Holotype: male. VENEZUELA: Pmo. de Guaramacal, 3000 m., Bocono, Edo. Trujillo, Bordon 7-VIII-1981. In Instituto Biologia, UNAM, Mexico, D.F.

It is a pleasure to dedicate this striking new species to Dr. Harry Brailovsky who is contributing so much to our knowledge of Neotropical Lygaeidae.

ACKNOWLEDGEMENTS

I wish to thank Dr. Harry Brailovsky (Instituto Biologia, UNAM, Mexico) for bringing this interesting insect to my attention: to Ms. Mary Jane Spring and Mrs. Elizabeth Slater (University of Connecticut) for preparation of the illustrations and aid with the manuscript respectively.

This work was supported in part by a grant from the National Science Foundation.

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CORN RESIDUE AS AN OVERWINTERING SITE FOR SPIDERS AND PREDACEOUS INSECTS IN FLORIDA

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ABSTRACT

Corn residue was used as an overwintering site by 24 species of spiders (Araneae) and 25 predaceous Coleoptera, Hemiptera and Dermaptera in northern Florida. The two principal microsites were the cavity formed between the leaf sheath and stem, and between layers of imbricate bracts (husks) of shelled corncobs. Several pest species were also found in these sites: chinch bugs (*Blissus insularis*), false chinch bugs (*Pachybrachius vinctus*) and rice weevils (*Sitophilus orvzae*). When both sites were available, shelled corn cobs were highly preferred by both predators and pests.

RESUMEN

En un estudio hecho en el Norte de Florida, se encontró que los residuos del cultivo de maíz son utilizados como lugar de invernación por 24 especies de arañas (Araneae) y por 25 especies de depredadores pertenecientes a los ordenes Coleóptera, Hemíptera y Dermáptera. Dentro del ecosistema de la planta, los artrópodos se encontraron habitando principalmente la cavidad localizada entre la unión de la hoja y el tallo, así como también entre las diferentes capas brácteas imbricadas de la tusa del maíz. En estos mismos sitios fueron encontrados varias especies de plagas, tales como: chinches (*Blissus insularis*), falsos chinches (*Pachybrachius vinctus*) y gorgojos del arroz

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(*Sitophilus orizae*). Cuando ambos sitios estaban disponibles, tanto los depredadores como los insectos plaga se encontraron preferencialmente en la tusa de maíz.

Entomologists have learned to take advantage of the overwintering strategies used by herbivorous insects such as the boll weevil (Slosser et al. 1984), the southwestern corn borer (Archer et al. 1983), and the bean leaf beetle (Jeffords et al. 1983). Some overwintering populations can be limited by tilling, which breaks up the post harvest trash and exposes the insects, and/or by removing accumulated leaf litter in the borders where the hibernating stages are found. Data on overwintering of insects is used to time agricultural management decisions and to construct life tables that span more than one year.

Likewise, overwintering strategies of predaceous arthropods could be used to manipulate their populations; however, information about stages and sites is limited. Spiders, due to their long life cycles and slow rates of reproduction, should be particularly dependent on the adequacy of suitable overwintering sites. The purpose of this study was to identify the type and location of such sites in the corn field. Other insects using these same sites were also identified.

Methods and Materials

Locality Descriptions

Overwintering predaceous insects and spiders were studied in two northern Florida corn fields. The first was located near Archer, Florida, in southwestern Alachua County and was studied during the winter of 1982-83. The second field was located on the Tall Timbers Research Station in northern Leon County and was studied during the winter of 1983-84. The Archer site was on a deep layer of fine sand that supported xeric hammock or turkey oak scrub on near by, less disturbed sites. Peanuts, corn, watermelons, and forage grasses were rotated on irrigated fields. Cattle, and to a lesser extent hogs, were kept nearby, often put in the fields after harvest.

The Tall Timbers corn fields were planted on a sandy clay loam soil and were surrounded by a fire-managed slash pine plantation maintained to encourage wildlife populations, particularly quail and deer. The post-harvest corn residue was accordingly left in the field for the birds and other animals to glean.

Methods and Materials

Plant debris left in the fields following harvest included dead weeds, wind-blown leaves, corn stubble, shattered stalks, and at Tall Timbers only, shelled corn cobs with many of the bracts still attached. In a preliminary study at each field, these materials were each gathered and then carefully examined in the field, by breaking apart the collected materials and sorting them by hand over a white tray. Spiders and insects were collected and preserved in alcohol. This established that spiders and insects were abundant in the corn residue but were essentially absent in the other debris.

Further study was directed soley at the corn residue. At Archer the residue consisted of the crown attached to a meter or less of broken stalk; 16 sets of 10 corn stalks were examined for predators on three visits during December and January. The residue left by a sheller picker at Tall Timbers also left shelled corn cobs with many of the husks

still attached and covering the cobs. There, 24 sets of 10 corn stalks plus 10 cobs with husks were examined as described above on three dates in January and February.

Within field sites were not selected at random because the harvesters distribute the residue unevenly. All collections were made on cool days (<10°C), therefore the location of inactive spiders and insects in the stubble was noted.

Spiders were identified by use of the keys in Kaston (1981), by comparison with specimens in the Florida State Collection of Arthropods (F.S.C.A.), and verification by Dr. G. B. Edwards. Hemiptera were identified by Dr. Frank Mead and Coleoptera by Dr. R. E. Woodruff and Dr. J. Howard Frank. Voucher specimens of all species collected are deposited in the F.S.C.A.

RESULTS

The corn stubble provided two basic hiding places for numerous overwintering spiders and insects. The leaf sheath normally remained attached to the corn stalk, where it overlayed an indentation along the length of the stalk (Figure 1); this was the only site provided by the stubble left in the Archer field. The corn stubble that was left at Tall Timbers also included the shelled cobs with up to 20 enclosing husks. This protected and insulated site was greatly preferred by the overwintering spiders and insects at Tall Timbers as shown by their virtual absence from the protected leaf base cavities. This overwintering site is shown in Fig. 2. At either site, no more than an occasional specimen was collected from within the corn stalks.

In all, 24 species of spiders and 25 species of predaceous insects were identified. The spiders collected are listed in Table 1 and the predaceous insects in Table 2.

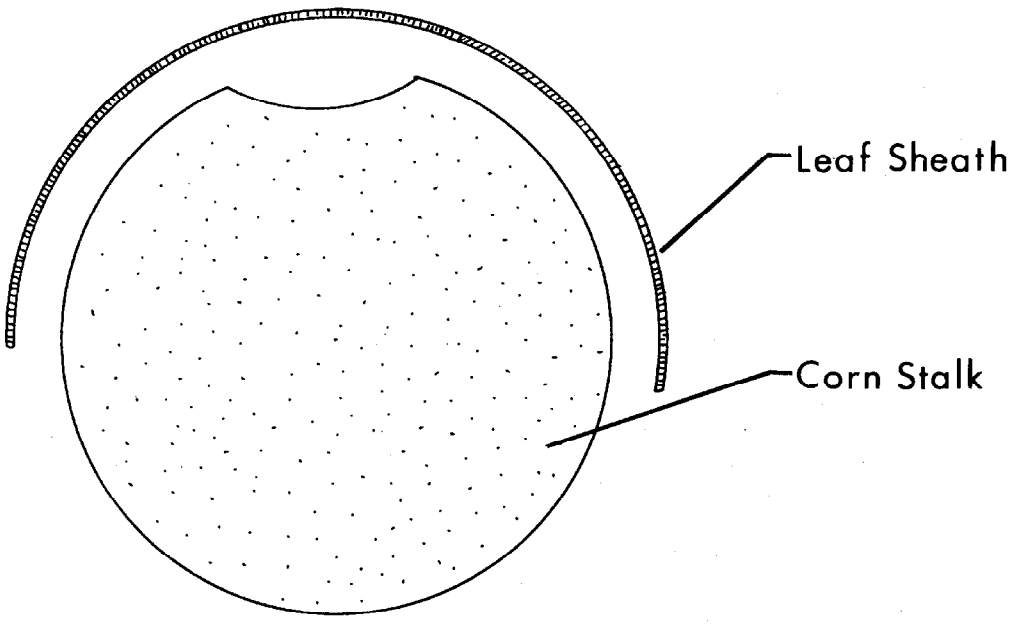

Fig. 1. Cross section of corn stalk and leaf sheath showing the protected cavity between them.

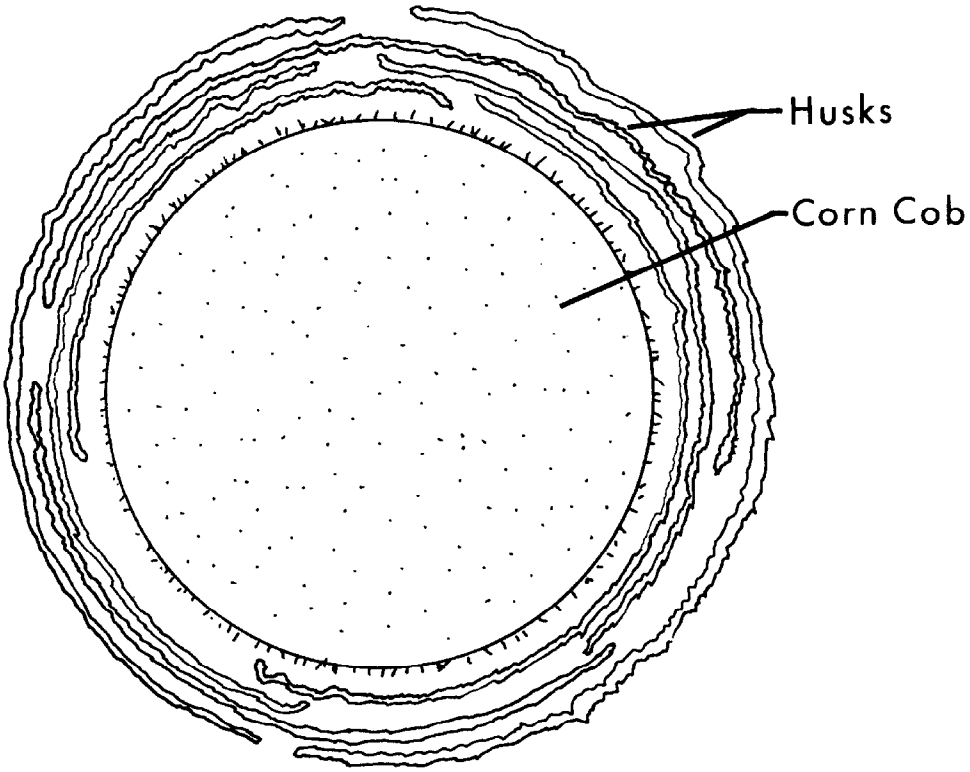

Fig. 2. Cross section of corn cob with enclosing husks showing the protected layers of air.

Discussion

Overwintering spiders have at least 3 requirements of their quarters. First, the site must insulate them from the coldest temperatures. Kirchner (1973) studied cold resistance in spiders, finding that many species spending the winter in the open or in hollow plant stems can survive temperatures as low as –16 to –3°C. Kirchner studied species inhabiting central Europe; the cold tolerance of Florida species has not been investigated.

Second, the spider must avoid desiccation (Edgar and Loenen 1974). Protection from the sun and wind is provided within plant stems, stalks and bracts. A third requirement is the need to avoid predation (Danks 1978). Poikilotherms, due to their decreased metabolic activity at low temperatures, are particularly vulnerable to winter-active birds and mammals. Gunnarsson (1983) found that overwintering spiders on spruce branches had much greater survival when foraging birds were excluded. The preference by overwintering spiders for geometrically complex situations such as birds' nests (Otzen and Schaefer 1980), Spanish moss (Rosenfeld 1911), and in this case, the numerous enclosing bracts around the corn cob, should be important in providing safety from homeothermic predators as well as insulation from cold temperatures.

The condition of the stubble left in a corn field is partly determined by the method used to harvest and by the postharvest treatment of the field. If the corn is chopped for silage, or if the field is disced and planted to a second crop, virtually no stubble is left. The combine with a picker head, which was used at the Archer field, leaves just the corn stalks. On the other hand, the picker sheller, which was used at Tall Timbers, leaves both the stalks and cobs in the field.

TABLE 1. SPIDERS COLLECTED DURING THE WINTER FROM CORN STUBBLE AT ARCHER (160 PLANTS) AND TALL TIMBERS (240 PLANTS) IN NORTH FLORIDA, 1982-1984.

FAMILY Genus species	Stages[1]	Archer[2]	Tall Timbers[3]
DICTYNIDAE			
Dictyna sp.	MJ		1
THERIDIIDAE			
Achaeranea globosa	EJ,MJ	1	4
Coleosoma acutiventer	MJ,F		2
Theridion spp.	LJ,M,F		6
LINYPHIIDAE			
Eperigone near *banksi*	EJ		1
Ceraticellus similis	M		1
MIMETIDAE			
Mimetus sp.	M		2
OXYOPIDAE			
Oxyopes salticus	MJ,LJ		1
Oxyopes scalaris	LJ		1
AGELENIDAE			
Agelenopsis sp.	M		1
HAHNIIDAE			
Neoantistea magna	F		1
LYCOSIDAE			
Pardosa milvina	EJ,MJ,LJ,M,F	9	16
Pardosa parvula	EJ,MJ,F		5
Pirata sp.	MJ		1
ANYPHAENIDAE			
Wulfila saltibunda	MJ,LJ		4
CLUBIONIDAE			
Castieniara sp.	EJ,MJ		6
Chiricanthium inclusum	MJ,LJ	2	3
Clubiona sp.	EG,LJ	5	
Trachelus sp.	MJ,LJ,M,F	4	20
GNAPHOSIDAE			
Cessonia bilineata	MJ		2
Poecilochroa sp.	LJ	2	
Zelotes rusticus	M		1
THOMISIDAE			
Misumenoides formosipes	MJ		2
SALTICIDAE			
Metaphidippus galathea	LJ,M	14	1

[1]EJ=Early Juvenile, MJ=Middle Juvenile, LJ=Late Juvenile, M=Male, F=Female.
[2]All specimens from Archer were collected from under the leaf sheath.
[3]All specimens from Tall Timbers were collected from between the layered husks around the cobs.

The importance of overwintering sites for predaceous arthropods in agroecosystems is undeniable. However, the corn residue provides overwintering sites for herbivorous species as well. We found chinch bugs (*Blissus insularis*), false chinch bugs (*Pachybrachius vinctus*), saw tooth grain beetles (*Oxyzaephilus surinamensis*) and grain weevils (*Sitophilus* sp.). In addition, Wright et al. (1983) recorded the southern corn billbug (*Sphenophorus callosus*) overwintering in the crowns of corn plants, while in

TABLE 2. PREDACEOUS INSECTS COLLECTED DURING THE WINTER FROM CORN STUBBLE AT ARCHER (160 PLANTS) AND TALL TIMBERS (240 PLANTS) IN NORTHERN FLORIDA.

FAMILY Genus species	Stages[1]	Archer[2]	Tall Timbers[3]
FORFICULIDAE			
Doru aculeatum	M,F	23	35
LABIDURIDAE			
Labidura	ADULT	1	
ANTHOCORIDAE			
Cardiastethus assimilis	ADULT	1	
Lasiochilus sp?	LI	3	12
Orius sp.	LI	1	
LYGAEIDAE			
Geocoris uliginosus	ADULTS		4
Geocoris punctipes	ADULTS		12
MIRIDAE			
Spanogonicus sp.	LI		1
NABIDAE			
Hoplistoscelis deceptivus	ADULTS	2	10
REDUVIIDAE			
Zelus cervicalis	ADULTS		2
CARABIDAE			
Calleida decora	ADULTS	1	
Harpalini spp. (6 species)	ADULTS		14
COCCINELIDAE			
Scymnus sp.	ADULTS	1	2
STAPHYLINIDAE			
Genus spp. (11 species)	ADULTS		80

[1]LI=Late Instar, M=Males, F=Females
[2]All specimens from Archer were collected from under the leaf sheath.
[3]All specimens from Tall Timbers were collected from between the layered husks around the cobs.

more northern latitudes stubble helps to retain a layer of insulating snow that increases the survival of Lepidoptera pupae (Turnock and Bilodeau 1984).

Two major pests of corn also make use of post harvest corn residue and the remaining crowns as overwintering sites, namely the European corn borer (*Ostrinia nubilalis*) (Brindley and Dicke 1963) and the southwestern cornstalk borer (*Diatraea crambidoides*) (Metcalf et al. 1962). Burkhardt (1952) also reported fall armyworm (*Spodoptera fruqiperda*) larvae pupating in parts of the corn plant. Thus, the use of corn stubble in management of predator populations in areas where these insects are important pests would be unwise.

However, the intensity and diversity of predators in corn residue suggests that overwintering sites could otherwise be limiting and that providing alternative sites could increase predator survival. Fye (1985) placed bundles of corrugated fiberboard as overwintering sites in pear orchards, but did not detect a significant increase in predator numbers the following spring despite large numbers of predators using the the traps. This result was attributed to variance in the reservoirs of predators the previous fall and the need for even higher densities of traps. How overwintering sites might be

provided while not benefiting pest species will require intimate knowledge of the overwintering biology of both pests and beneficials.

ACKNOWLEDGMENTS

The authors wish to extend sincere thanks to Mr. Jack Simmons who admitted us to his agricultural fields and to Dr. Edward V. Komerak who granted use of the Tall Timbers Research Station.

Florida Agricultural Experiment Station Journal Series #7179.

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