (1.2-7.4)	2.3 ± 0.1 (1.1-2.9)

[a] Not identified.

and kill cotton fleahoppers (Table 3, 108-hours visual observation in a cotton field), which implies that spiders of any length sampled from horsemint (Table 2) should be able to overpower this cotton pest. The smallest spiders (1- to 2-mm size class) may forage preferentially on small nymphs of the fleahopper.

Conclusions

Approximately 90% of the spider individuals found on horsemint plants (Table 1) belong to species known as predators of the cotton fleahopper (Dean et al. 1987; Breene et al. 1988, 1989a, b, 1990; Nyffeler et al. 1992b). This indicates that these spiders kill cotton fleahoppers on wild plants. The TEXCIM40 model also demonstrates that spiders are of economic value as predators of the cotton fleahopper in Texas cotton fields (Sterling et al. 1992).

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