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Distribution and Seasonal Incidence of Some Major Insect Pests of Sorghum in Burkina Faso*

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Abstract—This paper reports the results of extensive pest surveys conducted on farmers' fields and pest population studies at two national research stations between 1979 and 1981 in Burkina Faso. Major findings indicate that, under normal planting conditions, infestation of the sorghum shootfly, *Atherigona soccata* is very low in farmers' fields. This pest appears to be restricted to research stations. Stem borer infestation is caused by a complex of species, and species predominance varies with rainfall. South of latitude 12 N, *Busseola fusca* is the predominant species but further north it is replaced by *Acigona ignefusalis*, which is a primary pest of pearl millet. Panicle damage caused by the sorghum midge, *Contarinia sorghicola*, varies with season; is usually very low in the dry northern Sahelian zone but severe south of latitude 13 N. Maximum midge populations occurred between mid-September and early October.

Key Words: Burkina Faso, sorghum shootfly, *Atherigona soccata*, stem borers, *Busseola fusca*, *Acigona ignefusalis*, distribution, population studies, pest incidence, crop infestation

Résumé—Cet article présente les résultats des enquêtes extensives sur les insectes nuisibles réalisées en champs paysans et dans le cadre des études de population des ravageurs à deux stations de recherche nationales entre 1979 et 1981 au Burkina Faso. La plupart des résultats indiquent que dans des conditions de culture normales, l'infestation de la mouche des pousses du sorgho, *Atherigona soccata* est très faible en champs paysans. Cet insecte nuisible semble être limité aux stations de recherche. L'infestation par le borer des tige du sorgho est occasionnée par un complexe d'espèces dont la prédominance varie avec la pluviométrie. Au sud de la latitude 12 N, *Busseola fusca* est l'espèce la plus importante tandis qu'au plus nord elle est remplacée par *Acigona ignefusalis*, qui est le principal ravageur du mil. Les dégâts causés aux panicules par la cécidomyie du sorgho, *Contarinia sorghicola*, varient avec la saison. En général, ils sont très faibles dans la région sèche du Sahel du nord mais plus importants au sud de la latitude 13 N. La population de cécidomyies a atteint son niveau maximum entre la mi-septembre et début octobre.

Mots Clés: Burkina Faso, mouche des pousses, *Atherigona soccata*, cécidomyie du sorgho, *Contarinia sorghicola*, borers des tiges, *Busseola fusca*, *Acigona ignefusalis*, répartition, études de population, incidence des insectes nuisibles, infestation de culture

INTRODUCTION

Sorghum and pearl millet constitute the major cereal crops of the West African Sahel. In the south, sorghum is preferred over millet while the reverse is the case in the north. Yields of these crops on farmers' fields are pitifully low, ranging from 400–800 kg/ha for sorghum and 200–600 kg/ha for millet. In Burkina Faso, the largest producer of sorghum in the Sahel, an estimated 700,000 MT of grain was harvested from 1,100,000 ha in 1982 (FAO, 1983). However, average yields over the 10-year period 1968–1978 dropped from 638 to 565 kg/ha. Low and diminishing yields have been attributed to various factors: poor soils, erratic weather conditions, insect pests, diseases and weeds as well as several socio-economic and political constraints.

Numerous lists indicate well over 150 insect species as pests or potential pests of sorghum (Jotwani and Young, 1972; Seshu Reddy and Davies, 1979). However, only some are actually of economic importance and the major species in the Sahel are shootflies, stem borers, grain midges and head bugs (Nwanze, 1985).

Studies on these insect pests in the Sahel are rather limited (Risbec, 1950; Apert, 1964; Breniere, 1970; Nwanze, 1981; Bonzi, 1982; Bonzi and Gahukar, 1983; Gahukar, 1984) although considerable information may exist in the form of occasional and country reports which are not easily available. Given the importance of insect pests in sorghum production, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) initiated studies on pests of sorghum and millet in Senegal from 1976 and subsequently in Burkina Faso from 1979. This paper deals with results of studies undertaken by ICRISAT in Burkina Faso over a 3-year period (1979–1981) on the occurrence, distribution and seasonal abundance of the following major sorghum pests: sorghum shootfly, *Atherigona soccata*

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Rond., and a complex of stem borer species and sorghum midge, *Contarinia sorghicola* Coq. It provides information that is basic for the development of pest management strategies in the country.

MATERIALS AND METHODS

The incidence and distribution of pest species were assessed by sampling sorghum crops in farmers' fields. Surveys were extensive and conducted to coincide with farmers' crops at 3–5 weeks after sowing for shootflies and at flowering and harvest for midges and stem borers, respectively. Initially, fields were selected at random at 10–40 km intervals depending on their distribution, road accessibility and area to be sampled during a particular survey. On subsequent surveys, observations were carried out on the same fields and occasionally also on adjacent fields within the sampling area.

Our observations were mostly visual counts. For shootfly, depending on the size of the farm, we observed between 150 and 250 plants per field. "Dead hearts" were recorded for incidence of shootfly and 25 samples of affected plants were examined for the presence of shootfly larvae. Samples were also maintained in the laboratory for adult fly emergence and species identification. Adult midge counts on random samples of 50 panicles per field were carried out between 06.30 and 08.30 hr and infested florets were determined from samples of 45 by squeezing. To assess stem borer infestation, depending on farmer co-operation usually 5–10 stems were randomly selected, split and examined for borer damage and species identification. Stem infestation and internode tunnelling were recorded using the following parameters: per cent infested stems, internode tunnelled and number and species of borer larvae and pupae/stem.

We monitored the annual fluctuation of pest populations on sorghum at the national research stations at Kamboinsé, near Ouagadougou and at Farako-Bâ, near Bobo-Dioulasso. At both the locations, one local sorghum cultivar and an improved selection (E35-1) were sown at monthly intervals in four replications of 5×8 m^2 plots. These plots were laid out in a split plot design with sowing dates as main plots and cultivars as sub-plots. The crop was irrigated during the dry season from October to May. The sampling methods were similar to those used in pest surveys, but larger samples were taken and observations were made more often: once a week for shootflies and 50 stems/week for stem borers. Midge observations were recorded three times a week. Our studies were aimed at actual pest incidence on the sorghum crop and at providing comparative observations with farmer's situation.

Using our survey results we developed pest distribution maps for Burkina Faso. To facilitate presentation and discussion, the country has been divided into five survey zones, namely, North, West, Central, East and South.

RESULTS AND DISCUSSION

The Sorghum shootfly Atherigona *spp.*

Occurrence, distribution and importance. Atherigona soccata is the predominant shootfly species in Burkina Faso. It made up 96% of the laboratory reared flies from plants with "dead hearts" collected both from farmers' fields and at Kamboinsé. However, studies by Bonzi and Gahukar (1983) revealed that out of 24 species of shootfly collected from fish meal traps at Farako-Bâ, *Atherigona marginifolia* V. Emd. was predominant, representing 36% of the male population. *A. soccata* represented only 14%. *A. marginifolia* is not known to infest sorghum and was probably only attracted to the fish meal bait.

The shootfly occurs mostly in the south and central zones of Burkina Faso (Fig. 1) and appears to have no economic importance in the eastern and the drier northern Sahelian zones where crop damage (measured by "dead hearts") was less than 1% (Table 1). Generally, infestation was very low (<10%) in farmers' fields surveyed between mid-June and August in 1980 and 1981 (mean crop age of 32 days, range 21–40). Out of a total of 135 farms that were surveyed, only 43% had plant hills with "dead hearts". Of these farms 62% were located in the wetter southern zone (rainfall >900 mm). Similarly, out of 34,811 plant hills observed in our surveys only 2.7% had "dead hearts" and the majority (60%) was in the south. High shootfly damage was recorded only in three fields; at Bama 46%, Serossarasso 26% and Toussiana 15%, all in the south.

However, compared to the situation on farmers' fields during the survey period, we recorded 21.7% "dead hearts" at Kamboinsé and 48.4% at Farako-Bâ. The practice of staggered planting dates, use of several varieties with varying degrees of susceptibility and dry season irrigated crops at research stations, encourage higher levels of infestation (ICRISAT, 1983, 1984). This was also the case in Ouahigouya in the north where high incidence was associated with the Centre de Formation Agricole.

Seasonal fluctuation. Shootfly infestation is usually very low in normal planting under rainfed conditions during June and July. Under this condition, peak infestation during the crop season occurs in the later part of July (Fig. 2a). However, under continuous cropping at Kamboinsé, the highest level of shootfly damage during the crop season occurred in late August and September but annual peak infestation was recorded in January (Fig. 2b). The local cultivar seemed more susceptible than the improved E35-1 variety. The normal pattern of infestation on farmers' fields is seen as non uniform scattered spots of dead hearts in hills that were resown to fill gaps.

Stem borers

Occurrence, distribution and importance. Stem borers are the most widely distributed pests of sorghum in Burkina Faso and species frequency and distribution vary from north to south and are closely related to rainfall. In the south, below latitude 11° 30'N where rainfall exceeds 900 mm, the maize stalk borer *Busseola fusca* Fuller is the predominant stem borer (Table 1, Fig. 3). However, north of this latitude, *B. fusca* does not occur on sorghum but is replaced by the millet stem borer, *Acigona ignefusalis* Hmps., which rarely attacks sorghum south of this latitude. Similarly, two other species of borers, the sorghum/maize borer, *Eldana saccharina* Walker and

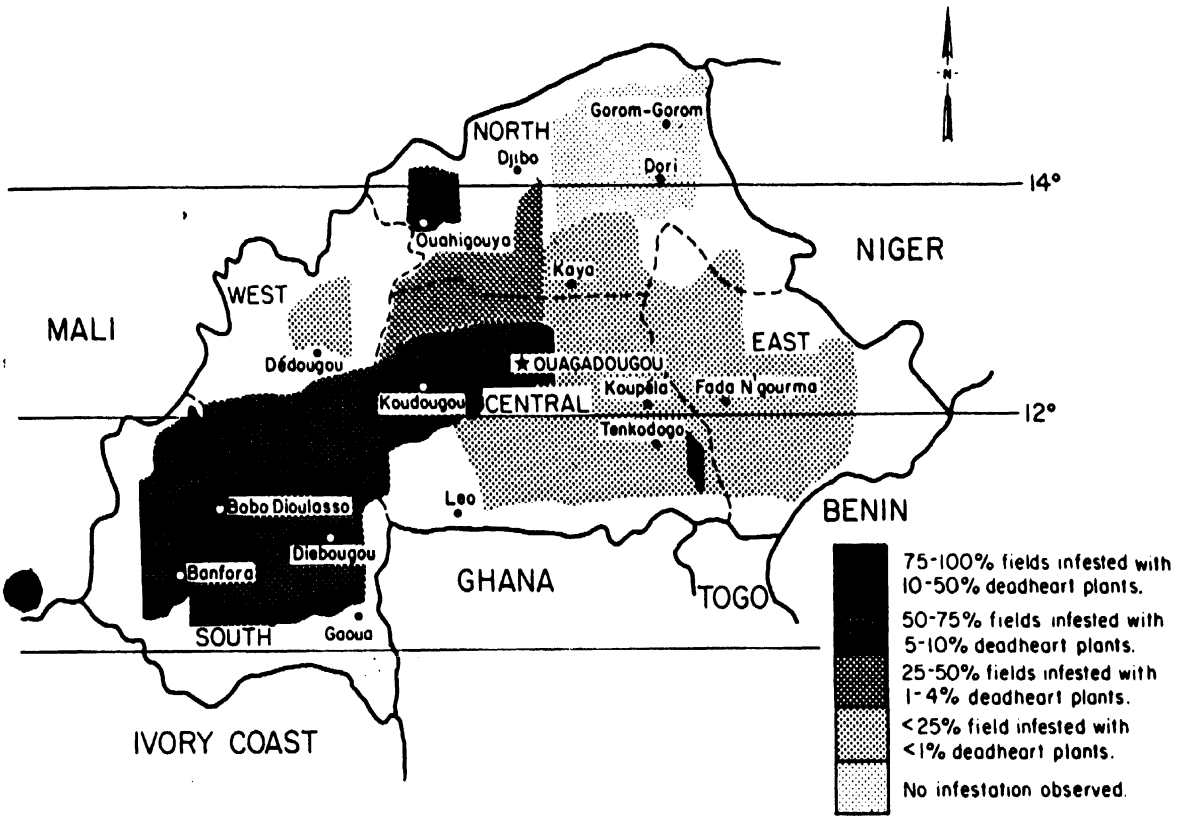

Fig. 1. Distribution of the sorghum shootfly *Atherigona soccata* in Burkina Faso (1980 and 1981 field surveys).

the sorghum pink borer, *Sesamia calamistis* Hmps. which make up about 50% of the borer species in the south, appear to be restricted below latitude 12 N in farmer's fields. These species however made up only 5.4% of the borer larvae in the central zone and were recorded only south of latitude 12 N. The situation was, however, different on the research station at Kamboinsé where *E. saccharina* and *S. calamistis* made up over 90% (51.7 and 39.1%, respectively) of the borer larvae during the crop season.

Stem borer infestation was also usually low in farmers' fields. Out of 71 fields, 61% of the fields showed borer infestation but only 20.3% of the 502 stems examined had borer damage, and only 4.2% of

Table 1. Incidence of some major insect pests of sorghum in farmers' fields in Burkina Faso*

Pest species	Zone				
	North	South	Central	East	West
Sorghum Shootfly (*Atherigona soccata*)					
% infested fields	30.0	91.2	94.6	17.1	22.2
% dead heart plants	0.7	9.5	2.2	0.1	1.1
Sorghum stem borers					
% infested fields	14.3	93.3	42.1	21.4	—†
% infested stems	3.0	43.8	12.8	10.3	—
% bored internodes	1.1	10.3	3.8	3.9	—
% frequency of borer species					
A. ignefusalis	100	0	94.6	100	—
B. fusca	0	47.3	0	0	—
E. saccharina	0	27.3	2.4	0	—
S. calamistis	0	25.4	3.0	0	—
Sorghum midge (*Contarinia sorghicola*)					
% infested fields	0	100	85.0	72.4	50.4
% infested heads	0	65.9	45.7	54.5	10.3
% infested grains	0	35.4	13.2	13.0	2.4

*Summary of surveys conducted between 1979 and 1981.
†Insufficient data.

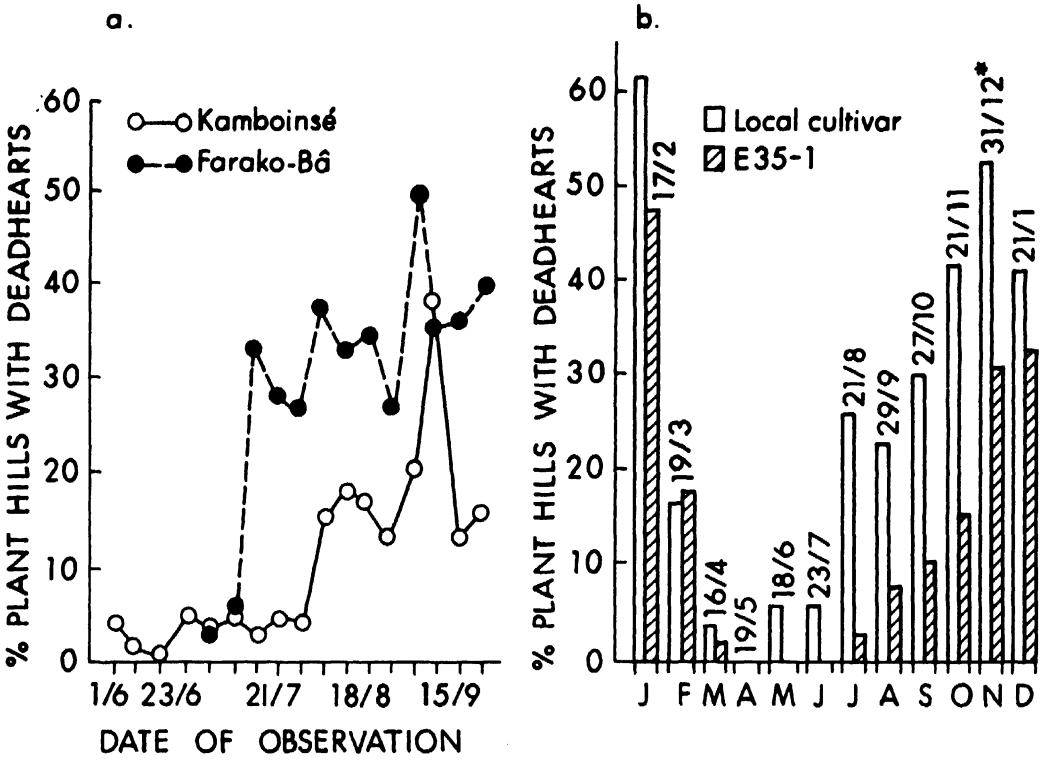

Fig. 2. Incidence of shootfly in sorghum: (a) crop season infestation at two locations, (b) annual infestation on two cultivars planted at monthly intervals at Kamboinsé, Burkina Faso. (Mean of 2 years, 1980 and 1981). *Indicates date of observation, approx. 28 days after seedling emergence.

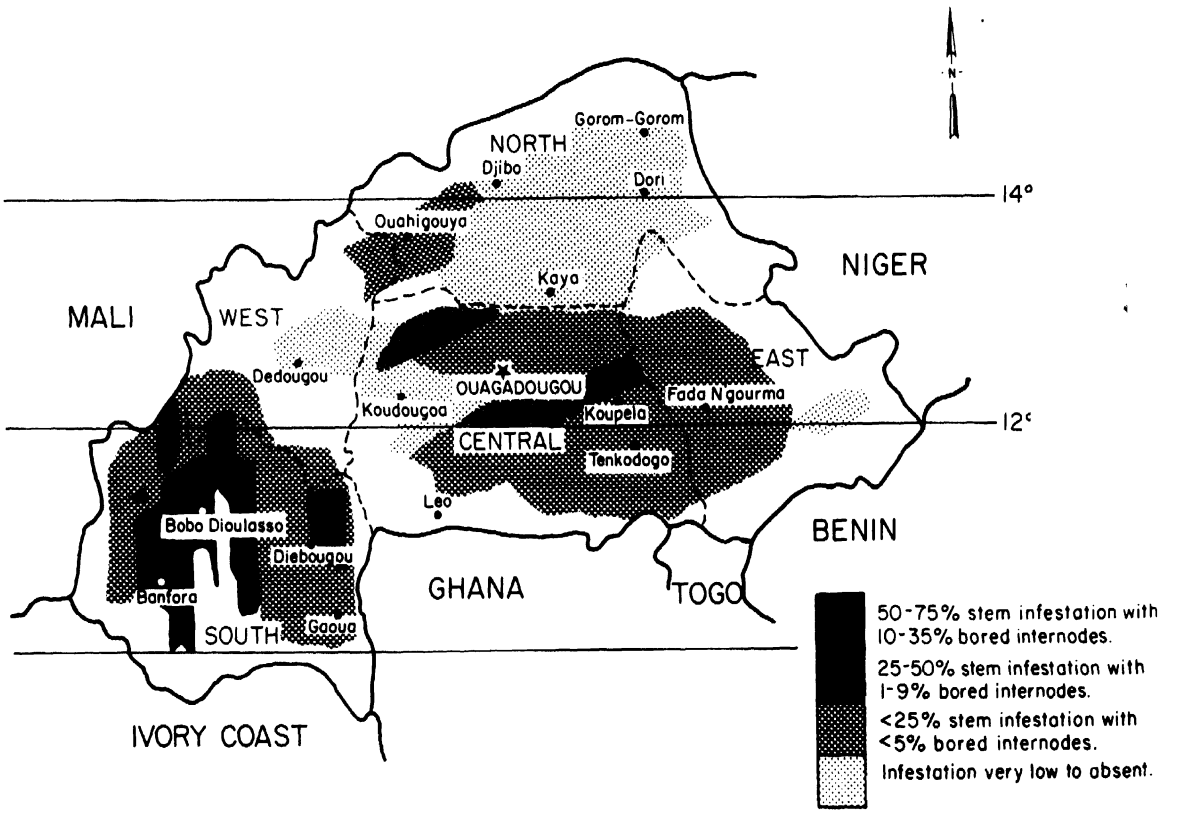

Fig. 3. Distribution of stem borers of sorghum in Burkina Faso (1980 and 1981 field surveys).

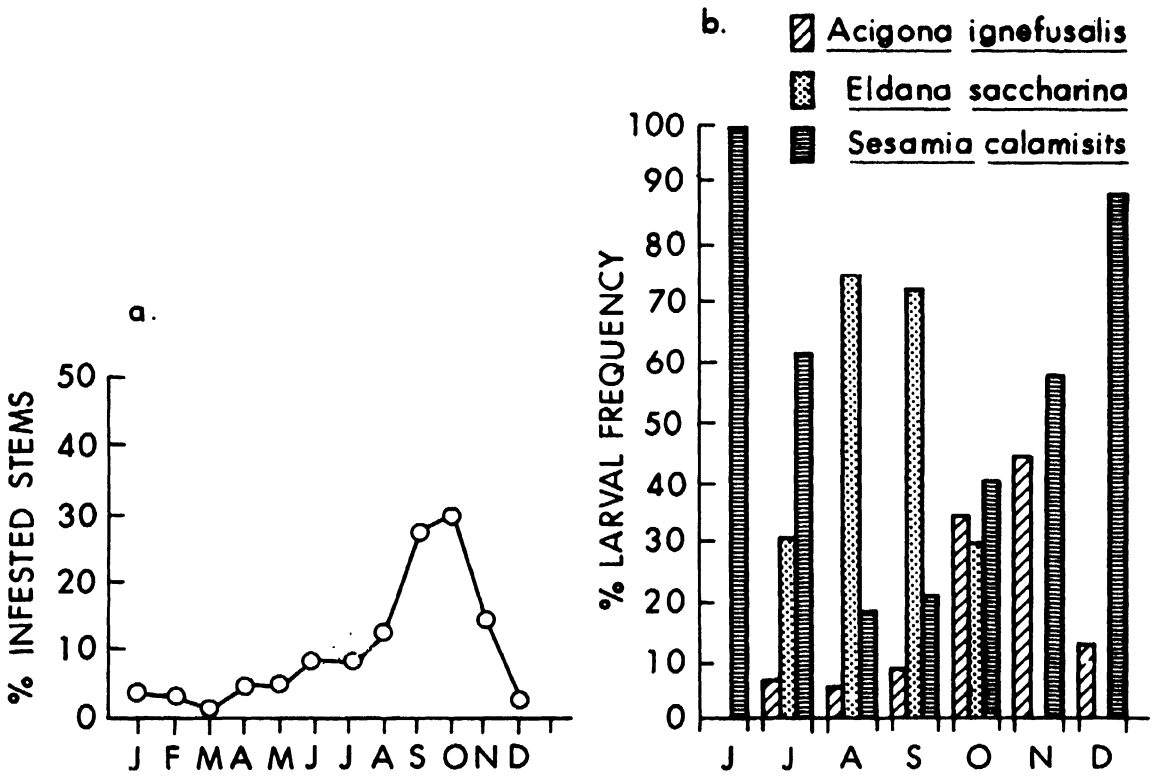

Fig. 4. Stem borer infestation of sorghum at Kamboinsé, Burkina Faso: (a) annual fluctuation, (b) relative abundance of borer species. Note: *Sesamia calamistis* was the only borer species from January to June. (Mean of 2 years, 1980 and 1981).

the internodes were tunnelled by borers. Leaf damage and stem breakage were very rare and grain filling of heads was hardly affected. The highest infestation was recorded in the south, but hot spots were also observed at Wayen, 65 km east of Ouagadougou and at Pobe Mengao, south of Ouahigouya.

Seasonal fluctuation. At the Kamboinsé research station, we observed the lowest stem borer infestation between January and May with maximum infestations occurring between August and October (Fig. 4a). The relative abundance of borer species also varied with season. While *S. calamistis* was the only borer on irrigated sorghum from January to June, *E. saccharina* was the predominant species in August and September. Larvae of *E. saccharina* were not recovered from sorghum after October (Fig. 4b). The increase in *Acigona* infestation in October and November corresponded with high levels of *Acigona* in pearl millet during this period.

Only two generations of *B. fusca* were observed at Farako-Bâ (Fig. 5a) although it is known that this species produces three generations at Samaru, northern Nigeria (Harris, 1962). The first generation larvae developing from the diapause population were recorded in very low numbers in mid-August. The second generation peaked in October and infestation continued until harvest in November. *Acigona ignefusalis* did not show any definite population pattern while infesting sorghum (Fig. 5b), but this pest is known to exhibit three generations on millet, its primary host. Both *B. fusca* and *A. ignefusalis* undergo larval diapause at the end of the crop season and this accounts for their absence in dry season irrigated sorghum. *S. calamistis* exhibits several generations at both research stations (Figs 5c, d) but while population peaks of *E. saccharina* occurred in August and September at Kamboinsé, they occurred much later in October and November at Farako-Bâ (Figs 5e, f). The abundance of *E. saccharina* and *S. calamistis* at Kamboinsé and Farako-Bâ during the crop season in contrast to results obtained in farmers' fields is attributed to the presence of carry-over populations from the dry season on irrigated sorghum and rice fields. Neither species undergoes diapause.

Sorghum midge, Contarinia sorghicola, *Coq.*

Occurrence, distribution and importance. The sorghum midge appears to be confined to the region below latitude 13 N corresponding to the 700 mm isohyet (Fig. 6, Table 1). Above this southern limit, out of 4995 sorghum panicles examined in 105 farms, we did not record any adults nor characteristic cast skins nor panicle damage in 1980 and 1981 although sorghum is grown extensively along low lying basins as far north as Dori.

The most severe panicle infestation in 1980 and 1981 was observed in the east at Fada N'gourma (100% of all sampled heads were infested); in the central zone at Lalgaye (95%), Tenkodogo (75%), Bazega (90%), Koudougou (75%) and in the south at Bobo-Dioulasso (100%). In the Banfora area, south

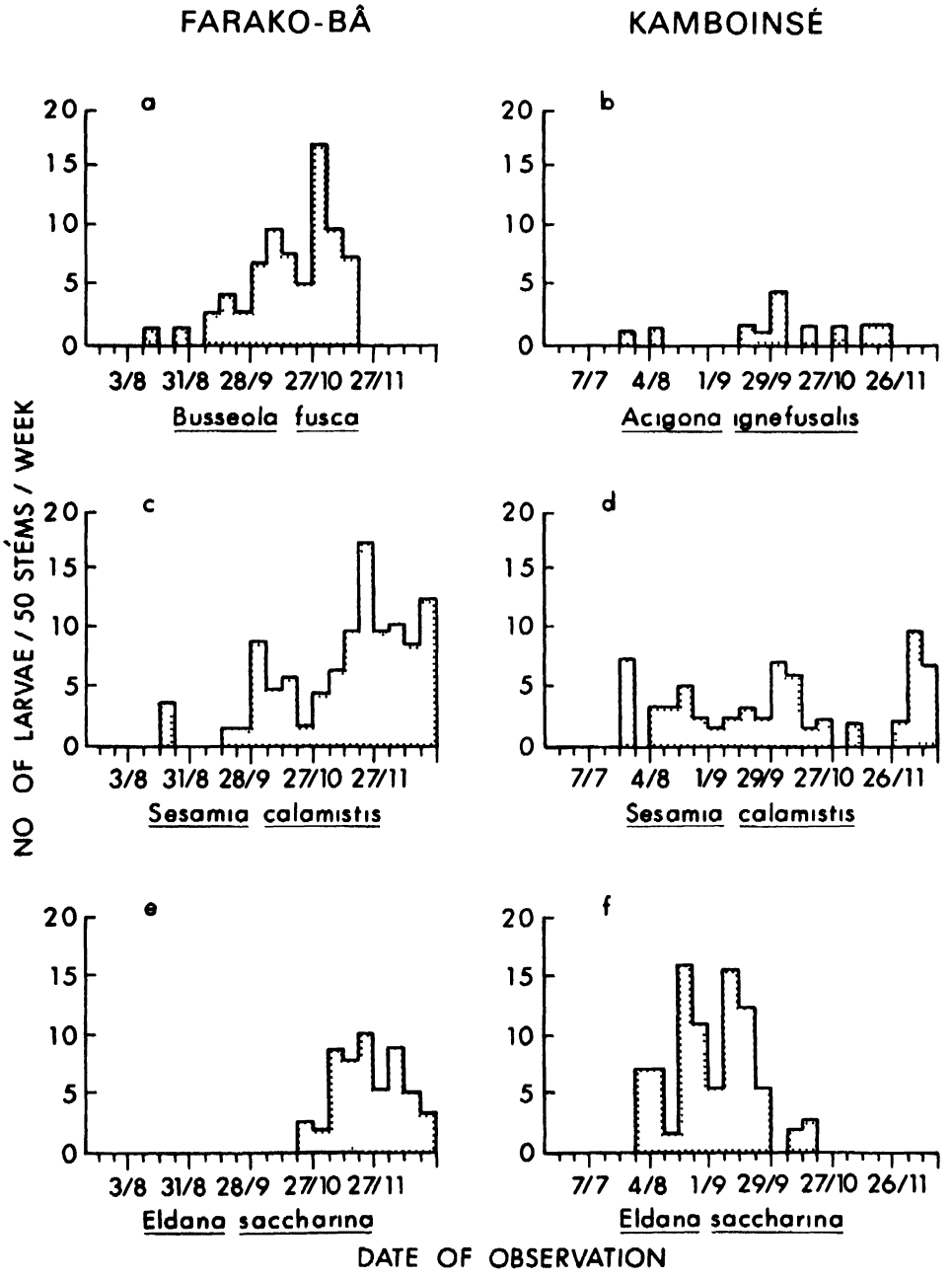

Fig 5 Weekly counts of larvae of stem borers in sorghum at two locations in Burkina Faso 1980

of Bobo-Dioulasso, midge infestation was extremely low in 1980 The sorghums in this area flowered much later at the end of October and escaped peak midge populations In contrast, in 1979, grain yield from over 90% of the fields in the Koudougou area was practically nil, due to midge damage

Seasonal fluctuation In 1980, adult midges were first observed at Kamboinse in mid-August and at Farako-Bâ in early September (Fig 7a) In 1981, they appeared 2 weeks earlier at both locations and so did rainfall that year In both years however, maximum midge populations occurred in late September at Kamboinsé and mid-October at Farako-Bâ This period coincided with the flowering of local photoperiod-sensitive sorghum cultivars During this period 80–100% of all flowering heads were observed with adult midges (Fig 7b) The introduced early maturing sorghum cultivars escaped severe midge damage, but favoured midge build-up that infested local cultivars which flowered after 20 September at Kamboinse This was the situation at Koudougou in 1979

The duration of midge infestation was short in 1980 and 1981 and at the end of October we recorded less than one adult per panicle However, Gahukar (1984) reported a longer period of midge infestation

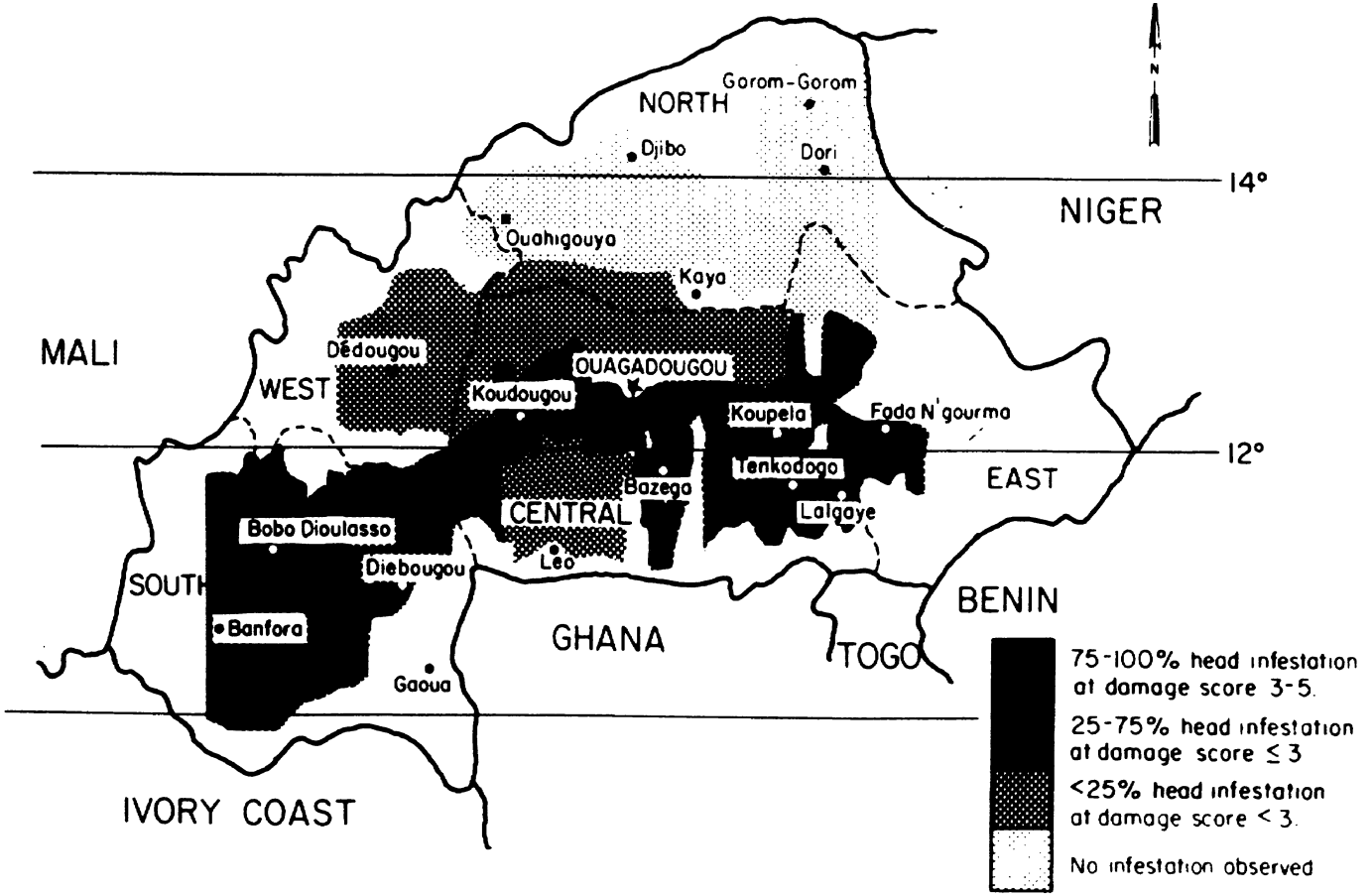

Fig. 6. Distribution of the sorghum midge, *Contarinia sorghicola* in Burkina Faso (1980 and 1981 field surveys).

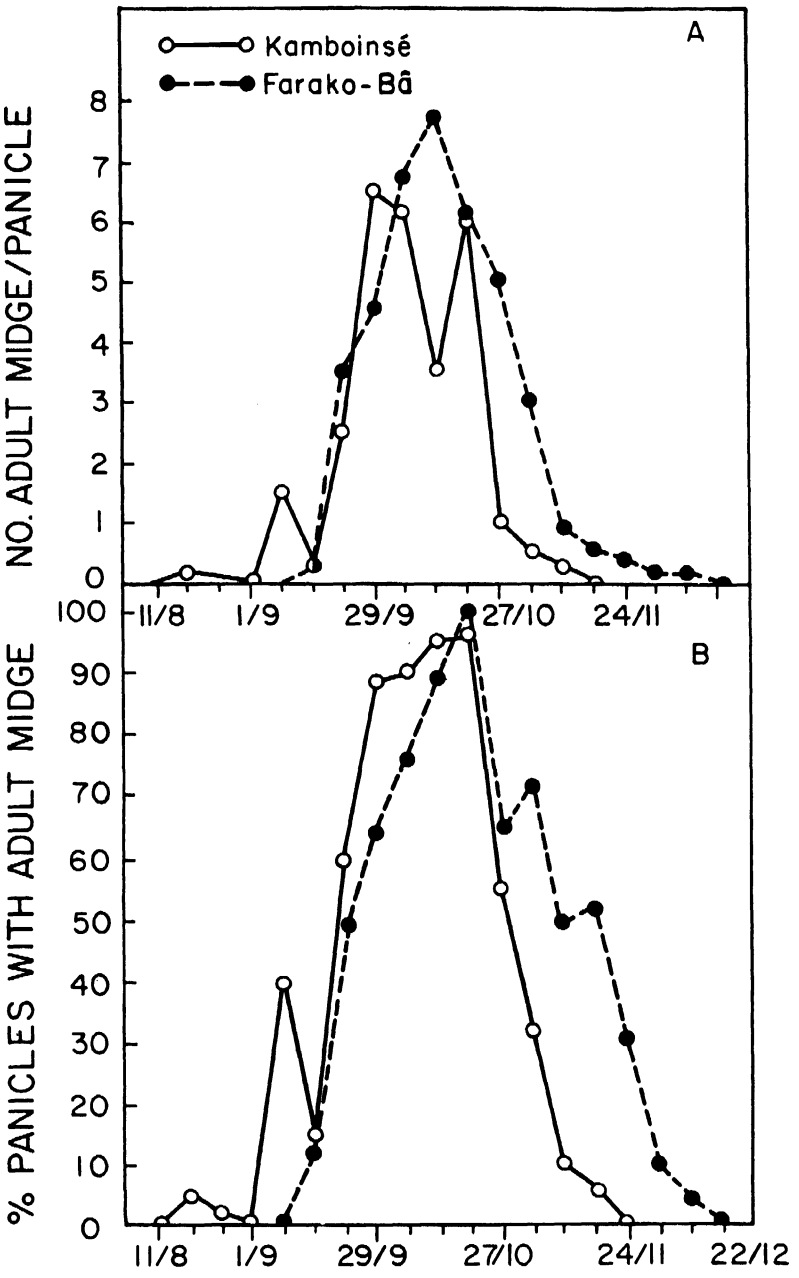

Fig. 7. Adult population fluctuation of the sorghum midge, *Contarinia sorghicola*. (Mean of 2 years, 1980 and 1981.)

in Senegal from September to December and attributed this to the continuous availability of flowering heads due to several staggered planting dates.

CONCLUSION

Our observations show that shootfly infestation does not attain a level of importance on farmers' fields in Burkina Faso, but that this pest is a problem at research stations on late planted sorghum and in dry season seed multiplication plots. Stem borer damage in general is low in the drier areas north of Bobo-Dioulasso, but becomes moderately important in the south where *Busseola fusca* is the predominant species. Borer infestations on the national research stations are much more severe than on farmers' fields.

However, the sorghum midge could be devastating in the southern part of the country especially when mixed maturity cultivars are grown. In order to reduce the effects of drought, present research objectives focus on producing short-cycle photoperiod-insensitive sorghums, which certainly will favour midge build-up onto local cultivars. It is necessary, therefore, that we follow a more holistic approach to sorghum improvement.

In general, pest problems are more severe in the southern part of Burkina Faso. While our observations may suggest that the situation north of latitude 11°30′N merits less emphasis, insect pest situations are a dynamic process and changes in climate, farming practices and the introduction of improved varieties have been known to result in pest outbreaks and changes in pest status. This is the situation with sorghum head bugs where a gradual increase in head bug damage has been reported since 1982 (Nwanze, 1985). The higher levels of pest infestations at the research stations provide adequate conditions for determining crop losses and such studies are good indicators of possible losses on farmers' fields. This kind of information is vital for future research activities.

REFERENCES

Apert J. (1964) Cereal borers in tropical Africa. *Agron. Trop.* **19**, 60–74.

Bonzi S. M. (1982) *Chilo diffusilineus* J. De Joannis (Lepidoptere, pyralidae) borer des tiges de cereales en cultures irriguees et pluviales en Haute-Volta. *Agron. Trop.* **37**, 207–209.

Bonzi S. M. and Gahukar R. T. (1983). Repartition de la population d'*Atherigona soccata*, Rondani (Diptere, Muscidae) et des especes alliees pendant la saison pluvieuse en Haute-Volta. *Agron. Trop.* **38**, 331–334.

Breniere J. (1970) Recherches entomologiques effectuees en Afrique de l'ouest francophone en matiere de sorgho et de mil. *Sols Africains* **15**, 85–91.

FAO (1983) *FAO Production Yearbook* 1982, Vol. 36. FAO Statistics Series No. 47 United Nations, Rome, Italy.

Gahukar R. T. (1984) Seasonal distribution of sorghum midge (*Contarinia sorghicola* Coq.) and its hymenopterous parasites in Senegal. *Agronomie* **4**, 393–397.

Harris K. M. (1962) Lepidopterous stem borers of cereals in Nigeria. *Bull. Ent. Res.* **53**, 139–171.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (1983) *Annual Report* 1982. International Cooperation, pp. 363–365, Patancheru, India.

ICRISAT (1984) *ICRISAT Sahelian Center Annual Report*, 1983. Entomology, pp. 31–37. ICRISAT Niamey, Niger.

Jotwani M. G. and Young W. R. (1972) Recent development on chemical control of insect pests of sorghum. In *Sorghum in the Seventies* (Edited by Rao N. G. P. and House L. R.), pp. 377–398. Oxford and IBH, New Delhi, India.

Nwanze K. F. (1981) Les borers des tiges des cereales en Afrique de l'Ouest Sahelienne: Distribution, importance relative et controle. In *Proceedings Lutte Biologique Contre les Ravageurs et ses Possibilities en Afrique de l'Ouest*. 9–13 February 1981, Dakar, Senegal, pp. 109–115. USAID Project 625-0928 Phase II.

Nwanze K. F. (1985) Sorghum insect pests in West Africa. In *Proceedings of the International Sorghum Entomology Workshop*, 15–21 July 1984, Texas A & M University, College Station, TX, USA. pp. 37–43. ICRISAT Patancheru, India.

Risbec J. (1950) *La Faune Entomologique des Cultures au Senegal et au Soudan Francais*. Dakar, Senegal: Gouvernement General de l'Afrique Occidentale Francaise.

Seshu Reddy K. V. and Davies J. C. (1979) Pests of sorghum and pearl millet and their parasites and predators recorded at ICRISAT Center, India upto August 1979. *ICRISAT Cereal Entomology* Progress Report No. 2. ICRISAT Patancheru, India. (Limited distribution).