

Insect succession on three coffee types in Ghana

BEATRICE PADI & E. AMPOMAH

Cocoa Research Institute, P. O. Box 8, New Tafo-Akim, Ghana

SUMMARY

The experiment was conducted for a 7-year period (1981-88) at Tafo, Ghana on three newly-established coffee plots of a local variety (*Coffea canephora*) and two introduced varieties (*C. canephora* and *C. arabica*). Insect counts were made weekly on 50 randomly selected plants of each coffee variety. Among the insects recorded during the 1st year of establishment were three economically - important pests viz. the defoliators (*Epicampoptera strandi glauca* Hamps., *E. ivoirensis* Watson), the grasshopper (*Zonocerus variegatus* Linnaeus) and the leaf skeletonizer (*Leucoprema dohertyi* Warren). Three other economically-important pests, the stem borer (*Bixadus sierricola* White), the twig borer (*Xylosandrus compactus* Eichh.) and the berry borers (*Hypothenemus hampei* Ferrari) were not found throughout the 7-year experimental period. The biting ants (*Oecophylla longinoda* Latr., *Crematogaster africana* Mayr and *C. clariventris* Mayr) which constitute a great nuisance during harvesting, weeding and other farm operations, were not found until the 6th year after establishment. The ants (*C. olivieri*, *P. megacephala* and *C. vividus*), the mealybug (*Planococcoides njalensis* (Laign)) and Stictococcidae were the most numerous insects recorded on all three coffee types, especially during the 4th and 5th years of establishment. Aphids, psyllids, crickets, spiders, grasshoppers, among other insects, reduced in numbers or were absent during a severe and prolonged drought period in 1983-84. It was concluded that findings from the study could serve as a useful guidance to coffee farmers in Ghana, and perhaps other producer countries in the West African sub-region, regarding which insect pests to expect during the early years of establishment.

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Introduction

Coffee is essentially a crop of the tropics and, in Africa, several varieties occur in about twenty producer countries including La Côte d'Ivoire,

RÉSUMÉ

BEATRICE PADI & EBENEZER AMPOMAH.: *La succession d'insecte sur trois types de café au Ghana. L'expérience s'est déroulée pour une période de 7 ans (1981-88) à Tafo, du Ghana sur trois terrains de café nouvellement établis d'une variété indigène (Coffea canephora) et deux variétés introduites (C. canephora et C. arabica). Les comptes d'insectes étaient fait hebdomadairement sur 50 plantes de chaque variété de café sélectionnées au hasard. Parmi les insectes enregistrés pendant la année d'établissement étaient trois ravageurs économiquement importants, à savoir: les défoliateurs (Epicampoptera strandi glauca Hamps., E. ivoirensis Watson), La sauterelle (Zonocerus variegatus Linnaeus) et le squelettisateur feuille (Leucoprema dohertyi Warren). Trois autres ravageur économiquement importants, insecte térébrant du tronc (Bixadus sierricola white), insecte térébrant de la brindille (Xylosandrus compactus Eichh.) et les insectes térébrants de la baie (Hypothenemus hampei Ferari) n'étaient pas découverts tout au long des 7 années, de la période expérimentale. Les fourmis piquantes (Oecophylla longinoda Latr., Crematogaster africana Mayr et C. clariventris Mayr) qui constituent un grand embêtement pendant la récolte, le désherbage, et d'autre opérations au champ, n'étaient pas découvertes jusqu'à la 6^e année après l'établissement. Les fourmis (C. olivieri, P. megacephala et C. vividus), la cochenille des serre (Planococcoides njalensis Laign) et Stictococcidae étaient les plus nombreux insectes enregistrés sur les trois types de café surtout pendant la 4^e et 5^e années d'établissement. Pucerons, psyllids, cri-cri, araignées, sauterelle parmi d'autre insectes avaient réduit en quantité ou bien étaient absent pendant une période de la sécheresse sévère et prolongée de 1983-84. La conclusion était tirée que les découvertes provement de l'étude pourraient servir de guide utile pour les cultivateurs de café au Ghana, et peut-être pour d'autre pays producteurs de la sous-région de l'Afrique de l'ouest, à l'égard d'insectes ravageurs à espérer pendant les premières années d'établissement.*

Uganda, Angola, Kenya, the Cameroons, Ghana and Nigeria (Le Pelley, 1968).

In Ghana, coffee, as a cash crop, has been relatively unimportant (Anonymous, 1962b; Le

Pelley, 1968) but, in recent years, production has increased considerably in pursuance of Government policy of diversification. In the late 1970s and 1980s, many state-owned plantations covering over 16,000 hectares, in addition to over 29,150 hectares of peasant-owned farms, were established. Currently, however, a greater part of the state-owned plantations have been sold out to private companies who, encouraged by the rising producer price, continue to expand their holdings.

In Ghana, *Coffea canephora* Pierre (robusta coffee) was the main coffee variety cultivated (Anonymous, 1962b) until the Cocoa Research Institute of Ghana (CRIG) developed and released improved cultivars of local and introduced robusta varieties. These improved varieties have been established in seed and wood gardens and farmers' farms distributed within the coffee-growing areas (Adu-Ampomah, 1994). *Coffea arabica* Linnaeus, the high-quality coffee of high-altitude countries, including Kenya and Uganda in East Africa, is grown in isolated localities and in experimental plots in Ghana but does not produce high quality or quantity coffee due to the low altitude in these areas (Anonymous, 1962a; Adu-Ampomah, 1994).

A number of economically-important insect pests attacking various parts of the coffee plant occur in Ghana and other producer countries (Anonymous, 1962b; Forsyth, 1966; Le Pelley, 1968; Opuni, 1978; Padi, 1979, 1985a, 1985b) but there is very little information on the sequence of pest incidence in relation to age of the coffee plant. Among the important pests of the crop are the defoliators *Epicampoptera strandi glauca* Hamps., *Epicampoptera ivoirensis* Watson (Lepidoptera: Drepanidae), *Zonocerus variegatus* Linnaeus (Orthoptera: Pyrgomorphidae), the berry borer *Hypothenemus hampei* Ferrari (Coleoptera: Scolytidae), the stem borer *Bixadus sierricola* White (Coleoptera: Cerambycidae), and the biting ants *Oecophylla longinoda* Latr., *Crematogaster clariventris* Mayr, *Macromischoides aculeatus* (Mayr) and *Crematogaster africana* (Mayr) which constitute a great nuisance during harvesting, weeding and other farm operations. These pests

are controlled mainly with insecticides and by good cultural practices (Anonymous, 1962b; Padi, 1979, 1985, 1993; Owusu-Manu & Ampomah, 1991).

Another berry borer of minor importance, *Virachola lorisona* Hewitson (Lepidoptera: Lycaenidae) has also been recorded in Ghana (Padi, 1984) whilst termites, which kill coffee plants by damaging their roots, are also becoming increasingly important in Ghana in recent years (Ackonor, Personal Communication).

The serious consequences of damage caused by coffee tree borers and defoliators, including the loss of plants, have extensively been discussed by Le Pelley (1968) who observed that the establishment of a new coffee plant in the place of one lost is so difficult that it is rarely attempted. It is, therefore, important that farmers are made aware of which pests are to be expected during the establishment period to enable them to plan for their effective control before serious damage leading to the loss of plants occurs.

The present study was, therefore, undertaken to investigate the sequence of insect infestation on newly-established plots of three coffee varieties, a local *C. canephora*, and exotic *C. canephora* and *C. arabica*, over a 7-year period, the aim being the determination of guidelines which will help coffee farmers in predicting the sequence of pest incidence on newly-established coffee farms for their effective control.

Materials and methods

The study area, Plot UX2, established in July, 1981, at the Cocoa Research Institute of Ghana (CRIG), Tafo, comprised three sub-plots of local *C. canephora* (0.47 ha), introduced *C. canephora* (0.13 ha.) and *C. arabica* (0.20 ha.). The planting distance was 3 m × 3 m for the introduced *C. canephora* and *C. arabica* and 3 m triangular for the local *C. canephora*.

Weekly counts of all visible insects (adults and larvae) were made, starting from November 1981, on 50 plants of each coffee type randomly selected at the centre of each plot. Assessment was done between 8.00 a.m. and 11.00 a.m. Insects, other than

borers, were counted by inspecting whole plants (i.e. from ground level to the canopy). The main trunk, and twigs in the tree canopy were inspected fortnightly for borer holes made by *B. sierricola* and *X. compactus*, respectively, starting from November 1982. In 1985 and subsequent years when the coffee started bearing, all berries harvested from ten of the sampling trees of each coffee type were soaked in water and the bad floating berries, dissected in the laboratory for the presence of berry borers.

For insects like ants, termites, aphids, mealybugs and psyllids which occurred in large numbers and were difficult to count, a colony of more than 20 insects was given a score of 50. The annual total numbers of the different insects per 50 trees of each coffee type were compared in histograms as presented in Fig. 1-6.

The recommended agronomic practice of weeding four times a year, pruning when necessary, and thorough harvesting of berries (Padi, 1985; Ampofo & Osei Bonsu, 1988), were followed throughout the experimental period.

Results

The majority of insects recorded occurred within the 1st year of establishment. These included the major pests *Epicampoptera* spp. (*E. ivoirensis* and *E. strandi glauca*), grasshoppers mainly *Z. variegatus*, the minor pest *L. doherityi*, *Toxoptera aurantii* (B. de Fonsc) (Homoptera: Aphididae) and the ants *Polyrachis* sp. and *Platythyrea* sp. recorded on the introduced *C. canephora* only (Fig. 1A, 2A, 2B, 5B). Other insects which occurred in the 1st year were scale insects (Homoptera: Stictococcidae) recorded on the local and introduced *C. canephora* (Fig. 1B) and the psyllid *Tyora tessmanii* (Aulm) which occurred on the local *C. canephora* only (Fig. 2C). Coleoptera, crickets (Orthoptera: Caelifera) (Fig. 3A, B), Reduviidae, spiders (Arachnida: Araneidae) and Mantidae (Fig. 4B), also occurred within the 1st year on all three coffee types. It is, however, significant to note that the stem borer *B. sierricola*, the twig borer *X. compactus*, the nuisance ant *Macromischoides*

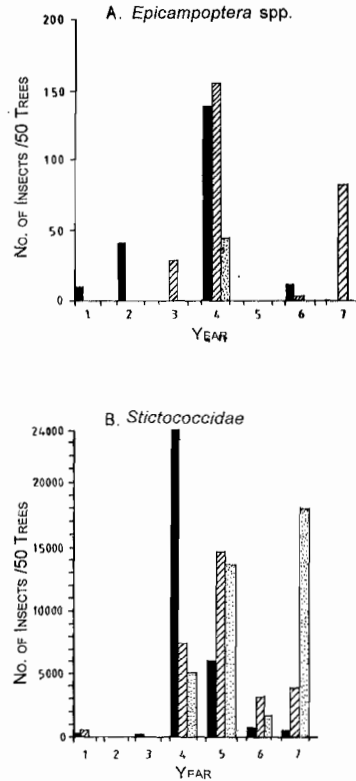


Fig. 1. Annual incidence of *Epicampoptera* spp. (A) and scale insects (B) on newly established introduced *C. canephora* (■), local *C. canephora* (▨) and *C. arabica* (□) over a period of 7 years

aculeatus and the leaf feeder *Cephonodes hylas* Linnaeus were not recorded on any of the three coffee types throughout the experimental period. Similarly, no berry borers (neither *H. hampei* nor *Virachola lorisona* Hewitson) had been observed by the end of the experimental period, 3 years after the trees had started bearing.

The nuisance ants *O. longinoda*, *C. africana* and *C. clariventris* occurred mainly during the 6th and 7th years after establishment (Fig. 5C).

Diptera and Blattidae (Fig. 4A), the ants *Pheidole megacephala* F. and *Camponotus (Othonomyrmex) vividus* (Fig. 5A) first appeared during the 2nd year (1982-1983) of establishment. The mealybug *Planococcoides njalensis* (Laing) oc-

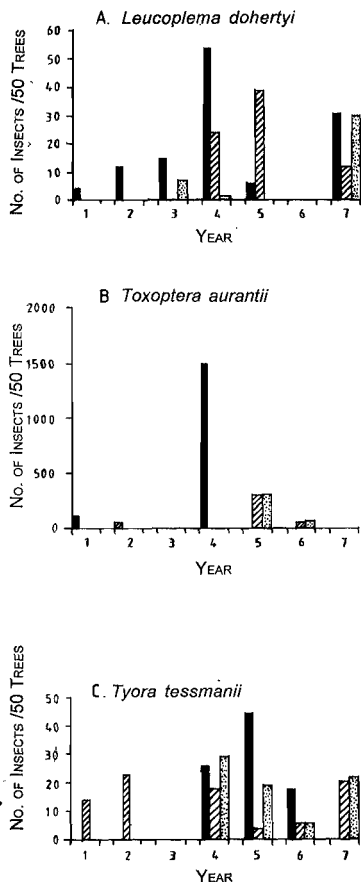


Fig. 2. Annual incidence of *Leucoplemma dohertyi* (A), *Toxoptera aurantii* (B) and *Tyora tessmanii* (C) on newly established introduced *C. canephora* (■), local *C. canephora* (▨) and *C. arabica* (□) over a period of 7 years

occurred in very low numbers during the first 3 years of establishment but was present in fairly large numbers during the 4th and subsequent years on all three coffee types (Fig. 6A). Termites were first recorded during the 3rd year of establishment (Fig. 4A).

The ants *C. (Myromtremia) olivieri* (1140/tree), *P. megacephala* (377/tree), *C. (Orthonomyrmex) vividus* (357/tree), the mealybug *P. njalensis* (685/tree), Stictococcidae (641/tree) and Termitidae (152/tree), were the most abundant insects recorded on

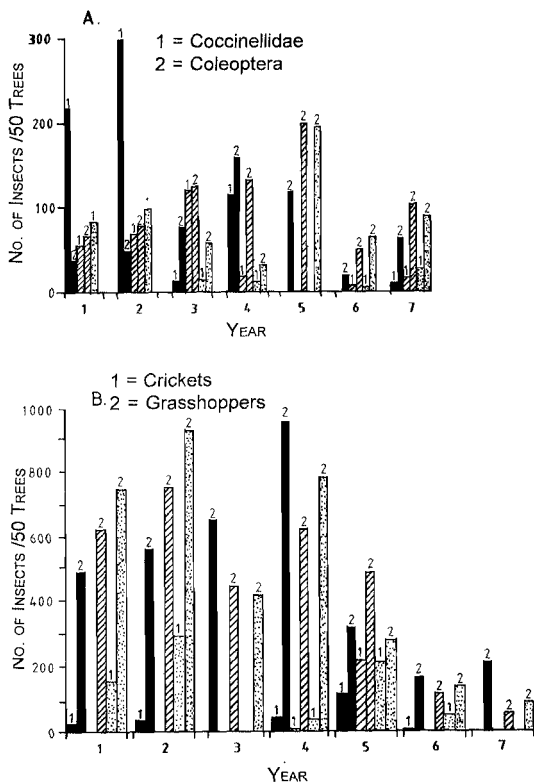


Fig. 3. Annual incidence of Coccinellidae and Coleoptera (A), crickets and grasshoppers (B) on newly established introduced *C. canephora* (■), local *C. canephora* (▨) and *C. arabica* (□) over a period of 7 years

all three coffee types, particularly during the 4th and 5th years of the experimental period (Fig. 1B, 5A and 6A). Other insects, including *Epicampoptera* spp. (Fig. 1A), *L. dohertyi* (Fig. 2A), the mealybugs *Planococcus citri* (Risso) and *F. virgata* (Fig. 6B), aphids and psyllids (Fig. 2B, C), occurred in relatively low numbers throughout the experimental period.

It is significant to note that several insect species including *Polyrachis* spp. (Fig. 5B), *T. aurantii* (Fig. 2B), *T. tessmanii* (Fig. 2C) and miscellaneous crickets, grasshoppers (Fig. 3B) and spiders (Fig. 4B) which were present during the 2nd year, re-

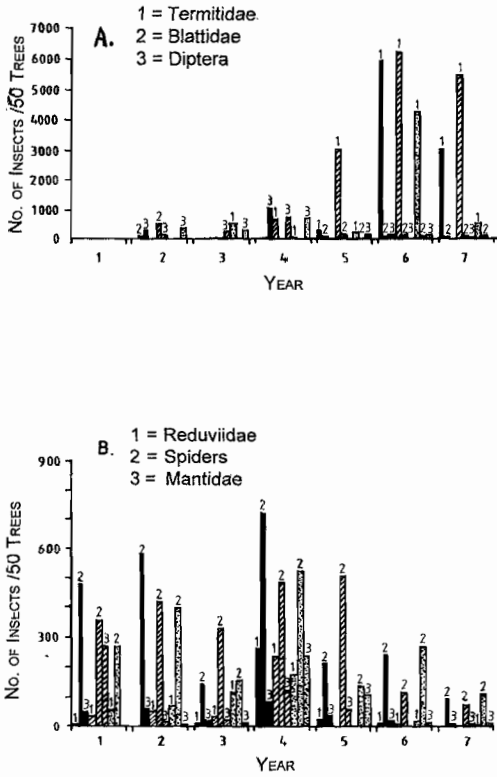


Fig. 4. Annual incidence of Termitidae, Blattidae and Diptera (A), Reduviidae, Mantidae and Spiders (B) on newly established introduced *C. canephora* ■, local *C. canephora* ▨ and *C. arabica* □ over a period of 7 years

duced in numbers or were entirely absent in the 3rd year (1983-84) when an unusually severe and prolonged drought occurred. Generally, insect populations rose to a peak in the 4th and 5th years (1984/1985 and 1985/1986) and dropped again in the 6th and 7th year on all three coffee types except for termites (Fig 4A) and the ants *O. longinoda* and *C. africana* (Fig. 5B), which continued to increase in numbers during the final two years.

The results show that most of the insect species recorded, e.g. *Epicampoptera* spp. and *L. dohertyi* (Fig. 1A and 2A), *T. aurantii* and *T. tessmanii* (Fig. 2B and 2C), grasshoppers and crickets (Fig. 3B), Blattidae (Fig. 4A), *P. megacephala* and *C. africana*

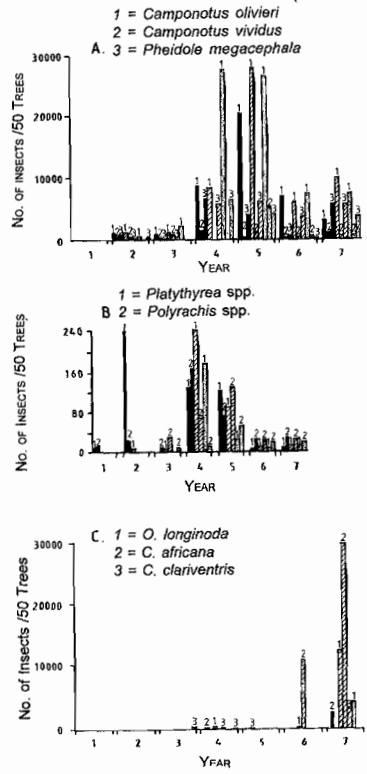


Fig. 5. Annual incidence of ants: *C. olivieri*, *C. vividus* and *P. megacephala* (A), *Platythyrea* sp., *Polyrachis* sp. (B) and *O. longinoda*, *C. africana* and *C. clariventris* (C) on newly established introduced *C. canephora* ■, local *C. canephora* ▨ and *C. arabica* □ over a period of 7 years.

(Fig. 5A, 5C) and the mealybugs *P. citri* and *F. virgata* (Fig. 6B), were more abundant on the two robusta coffee types than on *C. arabica*. However, the ants *O. longinoda* (Fig. 5C), *C. olivieri* (Fig. 5A), the scale insects (Fig. 1B) spiders and reduviids (Fig. 4B) were relatively more abundant on *C. arabica*. Moreover, the sequence of insect occurrence on all three coffee types generally followed a similar pattern over the years (Fig. 1-6) except for *Epicampoptera* spp. (Fig. 1A), *L. dohertyi* (Fig. 2A), and *P. njalensis* (Fig. 6A) which were entirely absent from *C. arabica* and the local *C. canephora* during the first three years.

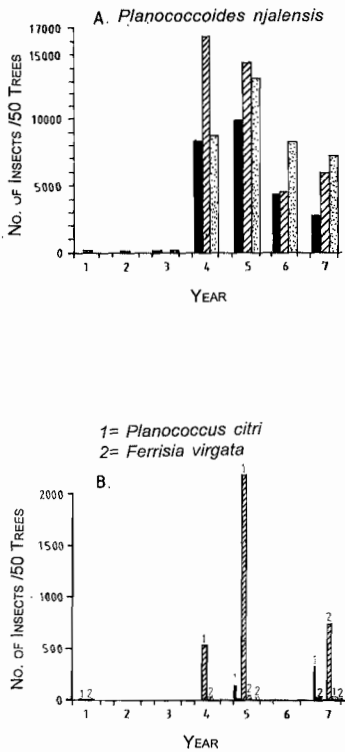


Fig. 6. Annual incidence of mealybugs: *P. njalensis*, (A), *P. citri* and *F. virgata* (B) on newly established introduced *C. canephora* ■, local *C. canephora* ▨ and *C. arabica* □ over a period of 7 years

Discussion

The early occurrence during the 1st year of the important pests, *Epicampoptera* spp. and *Z. variegatus* and the minor pest *L. dohertyi*, as well as the aphid *T. aurantii*, and the psyllid *T. tessmanii*, reduviids, mantids, crickets, grasshoppers and some ant species, is an indication that these are early colonizers. These insects probably entered from the nearby secondary forest and bordering experimental cocoa plots. It has been observed that *Epicampoptera* outbreaks usually occur on coffee close to moist forests (Le Pelley, 1968) but the alternative host forest trees have not been determined. *Z. variegatus*, on the other hand, is

polyphagous and attacks crops like cocoa and cassava as well as ornamental plants and weeds. The aphid, *T. aurantii* and the psyllid *T. tessmanii* also occur on cocoa (Entwistle, 1972).

The mealybug *P. njalensis* which was first found in the 1st year and *F. virgata* which was first recorded in the 4th year, also probably entered the coffee plots from the nearby forest and cocoa trees. *P. njalensis* commonly occurs on cocoa and over a hundred forest trees have been recorded as its alternative host plants (Entwistle, 1972).

The nuisance ants *O. longinoda*, *C. africana* and *C. clariventris* which occurred in the latter years on all three coffee types, may be considered as late colonizers which perhaps prefer bushy coffee plants.

The fact that the stem borer *B. sierricola* and the twig borer *X. compactus* are generally quite widespread on coffee in Ghana (Anon. 1962; Forsyth, 1966; Padi, 1984, 1985a), but were absent from the experimental plots throughout the 7-year period may be attributed to the good farm hygiene, including regular weeding and pruning, practised on the plot. This supports previous views that the stem and twig borers on coffee may be effectively controlled by practising good farm hygiene, without the use of insecticides (Le Pelley, 1968; Padi, 1985). Another possible explanation for the absence of the borers is that they may be pests of older coffee trees as observed in previous studies by Padi (1984, 1985a). This view is at variance with observations by Le Pelley (1968) that *B. sierricola* attacks coffee trees of all ages. This needs to be further investigated. Similarly, the absence of *H. hampei* three years after the coffee trees had started bearing indicates that it is also a late colonizer. This is supported by the fact that the berry borer was recorded the following year in a subsequent study conducted on the same plots (Padi & Owusu-Manu, in preparation). The absence of *C. hyalas* throughout the experimental period seems to support the view that its occurrence on coffee is sporadic as reported by Le Pelley (1968) and Padi (1985a).

The reduction in numbers of aphids, psyllids and *Polyrachis* spp., and the absence of other species including some mealybug and ant species in the 1983/84 season, followed by increases in their numbers in the 4th and 5th years, was probably the result of the prolonged drought which occurred in the 1983/84 season.

In conclusion, this study has shown that *Epicampoptera* spp. and *Z. variegatus* which are known to be important pests of coffee in Ghana, and the minor pest *L. dohertyi*, are early colonizers on newly-established coffee and may occur within the 1st year of establishment. Other pests like the berry, twig and stem borers, on the other hand, are late colonizers which are unlikely to be found within 7 years of establishment, whilst the nuisance ants may not pose any problems till about 4 years after establishment.

These findings may serve as useful guidance to coffee farmers in predicting the sequence of pest incidence on newly-established coffee farms. This will ensure the execution of timely and effective control measures. It must, however, be noted that certain variable ecological factors such as the location of the farm and prevailing climatic conditions, e.g. the prolonged drought which occurred during the present study in 1983/1984, could alter the sequence of pest incidence in different geographical areas.

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REFERENCES

- Adu-Ampomah, Y.** (1994) Coffee breeding programme. *Rep. Cocoa Res. Inst. Ghana*, 1992/93. 114-115.
- Ampofo, S. T. & Osei-Bonsu, K.** (1988) *A Practical guide for coffee extension workers*. 24 pp. Cocoa Research Institute.
- Anon.** (1962a) Coffee pests. In *Reports of Ministry of Agriculture, Division of General Agriculture, miscellaneous information, Ghana, (1961 -1962)* pp. 64-65.
- Anon.** (1962b) Crops other than cocoa and diseases and pests which affect them. In *Agriculture and land use in Ghana* (ed. S.B. Wills), pp. 357-359. London: Oxford University Press.
- Entwistle, P. F.** (1972) *Pests of cocoa*. London: Longman Group Ltd.
- Forsyth, J.** (1966) *Agricultural insects of Ghana*. Accra: Ghana Universities Press.
- Le Pelley, R. H.** (1968) *Pests of coffee*. London: Longmans Green & Co. Ltd.
- Opuni, E. K.** (1978) *Pest problems in the coffee plantations established by the plantation unit of the Ghana Cocoa Marketing Board (GCMB)*. Accra: Pamos Ghana Ltd Press.
- Owusu-Manu, E. & Ampomah, E.** (1991) Coffee berry borer control with insecticides. *Rep. Cocoa Res. Inst. Ghana*, 1988-1989. 67-68.
- Padi, B.** (1979) *Report on a Visit to the Cocoa Research Institute of Nigeria (CRIN) to Understudy Coffee Pest Problems and their Control in Nigeria, 20th May - 9th June, 1979*. Tafo: Cocoa Research Institute of Ghana (CRIG).
- Padi, B.** (1984) Insect survey. *Rep. Cocoa Res. Inst. Ghana (1976-79)* pp. 99-104.
- Padi, B.** (1985a) Coffee entomology. *Rep. Cocoa Res. Inst. Ghana (1979-82)* pp. 44-51.
- Padi, B.** (1985b) Proposed integrated control approach to insect pests of coffee in Ghana. *Proceedings of the 11th Scientific Colloquium on Coffee, Lome, Togo*, pp. 647-653.
- Padi, B.** (1993) Laboratory and small-scale field tests of four insecticides against defoliating caterpillars of *Epicampoptera strandigluca* Hamp. (Lepidoptera: Drepanidae). *Proceedings of the 15th International Scientific Colloquium on Coffee, Montpellier, France, 6th-11th June, 1993*, 2, 853-857.