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Incidence of Millet Stem Borer, *Coniesta ignefusalis* Hampson (Lepidoptera: Pyralidae) in Farmers' Fields in Northern Nigeria

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ABSTRACT

Farmers' millet fields in northern Nigeria were surveyed in 1995 and 1996 to determine the current status of stem borers on pearl millet. The surveys confirmed *Coniesta ignefusalis* Hampson as the predominant stem borer on millet. *Sesamia* sp. was recorded on millet only once in a sorghum/millet intercrop. *C. ignefusalis* attacked millet stems in all ecological zones (Guinea and Sudan savannas, and the Sahelian zone), and in all the northern states surveyed (Adamawa, Bauchi, Benue, Borno, Jigawa, Kaduna, Kano, Kebbi, Katsina, Niger, Plateau, Sokoto, Taraba and Yobe). Infestation ranged from 0 to 100%, depending on the millet variety, and was lower in the Sahel than in the Sudan, Northern Guinea and Southern Guinea savanna ecological zones. Millet intercropped with legumes (cowpea and groundnut) had higher stem borer attack than sole millet or millet intercropped with cereals (maize and sorghum) or cereals plus legumes. Millet near villages where old millet stems were used for fencing and thatching had unusually high stem borer infestation levels, sometimes up to 100% with associated severe damage and yield loss. *Syzeuctus* sp. was the most prevalent stem borer parasitoid. Mean natural infestation of the stem borer by parasitoids was 10.25%. Other insects recorded on millet included various flower and grain feeding beetles, sucking and spittle bugs, grasshoppers, the millet head miner, flies, earwigs, bees and wasps.

INTRODUCTION

Harris (1962) described the biology and distribution of the pearl millet stem borer, *Coniesta ignefusalis* Hampson (Lepidoptera: Pyralidae) in Nigeria.

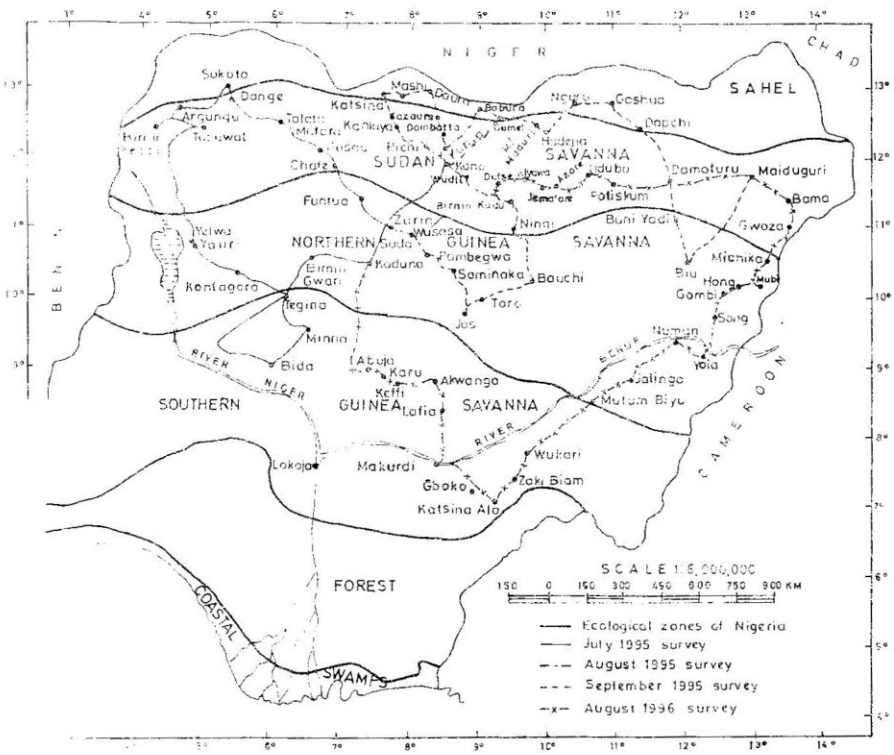
His survey revealed that the insect was a pest of millet in virtually all the millet producing areas of Nigeria. Since his report, however, there has been no systematic survey to determine the current distribution and importance of the insect, except for the survey by Dike *et al.* (1999) on late maturing pearl millet. Ajayi (1985, 1990) however, showed that the millet stem borer causes economic damage and that severe infestations can cause total yield loss. Cropping practices, systems and patterns in northern Nigeria are highly dynamic and changes in these can influence the pest status of the millet stem borer. In order to establish the current status of the insect, a series of on-farm surveys was conducted in 1995 and 1996 in the millet growing areas of Nigeria, including the Southern and Northern Guinea savannas, Southern and Northern Sudan savannas, and the Sahel zone.

MATERIALS AND METHODS

There were three surveys in 1995 (24-27 July, 7-8 August, and 4-7 September) and two in 1996 (10-17 August, and 29-30 August).The surveys involved travelling along the highways and stopping every 50 km to examine the nearest millet farm. In a few villages where stem borer infestation was unusually high, stops were made at distances of half, one and two km before and after each village, to determine the influence of human settlements on stem borer infestation. Farmers were interviewed about the type and variety of millet in their farms, date of sowing, expected harvest date, constraints to millet production, and their knowledge and perception of insect pests of millet, particularly the millet stem borer. Fifty randomly chosen millet stands were examined and the proportion of stands showing stem borer dead heart and/or holes was recorded. Infested tillers were dissected to ascertain the species of stem borer involved. Stem borer larvae and pupae and their parasitoids were collected and reared to adult in the laboratory for identification. *Gero* millet was the first crop to be sown and the companion crops were sown later, but at Wusasa near Zaria in the Northern Guinea savanna zone, millet was sown after maize. Millet was sown between April and July, depending on the rainfall pattern and millet type - *maiwa* was sown in June in Niger State while *gero* was planted in April/May in Kaduna State, June in Niger State and June/July in Sokoto, Kaduna and Kebbi States. Rainfall in 1995 was late and erratic and this explained why millet was still being sown in July at some locations. In Sokoto and Kebbi States, millet was sown several times in the same farm and plants were, therefore, at different growth stages at the time of the survey. *Gero* was harvested three months after sowing, between August and September while *maiwa* was harvested in November. *Gero* was prevalent in the Sahel, Sudan and Northern Guinea savanna zones while *maiwa* was more common in the Southern Guinea

savanna. The larvae and pupae were placed in groups of 50 in rearing jars and the rate of infestation by the parasitoids recorded. A note was made of other insects such as flower feeding beetles, the head miner, head bugs etc, some of which were collected and identified at the insect museum of the Institute for Agricultural Research (IAR), Samaru, Nigeria.

The route followed in each survey is shown in Figure 1. The following states were surveyed: Adamawa, Bauchi, Benue, Borno, Jigawa, Kaduna, Kano, Kebbi, Katsina, Niger, Plateau, Sokoto, Taraba, and Yobe. A total of 183 stops were made and 8832 km were covered.



RESULTS AND DISCUSSION

Cropping Systems

Dauro (late maturing) and *gero* (early maturing) millet types were grown in the areas surveyed. Millet was sown either sole or in various combinations with sorghum, cowpea, groundnut, okra, roselle, cassava, soybean, bambara groundnut, sweet potato, and *egusi* melon. There were 8 crop combinations in the Sudan savanna, 11 and 10 in the Northern and Southern

Guinea savanna zones, respectively (Table 1). Only sole *gero* and *gero* + sorghum were common to all four ecological zones. *Gero* millet was generally strip cropped with one row of millet alternating with one or more rows of sorghum, cowpea or groundnut. Sometimes, millet was alternated with cowpea and/or sorghum along the same row. *Maiwa* and roselle were normally planted on the border of the farm rather than as typical intercrops.

Table 1: Crop mixtures involving pearl millet in northern Nigeria in 1995 and *1996.*

Table 1. Crop mixtures involving pearl millet in northern Nigeria in 1995 and 1996

S/No.	Cropping System	Percentage Occurrence			
		Sahel	Sudan	Northern Guinea	Southern Guinea
1.	Sole gero millet	12.5	7.9	21.0	15.4
2.	Sole maiwa millet	-	6.3	10.5	7.7
3.	Gero millet + cowpea	12.5	19.0	-	-
4.	Gero millet + roselle	12.5	-	-	-
5.	Gero millet + sorghum + cowpea	12.5	28.6	-	-
6.	Gero millet + okra	12.5	-	-	-
7.	Gero millet + sorghum	12.5	17.5	10.5	23.1
8.	Gero millet + sorghum + Roselle + cowpea	12.5	-	-	-
9.	Gero millet + maize	12.5	-	-	-
10.	Gero millet + groundnut + cowpea	-	9.5	-	-
11.	Gero millet + groundnut + sorghum + cowpea	-	7.5	-	-
12.	Gero millet + groundnut	-	4.8	-	7.7
13.	Gero millet + sorghum + Roselle + cowpea	-	4.8	-	-
14.	Gero millet + sorghum + sesame + cowpea	-	4.8	-	-
15.	Gero millet + sorghum + Roselle + g/nut + cowpea	-	4.8	-	-
16.	Maiwa millet + cowpea	-	3.2	-	-
17.	Gero millet + maiwa millet	-	3.2	-	-
18.	Gero millet + bambara groundnut + cowpea	-	1.6	-	-
19.	Gero millet + cotton	-	1.6	-	-
20.	Gero millet + sesame	-	1.6	10.5	-
21.	Gero millet + sorghum + groundnut	-	1.6	10.5	-
22.	Gero millet + maiwa millet + Roselle + cowpea	-	1.6	-	-
23.	Gero millet + sorghum + sesame	-	1.6	-	-
24.	Gero millet + sorghum + maize + okra + cowpea	-	1.6	-	-
25.	Gero millet + maiwa millet + cowpea	-	1.6	-	-
26.	Maiwa millet + sorghum	-	1.6	10.5	-
27.	Gero millet + maiwa millet + Roselle	-	-	5.3	-
28.	Gero millet + maize	-	-	5.3	-
29.	Gero millet + sweet potato	-	-	5.3	-
30.	Maiwa millet + sorghum + cowpea	-	-	5.3	-
31.	Maiwa millet + groundnut	-	-	5.3	7.7
32.	Gero millet + sorghum + egusi melon	-	-	-	7.7
33.	Gero millet + groundnut + egusi melon	-	-	-	7.7
34.	Gero millet + egusi melon	-	-	-	7.7
35.	Maiwa millet + maize + okra	-	-	-	7.7
36.	Maiwa millet + sorghum + groundnut	-	-	-	7.7

- = Not seen

Farmers' Perception of Millet Stem Borer

Most of the farmers interviewed were aware that insects damage and reduce the yield of millet. The millet stem borer was called *tsutsa* in the Hausa language. Some farmers correctly identified the stem borer and described damage associated with it. Farmers knew that the severity of stem borer infestation varied from year to year and regarded the incidence in 1995 as high. Most farmers did not apply any control measures against millet pests, although one farmer removes infested tillers to avoid the spread of the infestation. Most farmers would not apply insecticides due to the high cost and scarcity of such chemicals.

Stem Borer Incidence

25 - 27 July, 1995

Coniesta ignefusalis occurred in all the farms visited except in Sabon Gari Masha in Niger State. In the other farms, the percentage of infestation ranged from 2 in Birnin Kebbi, Kebbi State to 38 in Kurga, Kaduna State. In some plants, almost all the tillers were infested, resulting in the characteristic dead heart symptom, stunted growth and yellowish leaves. *Sesamia* also infested millet at Kurga.

7 – 8 August, 1995

C. ignefusalis was the only stem borer on millet. About 96% of farms were infested, with infestation ranging from 2 to 100%; 8 farms had 30 – 100% infestation. Stem borer infestation was particularly high at Tsamiyar Kwanche (92%), Dumma (66%), and Kore (100%), all in Jigawa State. Infestation declined with increasing distance from each of these villages. Thus, infestation declined to 12% only 1 km after Tsamiyar Kwanche, 8 and 4% at 1 km and 2 km, respectively, after Dumma, 0% at 1 km before and 1 km after Kore. This observation indicated that human settlement favoured stem borer incidence. In each of these villages, millet stems from the previous year's harvest were used for fencing and thatching, thus encouraging the survival of large populations of *C. ignefusalis* which spends the dry season in a facultative larval diapause within millet stems. In other settlements where millet stems had not been used, e.g. Daura (6% infestation), and Katsina (4%), stem borer infestation was low.

Stem borer damage symptoms included dead hearts, yellowing and eventually death of leaves, stunting, failure of panicles to form or exert, and poor grain filling. Millet usually responded to stem borer infestation by producing more tillers than normal, sometimes up to 30 tillers per stand. Nevertheless, between 7 and 100% of tillers were infested and where all tillers were attacked, panicles were not formed.

Between 1 and 20 larvae and pupae lived in each infested stem and stems were frequently so riddled with tunnels that they bent over.

4 - 7 September, 1995

Millet in 59% of farms examined were infested by *C. ignefusalis* with percentage infestation per farm ranging from zero in 28 locations to 88 near Ningi in Bauchi State. In the most severely infested farm, there were 60 larvae per stem, 40% of tillers had chaffy panicles, and 60% of stalks were broken and fell to the ground.

10 - 17 August, 1996

In the Sudan savanna, the highest stem borer attack occurred at Kiyawa, Jigawa State (18%) where there were up to 40 *C. ignefusalis* larvae and pupae per stem. In the Sahel, the highest infestation was observed at Maiduguri (4%). Infestation was absent between Aulari in Konduga Local Government Area to Yola. However, 52% infestation was recorded at Sabon Gida in Taraba State (Northern Guinea savanna) close to human habitation where millet stems were used for fencing and thatching. Similar observations were made in other areas of high stem borer infestation such as Guduma, Taraba State their farms which were close to villages where millet stems were not used for fencing or thatching, stem borer incidence was comparatively low, e.g. Akwanga (0%), and Lafia (8%).

29 - 30 August, 1996

Stem borer incidence ranged from 0 to 39% among 25 breeders' lines at Kiyawa (Sudan savanna) and from 0 to 18% among 13 varieties at Samaru (Northern Guinea savanna). The wide range was due to varietal differences at each location.

Natural Enemies of Millet Stem Borer

The following parasitoids were recorded on the stem borer: *Syzeuctus* sp. (Ichneumonidae), *Iphiaulax* sp (Braconidae), *Rhaconotus* sp. (Braconidae), *Mintho proeceps* Scopoli (Tachinidae), and *Sturmiopsis parasitica* (Curran) (Tachinidae). *Syzeuctus* sp. was the most prevalent parasitoid on the stem borer. Adult *Syzeuctus* sp. were observed at Gululu and Guduma, probing stem borer holes in millet stems with their ovipositors. Percentage natural parasitism of the stem borer was 10.25 (Table 2).

Table 2. **Natural Infestation of *Coniesta ignefusalis* larvae and pupae by parasitoids**[1]

Batch No.	No. of larvae and pupae	No. Parasitized	% Parasitized
1	50	5	10
2	50	6	12
3	50	5	10
4	50	4	8
5	50	7	14
6	50	6	12
7	50	3	6
8	50	5	10
Mean	50	5.13	10.25

[1] All parasitoids taken together.

Effect of Intercropping on Stem Borer Incidence

Of the farms visited, 24 had sole millet and 99 had intercropped millet; the latter comprised 30 farms with millet + legumes, 27 with millet + cereals, and 42 with millet + cereals + legumes. Mean percentage stem borer incidences in these farms were 16 for sole millet, 16 for all mixtures, 18 for mixtures with legumes, 15 for mixtures with cereals, and 14 for mixtures with cereals and legumes. Millet intercropped with legumes (cowpea and groundnut) had higher stem borer attack than sole millet or millet intercropped with cereals (maize and sorghum) or cereals plus legumes.

Ecological Distribution of Stem Borer Incidence

The incidence of *C. ignefusalis* in 122 farms was partitioned according to the four main ecological zones in the survey area, i.e. Sahel (3 farms), Sudan (91 farms), Northern Guinea (14 farms) and Southern Guinea (14 farms). Mean percentage stem borer incidences were 1 for Sahel, 16 for Sudan and 17 for Northern and Southern Guinea.

Other Insects

Beetles

In July, 1995, *Psalydolytta* spp., *Melyris abdominalis* Fab. and *Coryna hermanniae* Fab. were seen feeding on flowers and developing grains of millet while *Pachnoda* sp. fed on immature grains. The population of each beetle species varied considerably between locations but *Coryna* was usually predominant with up to 40 adult *Coryna* per panicle at Auchan in Kaduna State (Northern Guinea savanna). *Coryna* also attacked flowers of groundnut, cowpea, and sorghum. Flea beetles, *Monolepta gossypiperda* Bryant and *Leptaulaca* spp were seen feeding on millet leaves at Auchan and Barifu - Bida. The click beetle *Heteroderes* sp. was collected from leaf whorls at Gidan Kobi, Tambawa and Dangere, Kebbi State while ladybird beetles *Cheilomenes sulphurea* Oliv., *Exochomus flavipes* Thunb., and *Cymnus* spp. were found on millet foliage at many locations. *Gametis* sp. were found on millet panicles at Baguwa and Tsiradamatarka, Jigawa State.

In August, 1995, *Coryna hermanniae* Fab. occurred as panicle pests in almost every farm, with infestation reaching up to 80% and 8 adults per panicle recorded. Other beetles found on millet were *Psalydolytta* spp., *Melyris abdominalis*., *Cylindrothorax westermanni* Makl., *Mylabris* spp., *Pachnoda* spp., *Pimelia senegalensis* Oliv., *Leptoglossus membranaceus* Fab., *Lycus* sp., *Philmatium festivum* Fab., *Silidius apicalis* Weterh., *Thalpophila* sp., and *Paederus sabaeus* Er. *Epilachna similis* Thunb., *Aulacophora africana* Weise, *Ootheca* spp., and *Buphonella africana* Jac. were observed feeding on millet leaves. In Maiduguri and Ududo, there were up to 10 *Pachnoda* sp. adults per panicle. At Zango Aya, about 50 km from Kaduna, there were up to 35 *M. abdominalis* per panicle compared to 4 - 5 in Kano. *Epilachna* sp. ate regular holes in the leaves. In August, 1996, *Lema* sp. severely infested and defoliated a crop of millet at the research farm of the University of Maiduguri. The devastating epidemic was attributed to the long dry spell that occurred when millet was at the vegetative stage.

Sucking bugs

Dysdercus volkeri F. was the most abundant and widespread head bug, with up to 27 adults per panicle at Argungu. Other head bugs recorded on millet panicles were *Rhinochoris* sp. at Buni Yadi, Yobe State, *Aspavia armigera* F., *Agonoscelis erosa* F., *A. vesicolor* F., *Lygaeus rivularis* Germ., *Nezara viridula* L., *Halydocoris* sp., *Mirperus jaculus* Thunb., and *Riptortus dentipes* F. These head bugs were all feeding on immature millet grains. Three spittle bugs - *Locris rubens* (Fichson), *L. erythromela* Walker, and *Poophilus costalis* (Walker) occurred in

about every farm and were associated with yellow leaf blotching symptoms on millet, sorghum and maize. *Locris* sp. was usually more conspicuous due to its bright orange - red colour and because *Poophilus* spp. tends to hide in the leaf whorl. At a farm near Yola, Adamawa State, infestation of *maiwa* by spittle bugs was as high as 20%. At Soba, Kaduna State, every plant was infested and had yellow leaf blotch symptoms: 90% of the spittle bugs were *P. costalis*. At Pambegwa, also in Kaduna State, spittle bug infestation was extremely high, with up to 32 adults per sorghum plant and 16 per millet stem. *Locris* spp. were predominant with a ratio of 11:5 *Locris* to *Poophilus*.

Grasshoppers

Zonocerus variegatus L. fed on millet leaves at Wusasa, Kurga and Karu. *Pyrgomorpha vignaudi* (Guer) occurred on millet leaves near Ningi, Bauchi State while *Oedaleus senegalensis* was seen on millet at Dazyau, Yola, Sabon Gida, and Akwanga.

Diptera

Dead hearts caused by the shoot fly, *Atherigona soccata* Rondani were observed on millet in Kano, Kaduna and Katari while adults were seen near Yauri in Kebbi State, Jengre, Plateau State, Karigidi and Gumel, Jigawa State. A few other unidentified flies were collected on millet foliage but their roles were not known. Several Calliphoridae, especially *Ancala* sp., *Chrysomia* sp., and *Sarcophaga* sp. occurred on millet at Kukuri, Garimi, Makurdi, Akwanga, and Kaduna. A platystomatid, *Elassogaster brachialis* Rond. was recorded at Abuja while a parasitoid, *Mintho proeceps* Scopoli (Tachinidae) was collected at Zongo Aya. *Diopsis* sp., the stalk-eyed fly, occurred at Pambegwa while maggots of *Cryptochetum pariceryae* Tharpe were recorded at Dange, Enagi, Takatuku, Runji and Dangere.

Hymenoptera

Ants were recorded on stem borer-infested millet stems at Kiyawa, Kururi, Damne, Hong, Makurdi, Guduma Ayua, Sabon Gida, Zongo Aya, and Zaria, colonizing them through the exit holes of stem borers. Honey bees, *Apis melifera* L. and wasps, *Ropalidia* sp., occurred on some millet farms.

Earwigs

Forficula sp. were found on millet foiage, usually between the leaf sheath and the stem.

Head Miner

In late July, 1995, one larva of the millet head miner, *Heliocheilus albipunctella* de Joannis was found on a millet panicle at Kurga in the Northern Guinea savanna; incidence was less than 1% of panicles. In September, 1995, 46 - 48% of panicles at Potiskum and Dogar Kuka in the Sahelian zone of Yobe State were infested by the head miner.

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