Spiders in South African cotton fields: species diversity and abundance (Arachnida: Araneae)

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Dippenaar-Schoeman A S, Van den Berg A M & Van den Berg A 1999. Spiders in South African cotton fields: species diversity and abundance (Arachnida: Araneae). *African Plant Protection* **5**(2): 93–103.

Spiders were collected from 1979 to1997 in five cotton-growing areas in South Africa. Thirty-one families, represented by 92 genera and 127 species, were recorded. The Thomisidae were the richest in species (21) followed by the Araneidae (18) and Theridiidae (11). The most abundant spider species were *Pardosa crassipalpis* Purcell (Lycosidae), *Enoplognatha* sp. (Theridiidae), *Eperigone fradeorum* (Berland) (Linyphiidae) and *Misumenops rubrodecorata* Millot (Thomisidae). Wandering spiders constituted 61.5 % and web-builders 38.5 % of all spiders collected. Information on guilds, relative abundance and distribution are provided for each species in an annotated checklist. Spiders are common and occur in high numbers in cotton fields and prey on a variety of cotton pests. Although spiders probably are incapable of controlling major pest outbreaks by themselves their role in a complex predatory community may be important in regulating pest species at low densities early in the season and between peaks of pest species activity. They therefore could play an important role in keeping pests at endemic levels and preventing outbreaks

Key words: agroecosystems, Araneae, biodiversity, cotton, relative abundance, South Africa, spiders.

Cotton (*Gossypium* spp.) is one of South Africa's five major field crops, and is steadily increasing in importance. Several pests that attack cotton have a wide range of natural enemies, of which spiders are prominent ones (Van den Berg & Dippenaar-Schoeman 1991) whose potential as biological control agents have nevertheless been largely ignored in applied scientific research in South Africa.

Spider communities on cotton in the USA have been widely studied, with more than 300 species having been recorded (Whitcomb & Bell 1964; Leigh & Hunter 1969; Young & Lockley 1985; Nyffeler & co-workers 1987–1994). Bishop & Blood (1977, 1981) and Bishop (1979, 1980, 1981) reported on work carried out in Australia while Wu et al. (1981), Zhao (1984) and Zhao et al. (1989) studied spiders on cotton in Asia.

Little information is available on the incidence of spiders on cotton in Africa. In southern Africa, Brettell & Burgess (1973) made some observations on spiders on cotton in Zimbabwe, while Coates (1974), Van den Berg (1989), Van den Berg et al. (1990) and Van den Berg & Dippenaar-Schoeman (1991) reported on spiders associated with cotton in South Africa.

Spiders are among the first predacious arthropods to colonise newly-planted cotton fields and their populations gradually build up in size as plant density and prey numbers increase (Dinkins et al. 1970; Van den Berg 1989; Van den Berg & Dippenaar-Schoeman 1991). Most spider species are polyphagous and feed on a variety of prey (Nyffeler et al. 1994a). Predation is not limited to adult insects but includes the egg and larval or nymphal stages as well (Whitcomb 1974; Nyffeler et al. 1990). Spiders use diverse foraging modes and hunting strategies to obtain prey, and could play an important role in the control of pest species (Dippenaar-Schoeman 1976; Sterling et al. 1992). A single species may not be able to control a single pest species but spider assemblages can be effective in stabilising pest populations. The buffering effect of spiders can only be achieved through the combined activities of a variety of species in a given habitat. Therefore, comprehensive surveys, to determine species diversity and numerically dominant species and their abundance, are essential before experiments on their effectiveness can be conducted (Green 1996).

This paper presents the results of a survey of spiders on cotton in South Africa that formed part of the South African National Survey of Arachnida (SANSA) in agroecosystems. We provide a checklist of spiders commonly found in some cotton-growing areas of South Africa, with reference also to spider guilds, abundance and distribution.

Materials and methods

Study areas

Spiders were collected in the following five cotton-growing areas in South Africa from 1979 to 1997: Hartebeespoort Experiment Farm near Brits, North-West Province (25.36S, 27.49E),

Loskop Research Station (25.10S, 29.24E) and Oudestad Experiment Farm near Groblersdal (25.12S, 29.12E), Northern Province, and Rust de Winter (25.15S, 28.29E) and farms near Marble Hall (25.00S, 29.25E) in Mpumalanga.

Sampling techniques

Spiders were collected from mainly two zones in cotton fields, using the following techniques:

i. Ground wanderers were sampled in pit-traps (Viljoen 1976) between the cotton rows. The traps were usually operational during the entire cotton season. Specimens were removed at weekly intervals. Pit-trapping was carried out in four of the five study areas.
ii. Plant wanderers were sampled by hand (Marble Hall), with a sweepnet or beating tray (Rust de Winter, Loskop Research Station), or with the whole-plant bag-sampling method (Brits), where the whole plant is removed from the field and spiders collected by hand and aspirator in the laboratory (Van den Berg 1989; Van den Berg et al. 1990).

Juveniles of some families were reared to maturity for species identification. A large number of preserved juveniles were unidentifiable. In addition, some specimens could not be identified to species owing to the unresolved taxonomy of their families. All material is in the National Collection of Arachnida, ARC - Plant Protection Research Institute, Pretoria.

Sampling period

Various aspects of cotton production have been studied at ARC - PPRI over the last 20 years, and included sampling of spiders during the 1979–1980 (Oudestad), 1980–1988 (Hartebeespoort), 1980–1981 (Rust de Winter), 1981–1982 (Loskopdam) and 1995–1997 (Marble Hall) growing seasons.

Experimental procedure

Abundance. The following relative abundance categories were used: (1) *common,* three or more specimens collected per week; (2) *occasional,* 6–30 spiders per season; (3) *rare,* six or fewer spiders per season.

Guild. A guild is a group of species potentially competing for jointly exploited, limited resources (sensu Polis & McCormick 1986). The following guilds were recognised based on foraging behaviour: web-builders (WB) – spiders that snare their prey with silk: wanderers (W) – spiders that wander around in search of prey. The wandering spiders can further be divided into plant wanderers (PW) and ground wanderers (GW). Web-builders construct orb webs (OWB), space webs (SPWB), sheet webs (SWB), funnel webs (FWB) and cribellated webs (CWB).

Feeding experiments. Some of the common spider species were subjected to feeding experiments in the laboratory where they were presented with a selection of pest species found on cotton.

Results and discussion

Species recorded

Table 1 lists the spider species collected, the guilds that they occupy, and their relative abundance and distribution. Thirty-one spider families, represented by 92 genera and 127 species, were collected in the five cotton-growing areas. This compares well with the spider assemblages in cotton fields in Arkansas (19 families, 102 genera and 189 spp.; Heiss et al. 1988) and in China (20 families and 130 spp.; Zhao 1984), but the families and genera differ since the African fauna is distinctly different from those of other continents (Dippenaar-Schoeman & Jocqué 1997).

The Thomisidae were represented by the highest number of species (21) (Table 1), followed by the Araneidae (18) and the Theridiidae (11). Fourteen families were represented by single species. The most abundant species were *Pardosa crassipalpis* Purcell (Lycosidae), *Enoplognatha* sp. (Theridiidae), *Eperigone fradeorum* (Berland) (Linyphiidae) and *Misumenops rubrodecorata* Millot (Thomisidae).

The family and species dominance differs from those reported from the USA and China. Dean et al. (1982) reported that 23 % of the spiders on cotton in Texas belonged to the Oxyopidae (*Oxyopes salticus* Hentz) followed by Lycosidae (*Pardosa milvina* Hentz and *P. pauxilla* Montgomery), Thomisidae (*Misumenops celer* Hentz), Tetragnathidae (*Tetragnatha laboriosa* Hentz), Dictynidae (*Phantyna segregata* (Gertsch & Mulaik)) and Miturgidae (*Cheiracanthium inclusum* Hentz). In China (Zhao 1984) the dominant families were Linyphiidae (*Micryphantes graminicola* (Sundevall), Lycosidae (*Pardosa astrigera* L Koch), Thomisidae (*Misumenops tricuspidatus* Fabricius) and Theridiidae (*Coleosoma octomaculatum* Bösenberg & Strand).

Guilds

Web-builders

In the present study, 49 species (38.5 %), represented by 11 families, were web-builders. The Araneidae (18 spp.), Linyphiidae (10 spp.) and Theridiidae (11 spp.) were the families most often encountered.

Araneidae. Araneids are orb-web spiders, constructing their webs on or between plants. Most are nocturnal and during their inactive period during the day they were collected from the leaves, stems and seed of cotton plants. Diurnal species were collected from webs between plants and leaves (Van den Berg 1989). Of the 18 species collected, most were rare except *Neoscona triangula* (Keyserling), which was commonly found at Brits and Marble Hall, and *N. blondeli* (Simon), *N. subfusca* (C L Koch) and *Nemoscolus obscurus* Simon which were only occasionally found at the same localities. Araneids were observed preying on *Helicoverpa armigera* (Hübner) moths and larvae, both in the laboratory and in the field.

Members of the Araneidae were also commonly found on cotton in other countries. In Texas, Nyffeler et al. (1987, 1989) reported that 10 % of the spiders collected were orb weavers belonging to five species in the families Araneidae, Tetragnathidae and Uloboridae. Most webs were small (40 cm in diameter) and intercepted relatively small prey, of which aphids were the most abundant (34.6–90 %). According to Dean et al. (1982), Araneidae were common on cotton in Texas where they preyed on various pests, while Lincoln et al. (1967) found that species of *Araneus* were one of the most important predators of bollworm moths. Other pest species preyed on by species of *Araneus, Neoscona* and *Argiope* included *Adelphocoris rapidus* (Say) (nymphs), *Brevicoryne brassicae* (Linnaeus), *Helicoverpa armigera* (larvae), *H. zea* (Boddie) (moths), *Myzus cerasi* (Fabricius), *M. lythri* (Schrank), *Pseudatomoscelis seriatus* (Reuter) (adults), *Rhopalosiphum padi* (Linnaeus) and spur-throated locust nymphs (Kagan 1943; Lincoln et al. 1967; Bishop & Blood 1981).

Linyphiidae. Spiders of this family are typical sheet-web weavers and were collected on cotton plants, in pit-traps and from webs close to the soil surface. On cotton they were mostly observed in small webs spun across the leaf (Van den Berg 1989). *Eperigone fradeorum* was the most common species collected from soil at Marble Hall, followed by *Microlinyphia sterilis* (Pavesi) and *Ostearius melanopygius* (O P.-Cambridge). *Erigone irrita* Jocqué and *Microlinyphia sterilis* were found in association with the red spider mite *Tetranychus lombardinii* Baker & Pritchard (Meyer 1996).

In China, the linyphiid *Micryphantes graminicola* was the most common species on cotton (Zhao 1984). Some linyphiids have been observed to attack second-instar bollworm (*Helicoverpa zea*) larvae as they crawl up the main stem of cotton plants (Whitcomb 1967). In Texas, Nyffeler et al. (1988) found that aphids were the dominant prey of the linyphiid *Frontinella pyramitela* (Walckenaer).

Theridiidae. Theridiids are gumfoot space-web spiders that build their irregular webs on, between and around the leaves, near the flowers and bracts of cotton plants (Van den Berg 1989). They cast viscid silk on their prey before biting. An *Enoplognatha* sp. was the most common species at Brits and Marble Hall, followed by *Theridion purcelli* O P.-Cambridge. In the laboratory both species fed on red spider mites, the first three larval stages and adult stages of *Helicoverpa armigera,* leafhoppers and aphids.

In Israel, Mansour et al. (1995) found that a *Steatoda* sp. is able to prey on 9.5 *Tetranychus cinnabarinus* mites per day in the laboratory. Theridiids are important predators of several insect pest species (Mansour & Whitcomb 1986). They have been found to prey on boll weevils and bollworm larvae (Whitcomb & Bell 1964). In Queensland, Australia, *Achaearanea veruculata* (Urquhart) was observed to prey on jassids, cotton aphids, looper larvae and cotton seed bugs (Bishop & Blood 1981). Prey records of *Theridion australe* Banks and *Tidarren haemorrhoidale* (Bertkau), often found on cotton in Texas, showed aphids to be their main prey (Nyffeler et al. 1988).

Wanderers

Of all the spiders collected during this study 61.5 % were wanderers in 22 families, of which 21.8 % were collected from the soil surface and 34.4 % from plants.

Ground wanderers

Thirteen families represented by 35 species were ground wanderers, with Gnaphosidae (10 spp.) and the Lycosidae (8 spp.) the most common families.

Lycosidae. Lycosids are cursorial hunters and were observed on the leaves and flowers of cotton plants or running on the ground and hiding under dry leaves (Van den Berg 1989). During this study the numerically dominant species, *Pardosa crassipalpis,* was recorded from all five localities. In the laboratory *P. crassipalpis* preyed on red spider mites and various stages of cotton bollworm larvae (*Helicoverpa armigera*). Coates (1974), Dippenaar-Schoeman (1976) and Botha (1986) found *P. crassipalpis* to be active predators of red spider mites.

Whitcomb et al. (1963) found that lycosids swarm over the plants at night in summer. Haynes & Lockley (1990) reported that a larger number of species of *Pardosa* than of *Lycosa* were present on the plants. Laboratory studies on feeding strategies of *Pardosa hortensis* Thorell showed that they can play a positive role in controlling agricultural pests in a density-sensitive way (Samu & Bíró 1993). They have a Holling type II functional response to different prey densities and during high prey densities they attack and feed on more than one prey item or kill prey without feeding or only partly feeding on them. Studies have shown that wolf spiders (*Pardosa* spp.) have low feeding frequencies in the field (Nyffeler & Breene 1990).

It is clear that lycosids play an important role in biocontrol in cotton. *Pardosa* spp. have been observed to prey on pink bollworm moths (Whitcomb et al. 1963) and they presumably destroy first and second-instar larvae of the bollworm on the plant as well as those that fall to the ground, as bollworm moths are vulnerable to predation during their brief exposure on the soil surface (Lincoln et al. 1967; Whitcomb 1967). Lycosids also prey on *Helicoverpa* pupae (Lincoln et al. 1967), cabbage looper moths (Whitcomb & Bell 1964), and *Heliothis virescens* (F.), *Lygus lineolaris* (Palisot de Beauvois) (Haynes & Lockley 1990) and noctuid moths (Whitcomb et al. 1963). Zhao et al. (1989) observed lycosids preying on 30 species of insects, including aphids, in China.

Gnaphosidae. Although 10 species were collected from cotton nothing is known about their prey preferences. There were mainly collected in pit-traps.

Plant wanderers

Eight families, represented by 44 species, were plant wanderers. Of these, Miturgidae (4 spp.), Oxyopidae (5 spp.), Salticidae (6 spp.) and Thomisidae (21 spp.) were the most common families.

Miturgidae. Of the miturgids, members of the genus *Cheiracanthium* are nocturnal, free-living hunters, hiding in a silk sac-shaped retreat made on plants, frequently in rolled-up leaves, when not active (Van den Berg 1989). They are aggressive spiders and will kill any prey that they encounter, even though not always feeding on them. According to Brettell & Burgess (1973), *Cheiracanthium furculatum* Karsch (then *C. lawrencei*) was frequently found in the narrow space between the bract and boll of cotton in Zimbabwe. Two species, *C. furculatum* and *C. africanum* Lessert, were occasionally found during this survey. In the laboratory they preyed on all larval stages of the cotton bollworm.

The genus *Cheiracanthium* is one of the most common genera found on cotton in the USA (Whitcomb & Bell 1964; Young & Lockley 1985), Australia (Bishop & Blood 1981), Israel (Mansour 1987) and Zimbabwe (Brettell & Burgess 1973). *Cheiracanthium* species have been reported to prey on second and third instars of *Helicoverpa* spp. larvae, cotton looper larvae, green vegetable bug and cotton seed bug (Bishop & Blood 1981). They also feed preferentially on abundant pests during pest outbreaks and show a direct numerical relationship with changes in *Helicoverpa* spp. larval abundance (Bishop 1979). McDaniel & Sterling (1982) found that an individual consumed on average14.2 *Heliothis virescens* eggs in the laboratory during a 24-hour period. Feeding studies in Israel showed that *Cheiracanthium mildei* L Koch are important predators of red spider mites (*Tetranychus cinnabarinus*). During feeding studies in the laboratory, females of *C. mildei* on average preyed on 27.5 mites per day and *C. mildei* juveniles on 18.8 mites per day. By contrast the predacious mite *Phytoseiulus persimilis* (Athias-Henriot), which is extensively used in biological control, has been reported to prey on only 11.3 mites per day (Mansour et al. 1995).

Oxyopidae. Oxyopids are diurnal and nocturnal, cursorial hunters that are found on cotton plants, frequently near the flowering parts (Van den Berg 1989). *Oxyopes bothai* Lessert was occasionally found at Brits, Loskop Reseach Station, Marble Hall and Rust de Winter.

Oxyopids were consistently among the most abundant arthropod predators in cotton agroecosystems in the USA (Young & Lockley 1985;

Nyffeler et al. 1987a,b; 1992a). According to Nyffeler et al. (1987a) 0.12 million prey may be killed per week per hectare by *O. salticus* in unsprayed cotton. In sprayed fields, spider density is often strongly reduced. Whitcomb (1967) found that *Oxyopes* spp. destroyed more second-instar larvae of *Helicoverpa zea* than did any other arthropod predator. They also preyed on mirids, cotton leafhoppers, tarnished plant bugs (Whitcomb et al. 1963), *Adelphocoris rapidus* (Say) (adults), *Pseudatomoscelis seriatus* (Reuter) (adults) and aphids (Kagan 1943; Nyffeler et al. 1992b). In Queensland, Bishop & Blood (1981) found that *Oxyopes mundulus* L Koch fed preferentially on *Helicoverpa* larvae during outbreaks and showed a numerical response to changes in *Helicoverpa* larval abundance. In feeding experiments in Israel, oxyopids consumed, on average, 16.8 red spider mites per day in the laboratory (Mansour et al. 1995).

Salticidae. Various salticid genera were found during the survey, including an ant-mimicking species of *Myrmarachne.* Salticids were common in all five areas and were found both in pit-traps and on plants, where they constructed sacs in rolled-up leaves (Van den Berg 1989). Most salticids are diurnal and their prey is limited to species present on the plants. They have acute eyesight and move within striking distance of their prey. In the laboratory, a single salticid devoured 17 red spider mites within a 12-minute period and also preyed on the first two larval stages of *Helicoverpa armigera.* Feeding experiments conducted in Israel showed salticids to consume on average 10.1 red spider mites per day (Mansour et al. 1995).

Salticidae are highly polyphagous but can narrow their prey spectrum when prey becomes available in high numbers (Nyffeler et al. 1994a). Salticids prey on bollworms (first to third instar), boll weevil, robber flies (Whitcomb & Bell 1964), *Helicoverpa armigera* larvae, *Alabama argillacea* larvae and adults, and nymphs of *Adelphocoris rapidus* (Kagan 1943). They seize second-instar larvae of *Helicoverpa zea* from cotton foliage and under bracts of squares and bolls of the plant (Whitcomb 1967; Young 1989) and are able to destroy large numbers of first and second-instar larvae in the field (Lincoln et al. 1967). In Texas, Dean et al. (1987) found that 5 % of the prey of *Phidippus audax* (Hentz) and *Pelegrina galathea* (Walckenaer) consisted of the mirid *Pseudatomoscelis seriatus. Phidippus audax* showed a sigmoid functional response to the availability of fleahoppers in a confinement test in the field (Breene et al. 1990). Jumping spiders accounted for 1.5 % destruction of bollworm eggs in a cotton field (Dorris 1970).

Thomisidae. Members of this family were mostly found on leaves and stems, near bracts as well as hiding under dry leaves on the ground (Van den Berg 1989). *Misumenops rubrodecorata* was the most abundant species and was collected in all five areas. In the laboratory they preyed on red spider mites, the first two larval stages of *Helicoverpa armigera* as well as on aphids.

Crab spiders are among the most abundant predators in agroecosystems and grassland (Plagens 1983; Nyffeler et al. 1994a). Most thomisids are sit-and-wait predators, waiting for prey to move to within grasping distance (Dean et al. 1982). However, McDaniel & Sterling (1982) and our observations have shown that some species actively move about in search of prey.

Lincoln et al. (1967) found *Misumenops* spp. on all parts of the plant, especially on or under bracts of cotton bolls and squares, but very few were taken from the ground. Thomisids are active during the day (Leigh & Hunter 1969) and they destroy second-instar larvae of *Helicoverpa zea* in terminals where they wait in ambush (Whitcomb 1967). They also prey on *Geocoris punctipes, Lygus lineolaris, Acalymna vittata* (Lincoln et al. 1967), syrphid flies and beetles (Whitcomb & Bell 1964), *Pseudatomoscelis seriatus* adults (Dean et al. 1987) and larvae of *Alabama argillacea* and *Helicoverpa armigera* (Kagan 1943). In China they have been observed to feed on eggs and first-instar larvae of *H. armigera* (Wu et al. 1981). *Misumenops celer* occurred in relatively high numbers and constituted a major portion (44.2–57.6 %) of the predator complex in two Arizona cotton fields (Plagens 1983).

Conclusion

Spiders are common and occur in high numbers in cotton fields, where they are also some of the very first predators to colonise the fields. In cotton fields they occur on the plants as well as the soil surface. Spiders have a very wide range of prey, including all stages of a pest such as eggs, larvae, pupae and moths. They can show a reproductive response to increased numbers of a pest and prey preferentially on pests occurring in large numbers.

Table 1. Annotated checklist of spiders collected in five cotton-growing areas in South Africa. The families are listed alphabetically. Guilds (based on foraging strategy), relative abundance and distribution are given for each species.

Family/genus/species	Guilds[a]	Relative abundance[b]	Distribution[c]
AGELENIDAE			
Mistaria sp.	FWB	3	M
ARANEIDAE			
Araneus haploscapus (Pocock, 1898)	OWB	3	B,L
A. nigroquadrata (Lawrence, 1937)	OWB	3	M,R
Argiope australis (Walckenaer, 1805)	OWB	3	M,R
A. trifasciata (Fórskal, 1775)	OWB	3	O,R
Caerostris sexcuspidata (Fabricius, 1793)	OWB	3	B
Cyclosa oculata (Walckenaer, 1802)	OWB	3	M,R
Cyrtophora citricola (Fórskal, 1775)	OWB	3	B,M
Isoxya tabulata (Thorell, 1859)	OWB	3	L,M
Kilima decens (Blackwall, 1866)	OWB	3	B,M,R
Pararaneus cyrtoscapus (Pocock, 1898)	OWB	3	L,M
Nemoscolus obscurus Simon, 1896	OWB	2	B,M
N. vigintipunctatus Simon, 1896	OWB	3	M
Neoscona blondeli (Simon, 1885)	OWB	2	B,M
N. rufipalpis (Lucas, 1858)	OWB	3	B,L,M
N. moreli (Vinson, 1863)	OWB	3	M
N. subfusca (C L Koch, 1837)	OWB	2	B,M
N. triangula (Keyserling, 1864)	OWB	2	B,M
Singa sp.	OWB	3	M
CAPONIIDAE			
Caponia sp. (immature)	GW	3	B,R
CLUBIONIDAE			
Clubiona africana Lessert, 1921	PW	2	M,R
C. revillioidi Lessert, 1936	PW	3	M
CORINNIDAE			
Castianeira fulvipes (Simon, 1896)	GW	3	B, M
Trachelas sp. (immature)	GW	3	B
CTENIZIDAE			
Stasimopus robertsi Hewitt, 1910	GW	3	M
CYRTAUCHENIIDAE			
Ancylotrypa nuda (Hewitt, 1916)	GW	3	B
DICTYNIDAE			
Dictyna sp. (immature)	CWB	3	B,M,R
ERESIDAE			
Dresserus colsoni Tucker, 1920	CWB	3	L,O,R
GNAPHOSIDAE			
Camillina cordifera (Tullgren, 1910)	GW	3	B,L,M,O,R
Drassodes sp. (immature)	GW	3	R
Megamyrmaekion transvaalensis Tucker, 1923	GW	3	B
Pterotricha varia (Tucker, 1923)	GW	3	B
Setaphis subtilis (Simon, 1897)	GW	3	B,L,M,O,R
S. browni (Tucker, 1923)	GW	3	O,R
Upognampa parvipalpa Tucker, 1923	GW	3	B,L,O
Zelotes frenchi Tucker, 1923	GW	3	L,M

Continued on p. 99

Table 1 (continued)

Family/genus/species	Guilds	Relative abundance	Distribution
Z. oneili (Purcell, 1907)	GW	3	B,L,O,R
Z. ungula Tucker, 1923	GW	3	B,R
LINYPHIIDAE			
Ceratinopsis idanrensis Locket & Russell-Smith, 1980	SWB	3	R
Eperigone fradeorum (Berland, 1932)	SWB	1	B,M,R
Erigone irrita Jocqué, 1984	SWB	3	B
Linyphia sp. (immature)	SWB	3	M,R
Meioneta habra Locket, 1968	SWB	3	B
M. natalensis Jocqué, 1984	SWB	3	B
M. prosectoides Locket & Russell-Smith, 1980	SWB	3	B
Metalepthyphantes perexiguus (Simon & Fage, 1922)	SWB	3	B,R
Microlinyphia sterilis (Pavesi, 1883)	SWB	2	B,M
Ostearius melanopygius (O P.-Cambridge, 1879)	SWB	2	B,L,M,R
LIOCRANIDAE			
Copa benina Strand, 1915	GW	3	M
LYCOSIDAE			
Evippomma squamulatum (Simon, 1898)	GW	3	L,M
Hippasa sp. (immature)	GW	3	M
Lycosa bimaculata Purcell, 1903	GW	3	O,R
L. darlingii Pocock, 1898	GW	3	L,R
Pardosa clavipalpis Purcell, 1903	GW	2	B,L,M,R
P. crassipalpis Purcell, 1903	GW	1	B,L,M,O,R
P. injucunda (O P.-Cambridge, 1876)	GW	3	R
P. umtalica Purcell, 1903	GW	3	L,O
MITURGIDAE			
Cheiracanthium africanum Lessert, 1921	PW	2	L,M,O
C. furculatum Karsch, 1879	PW	2	B,L,M,O,R
C. simplicitarse (Simon, 1910)	PW	3	M,R
C. vansoni Lawrence, 1936	PW	3	M
OONOPIDAE			
Gamasomorpha australis Hewitt, 1915	GW	3	O,R
OXYOPIDAE			
Hamataliwa sp.	PW	3	R
Oxyopes bothai Lessert, 1915	PW	2	B,L,R
O. jacksoni Lessert, 1915	PW	3	B,L,M
O. longispinosa Lawrence, 1938	PW	3	B,L,M,R
Peucetia transvaalica Simon, 1896	PW	3	M
PALPIMANIDAE			
Diaphorocellus sp. (immature)	GW	3	B
Palpimanus sp. (immature)	GW	3	R
PHILODROMIDAE			
Philodromus sp. (immature)	PW	2	B,L,M,0,R
Thanatus vulgaris Simon, 1870	GW, PW	2	B,M,O,R
Tibellus minor Lessert, 1919	PW	3	B,L,M,O,R
PHOLCIDAE			
Smeringopus natalensis Lawrence, 1949	SPWB	3	B

Continued on p. 100

Table 1 (continued)

Family/genus/species	Guilds	Relative abundance	Distribution
PHYXELIDIDAE			
Vidole sothoana Griswold, 1990	CWB	3	R
PISAURIDAE			
Cispius sp. (immature)	PW	3	B,M
Euprosthenops sp. (immature)	FWB	3	M
Rothus aethiopicus (Pavesi, 1883)	PW	3	M
PRODIDOMIDAE			
Anagraphis sp.	GW	3	L,O,R
SALTICIDAE			
Brancus bevisi Lessert, 1925	PW	3	M
Cosmophasis sp. (immature)	PW	3	B
Heliophanus hastatus Wesolowska, 1986	PW	2	L,M,R
H. orchestra Simon, 1885	PW	3	L
Myrmarachne sp. (immature)	PW	3	B,M
Thyene coccineovittata (Simon, 1885)	PW	3	M
SCYTODIDAE			
Scytodes sp. (immature)	GW	3	B
SICARIIDAE			
Loxosceles spinulosa Purcell, 1904	GW	3	O
SPARASSIDAE			
Olios tuckeri Lawrence, 1927	PW	3	B
Palystes superciliosus L Koch, 1875	PW	3	B
TETRAGNATHIDAE			
Leucauge festiva (Blackwall, 1866)	OWB	3	O,M
Pachygnatha sp. immature	OWB	3	R
Tetragnatha subsquamata Okuma, 1985	OWB	3	B,M
THERIDIIDAE			
Anelosimus sp.	SPWB	3	M
Argyrodes sp	SPWB	3	M
Dipoena sp.	SPWB	3	O
Enoplognatha sp.	SPWB	1	B,M,O,R
Euryopis sp.	SPWB	3	M
Latrodectus geometricus C L Koch, 1841	SPWB	3	B,L,M,R
L. renivulvatus Dahl, 1902	SPWB	3	B,M,O,R
L. rhodesiensis MacKay, 1972	SPWB	3	R
Steatoda capensis Hann, 1990	SPWB	3	M
Theridion purcelli O P.-Cambridge, 1904	SPWB	2	B,M,R
Theridula sp.	SPWB	3	B
THOMISIDAE			
Diaea puncta Karsch, 1884	PW	2	B,M
Parabomis martini Lessert, 1919	PW	3	B
Firmicus sp.	PW	3	M
Heriaeus sp.	PW	3	M
Misumenops rubrodecorata Millot, 1941	PW	1	B,L,M,O,R
Monaeses austrinus Simon, 1910	PW	3	O,R
M. fuscus Dippenaar-Schoeman, 1984	PW	3	R

Continued on p. 101

Table 1 (continued)

Family/genus/species	Guilds	Relative abundance	Distribution
M. paradoxus (Lucas, 1846)	PW	3	O
M. quadrituberculatus Lawrence, 1927	PW	3	O
Oxytate argenteooculata (Simon, 1886)	PW	3	B
Runcinia aethiops (Simon, 1901)	PW	3	B,M
R. affinis Simon, 1897	PW	3	O
R. depressa Simon, 1906	PW	3	O
R. flavida (Simon, 1881)	PW	3	B,O
Synema decens (Karsch, 1878)	PW	3	B,M,O,R
Thomisus blandus Karsch, 1880	PW	3	B,L,M,O
T. congoensis Comellini, 1957	PW	3	R
T. stenningi Pocock, 1900	PW	3	B,O,R
T. kalaharinus Lawrence, 1936	PW	3	L,M
Tmarus cameliformis Millot, 1941	PW	3	M
Xysticus natalensis Lawrence, 1938	GW	3	B,M,R
ULOBORIDAE			
Uloborus plumipes Lucas, 1846	CWB (orb)	3	B,M
ZODARIIDAE			
Chariobas sp. (immature)	GW	3	B
Diores recurvatus Jocqué, 1990	GW	3	R
D. rectus Jocqué, 1990	GW	3	M,R

[a]Guilds: GW = ground wanderers; PW = plant wanderers; WB = web builders; CWB = cribellated webs; FWB = funnel webs; OWB = orb webs; SWB = sheet webs; SPWB = space webs.
[b]Relative abundance: 1 = commonly sampled; 2 = occasionally sampled; 3 = rarely sampled.
[c]Distribution: B = Brits, Hartebeespoort Experiment Farm; L = Loskopdam Research Station; M = Marble Hall; O = Oudestad Experiment Farm; R = Rust de Winter.

Owing to the different guilds they occupy, various families are affected differently by pesticides. Their presence in cotton fields should be encouraged and steps should taken to protect them from harmful chemicals. Although spiders may be incapable of controlling major pest outbreaks by themselves, their role in a complex predatory community could be important in regulating pest species at low densities early in the season and between peaks of pest species activity. They may play an important role in keeping pests at endemic levels and prevent outbreaks from occurring in the first place.

Acknowledgements

We thank our colleagues at ARC - Plant Protection Research Institute who assisted in collecting spiders, staff at the South African Bureau of Standards for the material from Marble Hall, officials at the different experiment farms for assistance, and M K P Smith Meyer for commenting on the manuscript.

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Accepted 15 October 1999
Associate Editor was S W Broodryk