Insecticide Use Practices in Cocoa Production in Four Regions in Ghana

Akua K. Antwi-Agyakwa[1], E. A. Osekre[2]*, R. Adu-Acheampong[2] and K. D. Ninsin[3]
[1]*Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi Ghana.*
[2] *Entomology Division, Cocoa Research Institute of Ghana, New Tafo, Ghana*
[3]*CSIR-Animal Research Institute, Accra, Ghana*
*Corresponding author; E-mail: *osek652001@yahoo.co.uk*

Abstract

Chemical control of insect pests of cocoa started in 1950, and insecticides from the various classes have been recommended and used by farmers since then. Presently, Imidacloprid (Confidor®), Bifenthrin (Akatemaster®) and Thiamethoxam (Actara®) are recommended by Ghana Cocoa Board (COCOBOD) for insect pest management. A survey was conducted in the Ashanti, Eastern, Volta and Western regions of Ghana using questionnaires and farm visits of 147 cocoa farmers' fields to gather information on insecticide use practices by farmers. The survey showed that the farmers used mostly Imidacloprid and Bifenthrin insecticides and the frequency of application was more than that recommended by COCOBOD. Among the three recommended insecticides, 43% each of the farmers across the three regions used either Confidor® or Akatemaster® whilst the remaining 14% used Actara®. The number of years farmers had consistently used a particular insecticide ranged between 5 and 16 years. Whilst some cocoa farmers do not apply insecticides to their farms, others, however, do as many as 11 applications in a year. Most of the insecticides used are classified as class II under WHO Hazard category, and the farmers used very minimal protective clothing during pesticides application. The results of this study show that there is the need to intensify education on safe handling and use of pesticides to reduce pesticide abuse, especially by cocoa farmers, in order to sustain effective management of pests and protect farmers, consumers and the environment.

Introduction

Cocoa is a major cash crop in Ghana and West Africa (Asare, 2011) and is attacked by several insect pests including *Sahlbergella singularis* Haglund (Hemiptera: Miridae), *Distantiella theobroma* (Distant) (Hemiptera: Miridae), cocoa stem borer, *Eulophonotus myrmeleon* (Felder) (Lepidoptera: Cossidae) and the stink bug, *Bathycoelia thalassina* (Herrich-Schaeffer) (Hemiptera: Pentatomidae), but mirids are the most important economically (Padi *et al.*, 2001).

The main method recommended by the Cocoa Research Institute of Ghana (CRIG) for insect pests' management has been the use of synthetic insecticides (Owusu-Manu, 2001). The first attempt of chemical control of mirids was in 1910 (Dudgeon, 1910) when kerosene-soap emulsion (kerosene mixed with soap) was employed. In the early 1950s, excellent mirid control was achieved with Dichlorodiphenyltrichloroethane (DDT) (Arkotine®) and then Lindane (Gammalin® 20). Later, a number of organochlorine insecticides became available for use on the crop.

In the 1970's DDT and other

organochlorines were banned from usage due to their high persistence and the enormous residual effect they had on the soil and non-target organisms. Screening of a number of carbamates, organophosphates and synthetic pyrethroids was undertaken during that period leading to the recommendation of propoxur (Unden® 200 EC) as alternative to lindane. In the late 1990's imidacloprid (Confidor® 200SL) was introduced to gradually replace lindane and propoxur as evidence began to emerge that resistance was being built against them. It must be noted that cocktails of pirimiphos methyl and bifenthrin as Actellic Talstar and Promecarb-Carbamult insecticides were introduced alongside Confidor® but Cabamult was later banned from use on cocoa for abuse and safety concerns.

The Cocoa Extension Spraying Scheme was implemented to spray cocoa for farmers at no cost to them in the late 1950s in Ghana resulting in the nation producing more than 500,000 metric tonnes in the 1964/1965 season. Problems encountered with this arrangement led to its discontinuation. Consequently, pest control was left to cocoa farmers who bought their own pesticides and equipment. This affected productivity greatly because many farmers stopped applying pesticides due to increased cost. Government intervention to boost production under the Cocoa Sector Reforms Programme introduced a nation-wide Cocoa Diseases and Pest Control (CODAPEC) programme, popularly known as "Mass Spraying", in the 2001/2002 cocoa growing season to assist all cocoa farmers in the country to combat mirid damage and the black pod disease (Dormon *et al*., 2007), and one million ha were covered in 2010 (Adjinah & Opoku, 2010).

Currently, 72 political districts covering all the cocoa growing areas are benefiting from the programme; 21districts from the black pod disease only, 35 districts from mirids only and 16 from both programmes. Spraying against mirids covers parts of Ashanti, Central, Eastern and parts of Western regions. Each farm is programmed to be sprayed twice between August and December (Adjinah & Opoku, 2010) by spraying gangs recruited and trained in the communities. Even though pesticides abuse among cocoa farmers may be common, not much information is available on the subject in the face of the introduction of CODAPEC programme. This study examined the insecticide use practices presently employed by cocoa farmers in four major growing regions in Ghana.

Materials and methods

The study was undertaken between May and July 2013 and involved questionnaire administration and farm visits. In all, 147 cocoa farmers comprising 36 from Ashanti, 30 from Eastern, 31 from Volta and 50 from Western regions of Ghana were covered; the bulk of Ghana's cocoa is produced from these regions. Respondents were selected at random in each town visited. The questionnaire was structured mostly with closed-ended questions and a few open ended ones and administered using one-on-one interviews. The closed-ended questions enabled the exact information being sought to be collected for quantitative analysis, whilst the open ended ones gave the respondents more room to clarify certain responses provided.

Data processing and statistical analysis

The questionnaires were coded by assigning a unique abbreviation to each question. The Statistical Package for Social Sciences (SPSS) software (version 20.0.0, IBM Corporation and its Licensors 1989, 2011) was used for the analysis of the data.

Results

Type of chemical used in mirid control

Presently, bifenthrin (Akatemaster®), thiamethoxam (Actara® 240SC) and imidacloprid (Confidor®) are the insecticides approved by Ghana Cocoa Board (COCOBOD) for the management of mirids in Ghana (Table 1) and Pyrethrum used for mirid management in organic cocoa production (Adu-Acheampong, *personal communication*). However, 16.1% and 2% of farmers in Volta and Western regions, respectively, use insecticides not approved by Cocoa Board (Fig. 1). Among the three recommended insecticides, Confidor® and Akatemaster® are the mostly used (Fig. 2). Percentage of cocoa farmers (13.2%, 20%, 45%, 54.9% and 23.3%, respectively, in the Ashanti, Eastern, Volta and Western regions) use a combination of insecticides, and it was observed that in the Volta Region majority (54.9%) of the farmers use a combination of Confidor® and Akatemaster® or other insecticides on the open market.

Insecticide use practices

Majority of the farmers in the four regions benefitted from the CODAPEC programme (mass spraying exercise) (Fig. 3). Aside the mass spraying programme, farmers do their own chemical management of mirids and other insect pests. They use COCOBOD approved and unapproved insecticides. Almost all the insecticides that were not approved were broad spectrum. Generally, farmers consider the insecticides very effective in the management of insect pests of cocoa. Among the three recommended insecticides, 43% each of the farmers across the three regions used Confidor® and Akatemaster® whilst the remaining 14% used Actara®. Table 2 shows the classification of some of the insecticides used by farmers. In recent times, Pyrethroids, Neonicotinoids and Organophosphates (OP) were the classes of insecticides mostly used in the management of insect pests, and the insecticides fall under WHO Hazard Category II (moderately hazardous in WHO characterisation). The only OP identified in the study to be in use was Chlorpyrifos.

The maximum number of years farmers had consistently used a particular insecticide ranged between 5 and 16 years (Fig. 4). Some cocoa farmers do not apply insecticides to their farms; neither do they benefit from the government's mass spraying exercise. Others, however, apply as many as 11 times in a year in addition to the two spray applications they enjoy from the mass spraying exercise (Fig. 5). The distribution of farmers' knowledge of COCOBOD approved insecticides in the four regions is shown in Table 3 whilst that of the month of first insecticide application is shown on Table 4.

Discussion

Mirids are the main insect pests that are targeted for control by cocoa farmers in their bid to obtain desirable yield. They are expected to do about four spray applications in a year and are assisted with two spray applications under the CODAPEC exercise (Asare, 2011), and are, therefore, expected to do the other two applications. Some farmers, however, do not benefit from the CODAPEC

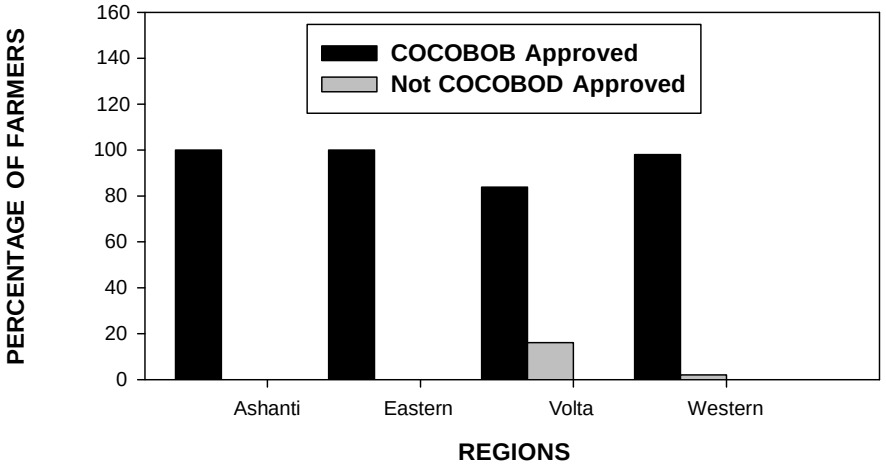

Fig. 1. Proportion of farmers in the Ashanti, Eastern, Volta and Western regions of Ghana that use COCOBOD approved insecticides on cocoa.

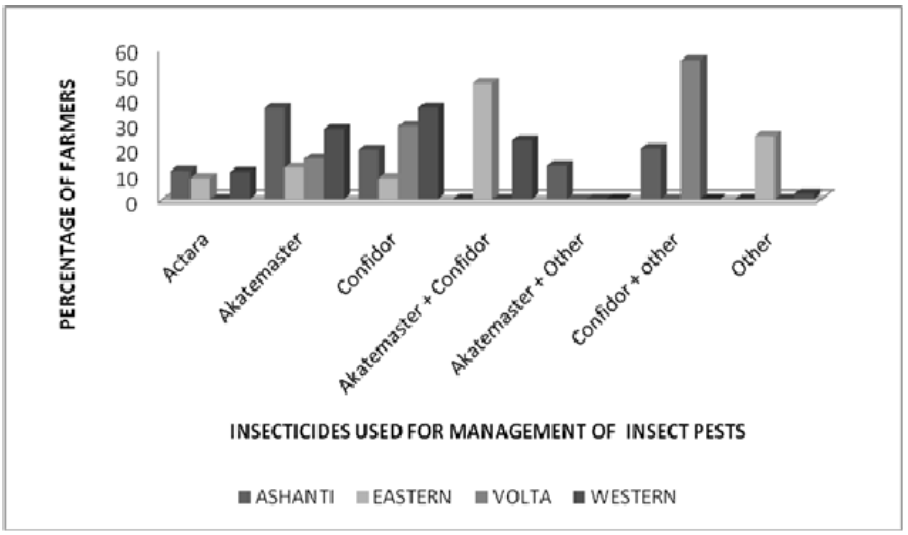

Fig. 2. Distribution of farmers with the insecticides used for mirid control in the Ashanti, Eastern, Volta and Western regions of Ghana

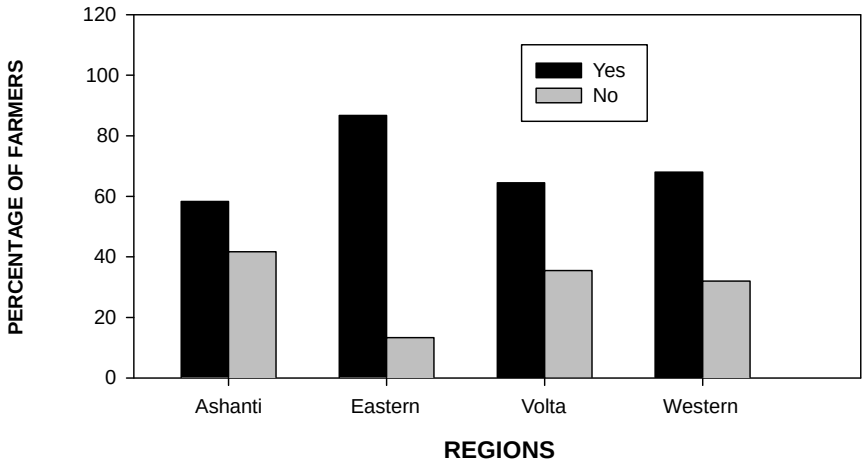

Fig. 3. Distribution of farmers benefitting from the cocoa mass spraying programme in the Ashanti, Eastern, Volta and Western regions of Ghana

TABLE 2

Insecticides used in cocoa production in the Ashanti, Eastern, Volta and Western regions of Ghana

Insecticide trade name	*Active ingredient*	*Chemical group*	*Chemical ai hazard category (WHO)*	*Registered for use on/as*
Akatesuro®	Diazinon	Organophosphate	II	Cocoa Mirids BP
	Pyrethrum	Botanical	II	Cocoa Mirids
Consider Supa®	Imidacloprid	neonicotinoids	II	Broad Spectrum
Confidor®	Imidacloprid	neonicotinoids	II	Cocoa Mirids
Actara®	Thiamethoxam	neonicotinoids	III	Cocoa Mirids and *Bathycoelia*
Dursban®	Chlorpyrifos	Organophosphate	II	Broad Spectrum
Sunpyrifos®	Chorpyrifos-ethyl	Organophosphate	II	Broad Spectrum
Buffalo®	Chlorfenvinphos	Organophosphate	Ib	Control of buffalo fly (*Haematobiairr itansexigua*) in cattle
AF Confidence®	Chlopyrifos and Lamdacyhalothrin	Organophosphate		Fertilizer/ Insecticide and Pyrethroid
Akatemaster®	Bifenthrin	Pyrethroid	II	Cocoa Mirids
Fastrack®	Alpha-Cypermethrin	Pyrethroid	II	Sucking insects
Controller Super®	Lambda-Cyhalothrin	Pyrethroid	II	Broad Spectrum
Sumico® 200 EC	Fenvalerate	Pyrethroid	II	Broad Spectrum
Super® 10	Permethrin	Pyrethroid	II	Broad Spectrum

ai = active ingredients

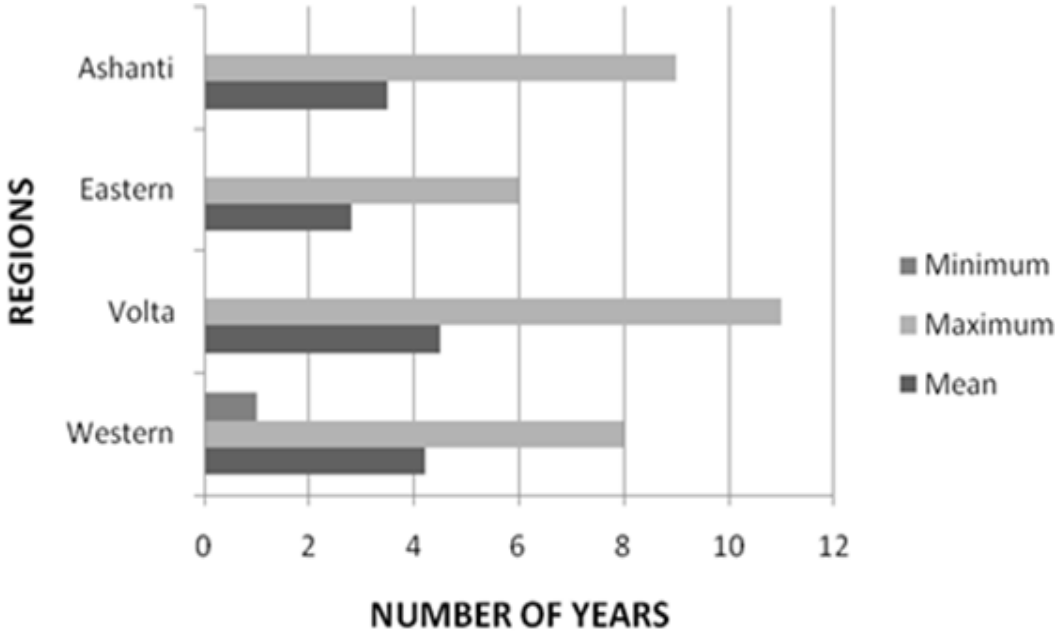

Fig. 4. Number of years farmers in the Ashanti, Eastern, Volta and Western regions continuously use a particular insecticide

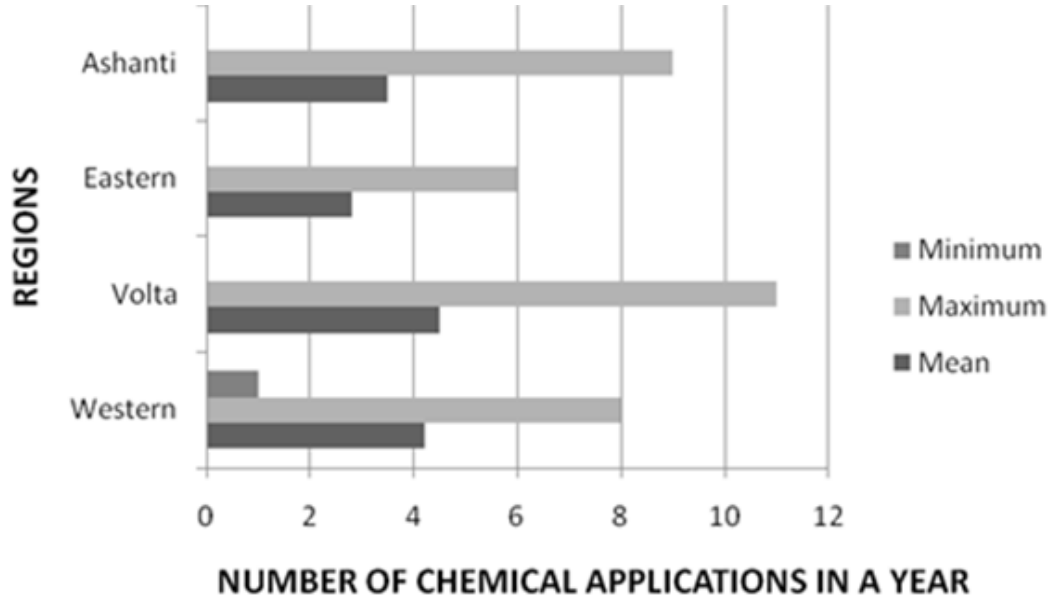

Fig. 5. Frequency of insecticide applications farmers do in a year in the Ashanti, Eastern, Volta and Western regions of Ghana

TABLE 3

Farmers' knowledge (%) of the three COCOBOD approved insecticides in the four study regions of Ghana

Farmers knowledge of insecticides	*Ashanti (%)*	*Eastern (%)*	*Volta (%)*	*Western (%)*	*Average*
All three	16.7	26.7	26.7	42	28.03
Only two	30.6	26.6	19.7	16	23.23
Only one	16.7	6.7	22.5	6	12.98
None	36	40	31.2	36	35.8

TABLE 4

Distribution of farmers' first insecticide application in a year in the four study regions of Ghana

Parameters	*Ashanti*	*Eastern*	*Volta*	*Western*
January	10.7	5	8.3	17.8
February	17.9	10	4.2	2.2
March	10.7	0	12.5	4.4
April	7.1	0	0	0
May	7.1	0	4.2	24.4
June	7.1	0	16.6	17.8
July	3.6	20	25	4.5
August	17.9	30	25	22.2
September	7.1	35	0	6.7
November	7.1	0	4.2	0
December	3.6	0	0	0

exercise due to various reasons including the issue of having too old cocoa trees on their farms, a breakdown of spraying machine or a lack of adequate amount of recommended chemicals. Farmers use several types of insecticides belonging to the various classes – botanicals, neonicotinoids, organophosphates and pyrethroids – for their own insect pest management and most of these chemicals are broad spectrum insecticides. Among the COCOBOD recommended insecticides, Actara® was least used because it has not gained popularity with farmers.

According to the farmers, insecticides on the open market are used because they are less expensive and readily available unlike the COCOBOD recommended products. The intensive use of non-selective insecticides to deal with pest outbreaks may have direct consequences for pest control through the appearance of insecticide resistant strains, pest resurgence, and secondary pest outbreaks (Tiwari *et al*., 2011). For instance, "Buffalo®" (a. i. Chlorfenvinphos, a broad spectrum nerve poison) which is registered for use on cattle is used on cocoa which raises a great public health issue. What is worrying is the minimal knowledge of the approved insecticides and the application frequency by farmers.

Knowledge of the COCOBOD approved insecticides is very necessary in identifying the right insecticide for the effective management of insect pests. Lack of

knowledge of the COCOBOD recommended insecticides and the recommendations for application can result in farmers using chemicals that are inferior or banned or improper handling and application. This can increase the issue of chemical residues in harvested cocoa beans as well as pesticide resistance and pest resurgence. The fact that farmers usually exceed the application frequency of insecticides even though they are aware of the recommended insecticides and the rates to apply suggests that farmers are not guided by the peak of mirids population or the economic threshold level (6 mirids per 10 trees) (Adu-Acheampong, *personal communication*) but that they control pests just when they deem appropriate. Some farmers indicated that they prepare to spray just when they notice mirids in the farm.

Some farmers believe that insecticides on the open market are more effective than the three approved by COCOBOD because they kill all insects in the field. Farmers need to get more education on pesticides and their effects on the environment. COCOBOD approved insecticides are less harmful to beneficial insects. For example, ants and termites on cocoa protect the tree from mirids (Ackonor & Nkansah, 1997). Wang *et al*. (2013) advised that pest managers should use insecticides that have minimal impact on natural enemies whenever possible. It is important farmers alternate the insecticides they use over short periods (at most 2 years) to prevent insects from building resistance to the pesticides. It is for this reason that Ghana COCOBOD encourages the alternation of insecticides after every 2 years (COCOBOD, 2012). In changing pesticides, it should be noted that insecticides in the same class should not be used after each other. Farmers' dependence on more than one insecticide is justified by Georghiou (1980) who indicated that such practice helps to manage pesticide resistance.

Chemical control is not the only way to protect plants from insects' attack. Cultural practices such as cutting off chupons from the trees, maintaining a close canopy, among others, are practical ways to prevent mirids attack (Leston, 1970). These practices are carried out by farmers but most are not aware of the effect of such a practice on the management of insect pests especially mirids aside the agronomic benefits it gives to the plant. Trimming chupons deprive mirids of their feeding and breeding sites and as such has the propensity of preventing mirid infestation; maintaining close canopy prevents the penetration of light into the farm and subsequently prevents the growth of offshoots (chupons). Integrating biological control with selective insecticides can minimize the likelihood of pest resurgence and possibly reduce the number of insecticide applications (Johnson & Tabashnik, 1999).

Conclusion

Some farmers have used particular insecticides for at least 3 years with others as long as 9–11 years. Farmers use both Ghana COCOBOD recommended and non-recommended insecticides sold on the open market. The most commonly used are Confidor® (imidacloprid) and Akatemaster® (bifenthrin). It was gathered that Actara® (thiamethoxam) is now gaining some popularity with farmers. Generally, farmers still consider the insecticides used for the management of cocoa mirids effective and useful. However, the cost of acquiring them is high making it very difficult to

access. Farmers need more education on pesticide use to ensure more effective management of insect pests and the environment.

Acknowledgement

The authors are grateful to the cocoa farmers and the agricultural extension officers in the areas visited for assisting in sampling and the provision of information for the project. They thank CHEMICO Ghana and Cocoa Research Institute of Ghana for logistics support.

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