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INCIDENCE AND DISTRIBUTION OF THE SORGHUM HEAD BUG, *EURYSTYLUS OLDI* POPPIUS (HETEROPTERA: MIRIDAE) AND OTHER PANICLE PESTS OF SORGHUM IN WEST AND CENTRAL AFRICA

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Abstract — The incidence and distribution of the sorghum head bug, *Eurystylus oldi* Poppius (Heteroptera: Miridae), and other panicle pests of sorghum in research stations and farmers' fields in West and Central Africa (WCA) were assessed from 1985 to 1994. Maximum head bug abundance was observed during the dough stage. Head bug abundance was greater on improved cultivars, while the local *guineense* sorghums with long glumes were less susceptible, both at the research stations and the farmers' fields. Grain damage was moderate to severe, although farmers were mostly unaware of this insect and its damage potential, because it remains hidden inside the panicle. Sorghum midge (*Stenodiplosis sorghicola* Coq.) damage was very high on farmer's fields in Burkina Faso, Niger, and Nigeria. The shootfly *Atherigona soccata* Rond., stemborer *Busseola fusca* Fuller, grasshoppers, spittle bug *Locris rubens* Erichson, *Campylomma* spp., *Creontiades pallidus* Ramb., *Agonoscelis* spp., head caterpillars *Helicoverpa armigera* Hub., *Pyroderces simplex* Wlsm. and *Eublemma gayneri* Roths., were other insect pests damaging sorghum in the areas surveyed. It is proposed that future efforts in sorghum improvement for WCA should focus on developing cultivars with resistance to sorghum head bugs.

Key Words: sorghum, insect pests, head bug, *Eurystylus oldi*, West Africa

Résumé: L'incidence et la distribution de la punaise du sorgho, *Eurystylus oldi* Poppius (Heteroptera : Miridae), et des autres ravageurs du panicule du Sorgho ont été évaluées de 1985 à 1994 en stations de recherches et en parcelles paysannes, en Afrique de l'Ouest et Centrale (AOC). L'abondance maximale du miride a été observée pendant le stade pâteux. L'abondance du miride était plus importante sur les cultivars améliorés que sur les sorghos guinéens locaux à longues glumes, aussi bien en stations de recherches qu'en parcelles paysannes. Les dégâts sur graines étaient modérés à sévères bien que les fermiers ignoraient la plupart du temps ces insectes et leurs dégâts potentiels car ils restent cachés dans les panicules. Les dégâts provoqués par le moucheron du Sorgho (*Stenodiplosis sorghicola* Coq.) étaient très importants dans les parcelles paysannes au Burkina Faso, au Niger et au Nigéria. La mouche du sorgho *Atherigona soccata* Rond., le foreur des tiges *Busseola fusca* Fuller, les criquets, le cercopide *Locris rubens* Erichson, *Campylomma spp.*, *Creontiades pallidus* Ramb., les chenilles de la noctuelle *Helicoverpa armigera* Hub., *Pyroderces simplex* Wlsm. et *Eublemma*

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gayneri Roths étaient également des ravageurs responsables de dégâts sur sorgho dans la zone prospectée. On suggère que les futures investigations pour l'amélioration de la culture du Sorgho en OAC pourraient porter sur le développement de cultivars résistants au miride du sorgho.

Mots Clés: sorgho, insectes ravageurs, miride, *Eurystylus oldi*, Afrique de l'Ouest

Introduction

Several species of mirids are known to feed on sorghum grain in West and Central Africa (WCA). Of these, *Eurystylus oldi* Poppius is the most important (Doumbia and Bonzi, 1985; McFarlane, 1989; Nwanze, 1985; Steck et al., 1989; Sharma et al., 1992). It reduces grain yield by as much as 86% (ICRISAT, 1991), and also affects the grain quality (Sharma et al., 1994). Although much on-station research has been conducted on the bioecology of this insect (Doumbia, 1992a,b; McFarlane, 1989; Steck et al., 1989), there is very little information on its incidence, distribution and damage potential on local and improved sorghum cultivars in farmers' fields in WCA. One of the recommendations of the International Consultative Workshop on Panicle Insect Pests of Sorghum and Pearl Millet (Nwanze and Youm, 1995) was to establish, through on-farm surveys, the distribution and importance of the sorghum head bug, *E. oldi* in farmers' fields in WCA. Such a diagnostic survey is important to priority-setting in head bug research for this region.

A study was therefore conducted on the incidence and distribution of the sorghum head bug, *Eurystylus oldi* Poppius (Heteroptera: Miridae), and other panicle pests of sorghum in research stations and farmers' fields in West and Central Africa, from 1985 to 1994.

Materials and Methods

Insect pest incidence at different stages of panicle development

Insect pest incidence was recorded at different stages of panicle development (half-anthesis, complete-anthesis, milk, and dough stages) during the 1986 rainy season in a plot of sorghum cultivar S 35 at Kamboinse, Burkina Faso, and ICSV 247 at Bagauda, Nigeria during the 1989 rainy season. The cultivars were planted on a large plot (24 rows, 10 m long with the ridges spaced at 75 cm), and the plants were thinned to a spacing of 10 cm between the plants 15 days after seedling emergence. Standard agronomic practices were followed for the crop, and no insecticides were sprayed during the reproductive stages. Five panicles were sampled in a muslin cloth bag (30 x 45 cm) at random in each plot, the insects immobilised in a deep freezer for 30 minutes, and counted in the laboratory.

Head bug distribution and abundance

1985 rainy season - Mali. Insect pest abundance in sorghum panicles at the milk and dough stages was recorded at the research stations at Sotuba, Bamako, Mali. Five sorghum genotypes were planted in 4-m-long 4-row plots with ridges 75 cm apart. There were three replications in a randomised complete block design. The plants were thinned to a spacing of 10 cm between plants 15 days after seedling emergence. Standard agronomic practices were followed with no insecticides sprayed during the reproductive stages. Insect abundance was recorded as described above. Sorghum panicles were also observed for insect damage in farmers' fields around Bamako, Cinzana, Segou and Kogoni.

1986 rainy season – Burkina Faso. Head bug abundance was recorded on four sorghum genotypes at the dough stage. There were three replications (each plot having four 4 m-long rows) in a randomised complete block design. Insect pest incidence was also recorded in sorghum panicles at the milk to dough stages in farmers' fields/ research stations at Kamboinse, Fada, Saria, Boromo and Farako Ba as described above.

1988 rainy season – Mali. Head bug abundance was monitored on four sorghum genotypes at Sotuba and Samanko. Each genotype was planted in eight, 9-m-long rows with four replications in a randomised complete block design. Head bug numbers were recorded in the middle of each plot in five panicles at the dough stage as described above.

1989 rainy season – Nigeria, Niger, Mali and Burkina Faso. Head bug incidence on sorghum in farmers' fields was recorded at intervals of 40 to 50 km along the survey route from Kano (Nigeria) to Niamey (Niger), and from Bamako (Mali) to Farako Ba (Burkina Faso). Head bug abundance was also recorded at the research stations at Bagauda in Nigeria, Sotuba and Cinzana in Mali, and Farako Ba in Burkina Faso. Head bug numbers were recorded by sampling diagonally across the fields at three locations.

Five panicles were sampled in a muslin cloth bag at random at each point. Numbers of head bugs were counted for each field and location. Other insects damaging the sorghum crop were also recorded. Head bug abundance was also recorded in seven genotypes planted at three locations at Cinzana, Farako Ba and Samako. There were three replications in a randomised complete block design (four 4-m-long rows). Five panicles were sampled at the dough stage in each plot to record head bug numbers under natural conditions as described earlier.

1993–95 rainy seasons – Nigeria, Niger, Chad and Cameroon. The first survey during 1993 covered seven states (Bauchi, Borno, Kaduna, Kano, Plateau, Sokoto and Yobe) in Nigeria. The 1994 survey covered parts of Bauchi, Jigawa, Kaduna, Kano, Kogi, Kwara, Plateau, Sokoto and the Federal Capital Territory (FCT) in Nigeria, southeastern Niger (Maradi and Tahoua Provinces), and northern Benin. Northern Cameroon and southeastern Chad were surveyed in 1995. The surveys included the Sahelian, Sudanian and Guinean agroecological zones. Based on the 1993 experience, the 1994 survey started on 23 September (three weeks earlier than in 1993). The survey in 1995 was carried out from 7 to 17 October. Sorghum cultivars were at different stages of development, ranging from panicle emergence to grain maturity. Stops were made at intervals of 8 to 50 km, and the nearest farm was sampled for head bug incidence and damage. At each farm, 5 to 12 panicles selected at random were sampled in a polyethylene bag measuring 55 x 38 cm. The insects were killed with chloroform and the numbers of *E. oldi* nymphs and adults per panicle were recorded. Information was also recorded on cropping pattern and cultivars grown. In Benin, insects in the panicles were dislodged onto a piece of paper by tapping, and visual observations were made on the severity of *E. oldi* infestation.

Results

Insect pest incidence in sorghum at different stages of panicle development

At the Kamboinse research station, Burkina Faso, up to 26 sorghum midges (*Stenodiplosis sorghicola* Coq.) per panicle were recorded at the half-anthesis stage in SPV 35 (Table 1). Maximum head bug and head caterpillar abundance were recorded at the milk and dough stages. Thrips were observed at the flowering stage. At Bagauda, Nigeria, head bug adults were observed on the sorghum panicles at the pre- and half-anthesis stages. However, the maximum numbers of adults were recorded at the complete-anthesis and milk stages, when they lay eggs inside the grain. Maximum head bug density was recorded at the dough stage, which appears to be the optimum stage for sampling for *E. oldi*.

Table 1. Insect pest incidence at different stages of panicle development in sorghum cv. SPV 35 at Kamboinse, Burkina Faso (1986 rainy season) and ICSV 247 at Bagauda, Nigeria (1989 rainy season)

	No. of midges per panicle	No. of head bugs per panicle		No. of thrips per panicle	No. of caterpillars per panicle
Stage of panicle development	Kamboinse 1986	Kamboinse 1986	Bagauda 1989	Kamboinse 1986	Kamboinse 1986
Half-anthesis	26 (4.8)*	<1 (0.6)	1.3 (1.0)	15	0
Complete-anthesis	0 (0.3)	2 (1.5)	4.0 (2.0)	0	0
Milk stage	0 (0.3)	30 (5.2)	14.0 (3.2)	0	0
Dough stage	0 (0.3)	47 (6.7)	43.0 (6.4)	0	8
Physiological maturity	0 (0.3)	<1 (0.5)	-	0	6
SE	±(0.38)	± (0.46)	± (0.79)	±1.7	±1.6

*Figures in parentheses are square root transformed values.

Table 2. Head bug abundance[+] (average number of insects per panicle) at the milk and dough stages in five sorghum genotypes at Sotuba, Mali (1985 rainy season)

	Eurystylus oldi		*Campylomma* sp.	
Genotype	Milk stage	Dough stage	Milk stage	Dough stage
CSM 388	3 ± 0.9	9 ± 3.8	9 ± 1.7	95 ± 34.9
Malisor 84-7	4 ± 0.3	20 ± 6.9	3 ± 0.6	10 ± 3.2
ICSV 197	7 ± 1.0	49 ± 16.9	7 ± 0.6	51 ± 17.7
A 13120	6 ± 1.2	74 ± 13.7	7 ± 2.0	105 ± 15.6
E 35-1	11 ± 0.7	100 ± 19.3	13 ± 1.6	32 ± 6.6

[+]Five randomly selected panicles were sampled for head bug numbers in each plot.

1985 rainy season - Mali. There were three to nine head bugs per panicle in CSM 388 and four to 20 in Malisor 84-7 compared to 11 to 100 bugs in E 35-1 at the milk and dough stages (Table 2). Numbers of head caterpillars (*Helicoverpa armigera* Hub. and *Pyroderces* sp.) were greater in the compact-panicled cultivar Malisor 84-7 than in CSM 388, which has loose panicles. Cultivars CSM 388 and E 35-1 were also less susceptible to grain mould damage (<10%). Head bug incidence in the farmers' fields at Sotuba, Segou, Cinzana and Kogoni was as severe as that on the research farms in the local *guineense* sorghums.

1986 rainy season – Burkina Faso. The sorghum midge (*S. sorghicola*), head bugs (mainly *E. oldi*), and head caterpillars (*H. armigera, Eublemma gayneri* Roths., *Pyroderces simplex* Wlsm., and *Mythimna* sp.) were the major panicle-feeding insects on sorghum at Kamboinse, Boromo, Saria, and Farako-Ba. More than 40 midges per panicle were observed at these locations during the first fortnight of October. Sorghum midge damage was heavy on the late-flowering crops in farmer's fields at Kamboinse, Fada, Saria, Boromo and Farako-Ba. At some locations, more than 100 bugs per panicle were recorded. Infestation by the head bugs was recorded at all the locations sampled. Head bug incidence in farmers' fields was as severe as that observed at the research stations. Infestation by head caterpillars was recorded at the dough stage. Compact-panicled varieties were severely damaged while those with loose panicles were free from infestation by the head caterpillars. Head bug and head caterpillar damage was generally confined to the inside portion of the panicle. Blister beetles (Coleoptera: Meloidae), chafer beetles (*Pachnoda* sp.), and the cotton stainer (*Dysdercus* sp.) were also recorded. Of the four cultivars sampled, maximum head bug numbers (30 bugs per panicle) were recorded on SPV 35, a *bicolor*-type sorghum variety from India, while the local *guineense* type sorghums SK 86, E 1140 and SK 140 were relatively less susceptible (3, 5, and 4 bugs per panicle, respectively).

Table 3. *Eurystylus oldi* abundance (number per 5 panicles)[+] on four cultivars under natural conditions at Sotuba and Samanko, Mali (1988 rainy season)

Genotype	Sotuba	Samanko
S 34	412 (20.1)*	78 (16.2)
Malisor 84-7	91 (9.5)	40 (6.3)
CSM 388	37 (5.9)	52 (7.1)
Sakoika (local)	36 (5.5)	83 (8.8)
Mean	144 (10.3)	113 (9.6)
SE	(0.76)	(1.86)

[+]Figures in parentheses are square root transformed values.

1988 rainy season – Mali. We recorded 37, 91 and 36 head bugs per 5 panicles in CSM 388, Malisor 84-7, and Sakoika respectively, compared to 412 bugs per 5 panicles in S 34 (Table 3). Amongst these, Malisor 84-7 had up to 9 larvae of head caterpillars (*H. armigera, Mythimna* sp., *Pyroderces* sp. and *E. gayneri*) per panicle compared to <1 larva per panicle in other cultivars. Malisor 84-7 also had high numbers of the earwig *Carpophilus fumatus* (Boheman). CSM 388 and Sakoika are *guineense* sorghums with long glumes, which cover the grain for 20 to 25 days after anthesis, and thus reduce the period of head bug feeding and oviposition. In Malisor 84-7, the glumes are of medium size, but the grain hardens quickly and is highly corneous, which possibly reduces the cultivar's susceptibility to head bugs.

1989 rainy season – Nigeria, Niger, Mali and Burkina Faso. Head bug incidence was generally higher on improved sorghum cultivars at the

Table 4. Insect pest incidence on farmers' fields and at research stations in Nigeria, Niger, Mali and Burkina Faso (Sept–Oct 1989)

Place	Cultivar	No. of bugs per panicle (range)	Other insects
Mali			
Research stations			
Cinzana	CSM 388, Malisor 84-7, and ICSV 1063	12 (3 – 34)	Sorghum midge, *Campylomma*, spp., *Creontiades pallidus, Helicoverpa armigera* and *Pyroderces simplex*
Samanko	CSM 388, Malisor 84-7, and ICSV 1063	294 (45 – 786)	Sorghum midge, *Campylomma*, spp., *Creontiades pallidus, Helicoverpa armigera* and *Pyroderces simplex*
Farmers fields			
Koutiala, N'Tarla Segou, Konobougou	*guineense*	11 (1 – 40)	Shoot fly, stemborer, sorghum midge, *Agonoscelis sp., Campylomma sp., C. pallidus, H. armigera* and *P. simplex*
Burkina Faso			
Research station			
Farako Ba	CSM 388, Malisor 84-7 and ICSV 1063	112 (24 – 272)	Sorghum midge, *Campylomma* spp. *C. pallidus, H. armigera* and *Agonoscelis* sp.
Farmers fields			
Samadina, Gerrabougou	*guineense*	9 (8 – 10)	Sorghum midge, *Campylomma* spp. *C. pallidus, H. armigera* and *Agonoscelis* sp.
Nigeria			
Research station			
Bagauda	ICSH 507 and ICSV 247	161 (77 – 244)	Stemborer, sorghum midge, spittle bug, shoot fly, and grasshoppers
Farmers fields			
Bichi, Saworowa, Majerebu, Kwarari, and Nigeria/Niger border	*durra-bicolor/fara-fara*	24 (7 – 45)	Stemborer, sorghum midge, spittle bug, shoot fly, and grasshoppers Heavy incidence of sorghum midge
Niger			
Farmers fields			
Maradi, Elkota, Kolo, Birni N'Konni, Koukoki, and Dosso	*durra-bicolor/guineense*	71 (1 – 250)	Heavy damage by midge and grasshoppers.

research stations than in farmers' fields (Table 4). Also, head bug numbers were low on *guineense* sorghum with long glumes both at the research stations and farmers' fields. However, *guineense* sorghums with medium-sized glumes and exposed grains (e.g., CSM 63) were susceptible to head bugs both at the research stations and on farmers' fields. Head bug numbers were high in *durra/bicolor* sorghums cultivated in Niger. Sorghum midge damage was high at certain locations in Niger while head bug incidence was generally low on *fara-fara* sorghums in Nigeria.

In Mali, head bug incidence was greater at Samanko than at Cinzana (Table 5) and its abundance was influenced by the date of flowering of a genotype. Cultivars CSM 388 and Malisor 84-7 had low head bug numbers across locations. CSM 63, though a *guineense* sorghum, had high head bug infestation at Samanko; its glumes are relatively shorter and do not cover the grain for a long time. Similar differences in susceptibility of *guineense* sorghums were also observed in the farmer's fields in Mali and Burkina Faso. Head bug population ranged from

3 (in Malisor 84-7) to 786 (in ICSV 16-5 BF) per 5 panicles.

1993–1995 rainy seasons – Nigeria, Niger, Benin, Cameroon and Chad. Of the 76 farmers'fields in northern Nigeria sampled in 1993, 56 were infested by head bugs (Table 6) at levels ranging from 50% in Plateau to 100% in Yobe. Forty-one percent of the 382 panicles examined were infested with head bugs; percent panicle infestation ranged from 13 in Plateau to 60 in Borno. At 13 locations, all the panicles sampled were infested. Differences between cultivars were masked, to some extent, by variation in crop maturity at the time of survey. Nevertheless, head bugs were observed more frequently on compact than on loose-panicled varieties (96% of the varieties with compact panicles were infested as compared to 68% of those with loose panicles). In addition, head bug infestation was greater at the hard-dough (100%) stage than at the milk (54%), soft-dough (67%), and mature (67%) stages. These observations were similar to those at the research stations (Table 1). One farmer at Sabon Gari Damboa in Borno State recognised *E. oldi* and described its damage.

Table 5. *Eurystylus oldi* incidence in seven sorghum cultivars at three locations in Mali under natural conditions (1989 rainy season)

	No. of head bugs/5 panicles		
Cultivar	Cinzana Mali	Farako Ba Burkina Faso	Samanko Mali
CSM 388	4 (1.8)*	24 (4.8)	45 (6.5)
Malisor 84-7	3 (1.8)	40 (5.7)	51 (6.6)
CSM 63	74 (8.2)	73 (8.1)	406 (20.1)
Framida	132(10.7)	287 (16.9)	418 (20.3)
ICSV 1166	50 (6.6)	318 (17.7)	664 (25.7)
S 34	26 (4.4)	237 (14.3)	369 (18.9)
ICSV 1063 BF	34 (5.7)	272 (16.2)	786 (26.3)
Mean	46 (5.6)	179 (12.0)	391 (17.8)
SE	± (2.7)	± (1.1)	± (5.1)

* Figures in parentheses are square root transformed values.

During the 1994 rainy season, 81% of the 88 fields surveyed in Bauchi, Jigawa, Kaduna, Kano, Katsina, Kogi, Kwara, Niger, Plateau and Sokoto States, and the Federal Capital Territory were infested with head bugs, and 50% of the 532 panicles sampled had *E. oldi* infestation (Table 7) with a mean population of 9.7 bugs per panicle (range 0 to 637). The highest population was recorded near Katsina on a compact-panicled *Kaura* (yellow endosperm) sorghum. The open-panicled *Kaura* types were free of head bug infestation. The percentage of fields infested ranged from 50 in Jigawa and Kogi states to 100 in Kaduna, Katsina and Kwara states, and the FCT. Percentage of panicles with *E. oldi* infestation ranged from 15 in Kwara to 77 in Katsina, and the number of head bugs per panicle ranged from 0.2 in Kwara to 40 in Katsina. At Nassarawa, in *makarho da wayo* sorghums, the glumes remain closed until grain maturity — these sorghums are said to be resistant to bird damage. However, they were found to be infested with *E. oldi* (20 bugs per panicle). The *guineense* sorghums also had low infestation. It is notable that all head bug-resistant cultivars identified to date, except Malisor 84-7, are of this type, i.e. their glumes remain closed around the grains until the grains are no longer suitable for oviposition or feeding (Sharma et al., 1992, 1994).

In Benin, high populations (more than 100 bugs per panicle) of *E. oldi* adults and nymphs were observed on improved early-maturing compact-panicled cultivars in on-station trials at Goubafari and Guené. The infestation was severe on the hybrids in the West African Sorghum Hybrid Adaptation Trial (WASHAT) at Guené. Open pollinated improved varieties ICSV 400 and ICSV 111 were also severely infested at both the locations. Green and brown morphs were observed on the same panicles. The local cultivars were at the boot leaf stage, and were therefore not examined.

Table 6. Head bug, *Eurystylus oldi* incidence on sorghum in farmers' fields in northern Nigeria (1993)

Parameter	Bauchi	Borno	Kaduna	Kano	Plateau	Sokoto	Yobe	Mean/total
No. of fields sampled	12	11	14	18	6	10	50	121 b
% of fields infested	67	91	64	67	50	90	100	76 a
Total no. of panicles sampled	60	55	70	92	30	50	25	382 b
% of panicles infested	32	60	30	51	13	40	48	39 a
Number of head bugs per panicle	0.8	13	4	6	0.3	1	2	3.9 a
Range	0–80	0–142	0–159	0–190	0–5	0–25	0–17	0–88.3 a

a, Mean values across locations; b, total numbers across locations.

Table 7. *Eurystylus oldi* incidence on sorghum in farmers' fields in Niger Republic, Nigeria, (October, 1994)

Parameter	Bauchi	Jigawa	Kaduna	Kano	Katsina	Kogi	Kwara	Niger	Plateau	Sokoto	FCT	Niger Republic	Mean*
No. of fields sampled	6	2	9	19	13	6	4	5	15	8	1	8	184 b
% of fields infested	83	50	100	89	100	50	75	100	47	88	100	100	82 a
No. of panicles sampled	45	10	72	150	65	30	20	25	70	40	5	40	572 b
% panicles infested	71	50	74	43	77	30	15	44	20	58	20	85	49 a
Number of head bugs per panicle	10	1.5	7.6	3.6	40	0.8	0.2	1.6	0.8	22	0.2	23.7	9 a
Range	0–62	0–4	0–50	0–15	0–637	0–9	0–1	0–9	0–16	0–210		0–217	0–637 a

FCT, Federal capital territory.
a, Mean values across locations; b, total numbers across locations

In Niger, head bugs were observed on sorghum panicles in all the 8 fields sampled (Table 7). Of the 40 panicles examined, 85% were infested. Most of the cultivars were early maturing with compact to semi-compact panicles, but there were mixtures of cultivars within the same farm. The hybrids at an INRAN (Institut National de Recherches Agronomiques du Niger) on-station trial at Birni N'Konni recorded the highest incidence of head bugs (217 bugs per panicle), and grain damage was apparent. Also, at Ilela, severe head bug damage (poorly developed and shrunken grains) was recorded on some farmers' varieties. The one farmer that was interviewed at Ilela did not recognise the cause of the damage, and attributed it to poor soils.

In Cameroon, of the 19 farms surveyed, 88% were infested with *E. oldi*, while 66% of the 160 panicles examined were infested with head bugs (16 head bugs per panicle, range 1–178) (Table 8). Maximum head bug incidence was recorded at Mokolo-Mandara Mountains. At this location, both compact and open-panicled sorghums were heavily infested, and grain damage was quite severe. At a farm in Maroua, there was > 70% grain damage, but the farmers were not aware of the cause of the damage. Head bug infestation and damage were higher in the Sudanian than in the northern Guinean savanna of Cameroon. Sorghum in the former area was earlier maturing and had more compact panicles than in the latter. *Walaganari* sorghums have long glumes, which provide cover to the grain for a longer period during grain development, and therefore make it difficult for the head bugs to lay eggs in the grain. *Damugari* sorghums have more compact panicles,

Table 8. *Eurystylus oldi* incidence on sorghum panicles in farmers' fields in Cameroon and Chad (1995 rainy season)

Parameter	Cameroon	Chad
No. of fields sampled	19	8
% of fields infested	88	100
Total no. of panicles sampled	160	73
% of panicles infested	66	79
Mean no. of head bugs/panicle	16	15
Range	1–178	1–73

and head bugs are apparently unable to nestle in them; head bug populations were quite low in this cultivar. Some farmers were aware that insects cause damage to sorghum panicles; but no traditional control measures were used.

In Chad, all the 8 farms surveyed were infested with *E. oldi* (Table 8). Seventy-nine percent of the panicles sampled were infested with head bugs. Farmers were sometimes aware of insect damage, but did not use any control measures.

In the farms surveyed, *guineense*, *caudatum*, and *durra* types of sorghums were common. The *guineense* types of sorghum cultivars were common in the wetter zones, while *durra* and *caudatum* types were predominant in the drier areas. Head bug incidence was greater on *durra* and *caudatum* (69% panicles infested, and 15 bugs per panicle) than in the *guineense* sorghums (42% infestation, and 7 bugs per panicle). Among the *durra/caudatum* types, the improved cultivars were more susceptible than the local landraces. Head bug incidence was higher in the drier Savanna (50% infestation, 11 bugs per panicle) than in the wetter Savanna (31% infestation, 3 bugs per panicle).

Other insect pests infesting sorghum

A severe infestation of the sorghum midge (*S. sorghicola*) was observed at Tahoua and Maradi provinces of Niger and in Sokoto in Nigeria. Sorghum midge damage in these areas at times resulted in complete loss of grain. The farmers interviewed were aware of the damage, but ascribed it to nutrient deficiency or pollen wash. Sorghum midge damage was also severe in Chad. Green shield bug (*Nezara viridula* F.), other species of head bugs, and earwig (*Forficula senegalensis* Serville) were also important pests of sorghum in Chad. *Sesamia calamistis* Hampson was an important pest on the off-season crop (*beriberi*). In Cameroon, *N. viridula* and spittle bug, *Locris rubens* Erichson caused serious damage to sorghum at a number of locations. Spittlebug incidence resulted in yellow blotches on the sorghum leaves. *Sesamia calamistis* was also an important pest of *muskwari* sorghums.

Discussion

The results of on-station and on-farm surveys indicated that *E. oldi* occurs on all varieties of sorghum in much of West and Central Africa. Earlier observations had shown that the species occurs on sorghum in Mali, Niger and Burkina Faso (Doumbia and Bonzi, 1985; Nwanze, 1985; Steck et al., 1989; Doumbia 1992, a,b; Sharma et al., 1992, 1994).

We found that head bugs are equally important on farmers' fields. Head bug abundance is lower on landraces with long glumes than on the improved cultivars, both on the research stations and farmers' fields. Most of the landraces have loose panicles, which do not provide sufficient protection for large numbers of the head bugs to develop. Furthermore, they flower in October when head bug populations begin to decline due to low humidity. Most of the *guineense* sorghums have long glumes that cover the grains until their endosperm becomes hard enough to resist oviposition and feeding by head bugs (Sharma et al., 1994). In contrast, many improved varieties in West and Central Africa are of the *caudatum* type, which have compact panicles, short glumes, and medium-hard to soft grains. A combination of these characteristics predisposes the improved varieties to head bug damage, thus necessitating protection with insecticides. For instance, insecticides are routinely applied to control *E. oldi* on ICSV 400 in the farms in Sudanian Savanna zone of Nigeria, where on-station trials have shown up to 86% yield loss due to head bug damage.

The majority of farmers in our study did not recognise *E. oldi* damage. This may be attributed to the relatively small size of the insect and the fact that it resides within the sorghum panicle. There is a need to inform farmers on how to identify *E. oldi* and its damage. Head bugs were more common in the dry savanna than in the wet savanna. The less susceptible *guineense* sorghums predominate in the wetter zones, while the more susceptible *durra/caudatum* type of sorghums are predominant in the drier Sudanian and Sahelian zones.

Intercropping early-maturing improved sorghum varieties with late-maturing local cultivars may aggravate the head bug problem on the local cultivars, as has been observed for sorghum midge infestation, which causes significant yield losses in Niger, Nigeria and Chad.

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