Farmers' perception on insect pests control and insecticide usage pattern in selected areas of Ghana

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Abstract: A survey of 60 farms in vegetable and cotton growing areas in the Greater Accra and Upper East Regions of Ghana revealed chemical control as the sole insect pests control practice of the farmers. Aphids, whiteflies, diamondback moth and grasshoppers were the most devastating insect pests that attack their crops whilst tomato, okra, cabbage and garden eggs were reported as the most affected by whiteflies. The farmers used synthetic insecticides to manage insect pests whilst those involved in both cotton and vegetable production used hazardous insecticides recommended for cotton on vegetables. Though 25% of farmers exceeded the recommended dose, the frequency of insecticide application was generally high (weekly or less). Most farmers lacked safety equipments with a few improvising some of these items such as applying insecticides using brooms. Farmers changed insecticides mostly as a result of their availability on the market rather than perceived ineffectiveness or cost. The storage and disposal of insecticides by farmers were risky and could adversely affect the health of humans and the environment. Farmers' knowledge of insect pest management practices were sourced mostly from experience, peer learning, extension agents, Ghana Cotton Company and the media. This study underlines the need for regular monitoring of insecticide usage patterns to ensure food safety, safeguard human and environmental health and prevent/detect resistance at the initial stages.
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1. Introduction

Agriculture is the largest sector of the Ghanaian economy and the highest contributor to the nation's GDP (ISSER, 2010), employing about 60% of the country's labour force (NDPC, 2005 in ISSER 2010). Agricultural productivity is however threatened by pests' infestations (Ruttan, 2005) and Ghana is no exception. Pesticides have been used to control crop pests and this has helped to increase crop yield and improve product quality (Cooper and Dobson, 2007). In Ghana, Blue-Skies, a local company has attributed the quality and quantity of its fruits to the judicious use of agrochemicals (Ablorh, 2008). The use of pesticides in Ghana has increased over time and is elevated in the production of high value cash crops and vegetables (Gerken et al., 2001). In 1990, about 13% of the pesticide use market was shared on vegetables (6.8%) and cotton (6.0%) with insecticides contributing 56% and 72% respectively (Suglo, 2008). Insecticide imports into Ghana has increased from 907 Mt in 2001 to over 5,078 Mt in 2009 (MoFA, 2010) with peak values of 6,921 Mt and 9,979 Mt in 2006 and 2007 respectively.

Pesticide use can be injurious to human and environmental health; hence its judicious use is essential. The exposure of human to insecticides through occupational or non-occupational means could lead to poisoning. About 80% of vegetable farmers surveyed in six (6) regions of Ghana had become ill from pesticide exposure (Ntow et. al, 2006), reporting weakness, headache and/or dizziness as frequent symptoms. Aside the health risk involved with pesticide use, the manner in which farmers store and dispose insecticides and their packages can have personal, public and environmental health implications. Farmers in Ghana have risky storage practices such as storage in poorly ventilated rooms which promote insecticide exposure to man (Clarke, 2008).

The pattern and frequency of insecticide use by farmers could play a role in the development of resistance in insect pest and also affect the health of humans and the environment. Pesticides contamination has been detected in water, sediment, crops and human fluids in areas of highly intensive vegetable production (Ntow, 2001). Due to the critical role of insecticides in crop production, there is the need to promote appropriate insecticides use, storage and disposal practices by first understanding current practices of farmers. This study assesses farmers' perception and practices of insect pests

management and insecticide usage pattern, storage and disposal methods.

2. Materials and Methods

Study sites and samples

The survey was conducted on 60 randomly selected farms in two cotton growing communities (Mirigu and Sirigu) of the Upper East Region and four vegetable growing areas (Haatso, Ashaiman, Dzorwulu and Airport) within the Accra Metropolis of the Greater Accra Region. A farm had several crops and was mostly managed by single families. The cotton farmers were also engaged in vegetable production. The survey was conducted from August – November, 2008.

A questionnaire containing open and closed ended questions was designed and used to obtain data through interviews with farmers and observations during farming activities. This was used to assess farmers' perception on insect pests, pest management practices, knowledge on application, pattern, storage and disposal practices of insecticides. Ten (10) farmers were randomly interviewed at each location. The selected farmers were those responsible for decision making concerning their respective farms.

The questionnaire was designed in English and translated into Nankani and Twi Asante (local languages understood and spoken by farmers) for the Upper East Region and Accra Metropolis respectively. It was pretested using a few farmers before being used in the study. The essence of the survey was explained to the farmers and their consent sought.

3. Results

Farmers' perception on insect pest control

The farmers cultivated a variety of crops (Figure 1) with the most predominant being tomato, okra, cabbage and garden eggs. Mostly, farmlands were subdivided to grow different crops. Some farmers in the Accra Metropolis cultivated cassava in addition to vegetables. The farmers complained that crop cultivation is severely hampered by several insect pests' species. Aphids (71.7%), whiteflies (70%), Grasshoppers and Diamondback moth were the most reported (Figure 2). The whitefly is a devastating insect pest on several host crops in Ghana especially vegetables and cassava. According to the farmers it affected several host crops; however, most of them named tomatoes as the most affected while others cited cotton, okra, garden eggs and cassava (Figure 1).

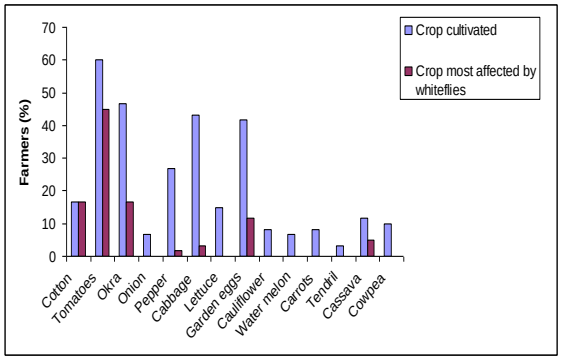

Figure 1: Farmers perception of crops most affected by whiteflies.

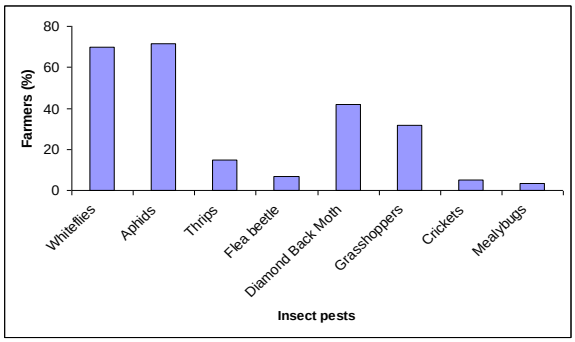

Figure 2: Insect pests of crops reported by farmers.

In the areas surveyed, though farmers were aware of other control practices such as physical and cultural methods, they all applied chemicals to manage insect pests (Table 1). Though, whiteflies were not specifically targeted, farmers expected insecticides to address the insect pest complex affecting their crops. About 95% of farmers do not have specific insecticide(s) for whitefly control (Table 1).

Table 1. Farmers' responses on insect pests control

Parameter	Respondents (%)
Methods used to control insect pests	
Chemical	100
Others	0
Any specific insecticide for whitefly control?	
Yes	5
No	95

A wide array of insecticides comprising organochlorine, pyrethroids, organophosphates, botanical, imidacloprid and fipronil were used by farmers (Table 2). The insecticides also included the banned pesticide DDT and some unlabelled insecticides. Insecticides were classified unlabelled if they had no labels/torn labels, labels were not legible or labeling were in a foreign language.

Table 2. Commonly used insecticides and their active ingredients

Insecticide	Active Ingredient
DDT	DDT
Karate 2.5EC®	25g/L Lambda-cyhalothrin
Cydim Super®	400g Dimethoate and 36g Cypermethrin
Plan D®	Deltamethrin
Attack 1.9% EC®	1.9% Emamectin Benzoate
Pawa 2.5 EC®	25g/L Lambda-cyhalothrin
Anty Ataa®	200g/L Imidacloprid
Neem extracts	*Azadirachta indica*
Dursban 4E®	480g/L Chlorpyrifos
Fipronil	Fipronil
Decis 25EC®	25.5 g/L Deltamethrin
Unlabelled	

Insecticide usage pattern

Karate®, Cydim Super® and Plan D® were the most commonly used insecticides with Cydim Super® and Karate® perceived as the most effective (Figure 3). Effectiveness of an insecticide in this instance is subjective and based primarily on the perception of the farmer. The neonicotinoid Anty Ataa® was not widely used by farmers (13.3%); however, a remarkably high proportion of the farmers using the product reported it as effective (Figure 3). There was a similar response from farmers who were using Fipronil. During this study, several unlabelled and French labeled insecticides were found. The French labeled insecticides were found in the Upper East Region. The use of botanicals such as neem extracts was not widespread as evident in the fact that it was the least used product (Figure 3).

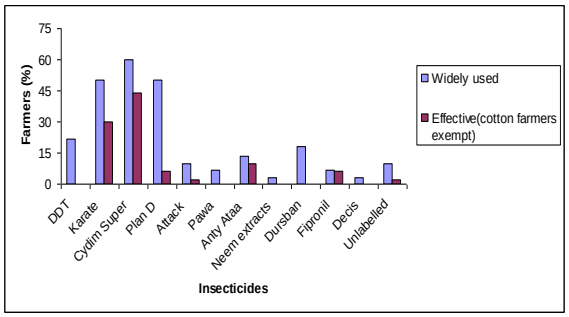

Figure 3: Commonly used insecticides and those perceived as effective by farmers.

About 30% of the farmers use cocktails of insecticides (Table 3) and this varied from place to place. In the cotton growing areas, the cocktails comprised foreign labeled insecticides, unlabelled insecticides and insecticide packages provided by the Ghana Cotton Company (GCC). At Airport, a cocktail of Karate®, Cydim Super® and Plan D® was commonly used. Most of the farmers applied insecticides at the recommended dose with a quarter of the farmers exceeding the recommended dose (Table 3).

Table 3. Use of insecticides cocktail and dosage application among farmers

Use of cocktails (%)	
Yes	30
No	70
Dosage application (%)	
Recommended dose	75
Below recommended dose	0
Above recommended dose	25

The frequency of insecticide use to manage insect pests' problems by farmers varied. More than half of the farmers applied insecticides on a weekly or less basis (Figure 4). Some farmers had longer application periods of monthly intervals whilst for others, they had no set/regular intervals and hence had varied application frequency.

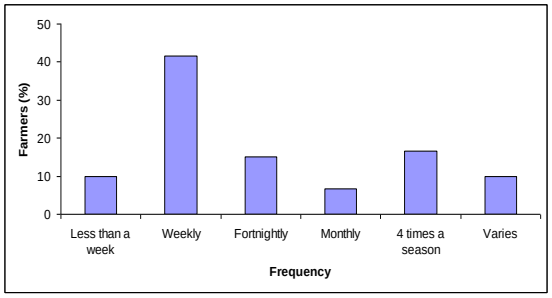

Figure 4: Frequency of insecticide application by farmers

Almost a quarter (23.3%) of the farmers spray on calendar basis while most (70%) of them are triggered to spray by the presence of the insect pest(s). A few of the farmers also apply insecticides whenever they detect pest damage on their crops (Table 4).

Apart from cotton farmers who were supplied insecticide packages by the Ghana Cotton Company(G.C.C.) and hence only changed insecticides based on what they were provided, the other farmers obtained insecticides from various sources such as agro-chemical shops, extension officers and other dealers (both licensed and unlicensed). Insecticides were changed due to two main reasons; availability and effectiveness (Figure 5).

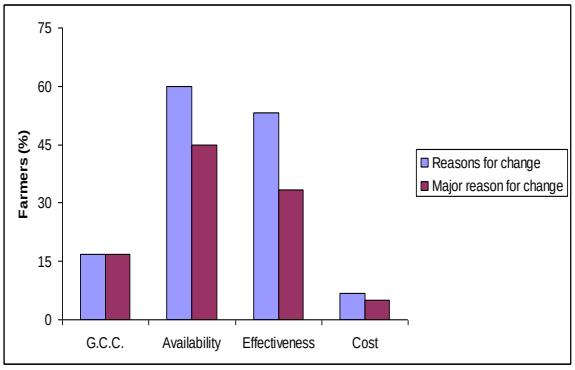

Figure 5: Reasons why farmers changed insecticides

More than half of the farmers (53.3%) claimed to take the necessary precautions during insecticide application (Table 4), though they did not have the necessary protective materials. They relied on improvised nose mask (covering the nose and mouth with cloth/handerkerchief), gloves (wearing the fingers with socks) and long sleeves. A few (6.7%) sometimes took precaution whilst the rest (40%), though aware of the associated health hazards took absolutely no precaution.

Most farmers (86.7%) applied insecticides to their crops using the knapsack sprayer, however a few of them dipped brooms into insecticide solutions to sprinkle on crops (Table 4).

Table 4. Farmers' insecticide usage pattern

Insecticide application indicator (%)	
Calender basis	23.3
Presence of insects	70
Presence of damage	6.7
Threshold of insects	0
Precautions during insecticide application (%)	
Always	53.3
No	40
Sometimes	6.7
Mode of insecticide application (%)	
Spraying using knapsack sprayer	86.7
Sprinkling with a broom	13.3

Insecticide storage and disposal

Insecticides were stored in rooms, barns, top of trees, boxes on/in farms, buried in the soil and hidden in the bush (Table 5). After use, the containers were mostly thrown away (66.7%) (Table 5). About 23.3% found secondary use as storage for water (10%) and other items (13.3%) including seeds. A few (6.7%) were buried whilst the bigger containers were sold by some farmers (3.3%).

Table 5. Farmers' storage and disposal practices of insecticides

Storage of insecticides (%)	
At home	51.6
Barns	10
Boxes/containers on farms	30
Top of trees	5
Buried in the soil	1.7
Hidden in the bush	1.7
Disposal of insecticide containers (%)	
Thrown away	66.7
Buried	6.7
Store water	10
Store seeds	13.3
Sold	3.3

Farmers' knowledge of insect pest control was gained mostly from experience (55%) through years of cultivation and peer learning from other farmers. Other sources include G.C.C., extension officers and the media (Figure 6). The G.C.C. was credited with the dissemination of pest control knowledge to cotton farmers.

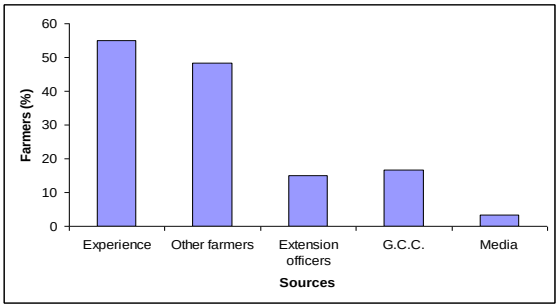

Figure 6: Source of farmers' knowledge about insect pest control.

4. Discussion

Insects such as aphids, whiteflies, diamondback moth and grasshoppers were identified by farmers as causing severe damage to their crops. Biney (2001) reported that tomato farmers identified the variegated grasshopper, aphids, whiteflies and mole crickets among their pests. The whitefly, *Bemisia tabaci* prior to 1990 was not recorded in any Ghanaian publication as a pest of vegetables; however, it is now reputed to be the most important insect pests of vegetables in the country (Obeng-Ofori, 1998). They have become important due to the misuse of insecticides on tomatoes, cabbage, okra and peppers (Critchley, 1995). These crops; tomato, okra, cotton and garden eggs were reported as severely affected by whiteflies.

The insect pests' management practice adopted by the farmers was chemical control using

mostly synthetic insecticides. This is in consonance with management practices of farmers recorded in several parts of the country. In a survey of tomato farmers, 100% preferred chemical control of insect pests to any other alternative methods, believing that there could be 50-100% yield loss if insecticides were not applied (Biney, 2001). Dinham (2003) also estimated that 87% of farmers in Ghana use chemical pesticides to control pests and diseases on vegetables. About 86% of vegetable growers surveyed in the Greater Accra, Ashanti, Brong Ahafo, Central and Volta regions of Ghana used insecticides (Horna et al., 2008). The above practice lends credence to the locally held view that farming without chemical control is a near impossibility.

The three most commonly used insecticides were either pyrethroids or had a pyrethroid component. It is suspected that the rapidity of action (paralysis) of pyrethroids could influence farmers' choice of it being widely used. Karate is active against a wide range of foliar insects and mites at low concentrations (Obeng-Ofori and Ankrah, 2002), hence its preference by farmers.

A worrying observation was the tagging of insecticides by farmers in cotton growing areas as DDT. To farmers in the sites sampled in the Upper East region, insecticides that were perceived effective were called DDT. It is likely this practice stems from the spectacular results of the use of DDT prior to its ban. In the Upper East region, cotton farmers engaged in tomato cultivation used insecticides supplied by G.C.C. and recommended for the control of cotton insect pests on tomatoes. Such a practice has been reported by some authors. According to Biney (2001), highly harzardous insecticides recommended for the control of cocoa and cotton pests were used on tomatoes whilst Ntow et al. (2006) observed the use of endosulfan (registered for use on only cotton in Ghana) on vegetables.

The use of botanicals is not widespread and it is used to augment synthetic insecticides by farmers who are already using high levels of pesticides (Horna et al., 2008). The presence of foreign labeled insecticides is suggestive of infiltration of insecticides from neighbouring Francophone countries. There is unauthorized cross-border trade in pesticides in Ghana with Cote D'Ivoire and Togo as evidenced by the widespread use of pesticides labeled in French (Williamson, 2003). This violates a labeling requirement in the FAO Code of Conduct on the Distribution and Use of Pesticides, which states that products and advice must be provided in an appropriate language (FAO, 2002).

Weekly insecticide application with cocktails of insecticides is common among vegetable farmers, as has been reported by Owusu-Ansah et al. (2001) whereby farmers used a weekly calendar application of a cocktail of Karate®, Actellic® and Dimethoate®. The use of cocktails at any given area and time was dependent on the availability of the insecticides. Unlike Owusu-Ansah et al. (2001), in which nearly a third of farmers surveyed used more than the recommended level and 10.9% reported using less, none of the farmers in this study used dosages below the recommended level whilst 25% used above the recommended level. This trend coupled with the exceeded dosages, may exert intense selection pressure on the insect populations thereby selecting for the more tolerant individuals and subsequently resulting in resistance development. Mixing of pesticides was encouraged by farmers desire to have rapid knockdown of pests (Ntow et al., 2006). According to Biney (2001), indiscriminate combination of insecticides on tomatoes may have contributed to the increase in insect pest infestation of tomato in Ghana.

The farmers had an adhoc culture of insecticide application. They were intolerable of insect numbers irrespective of how low they may be; hence spraying immediately they detect the presence of insects. They increased the frequency of insecticide application to minimize pest impact on yield and this is done without regard to pest status and critical time of infestation (Biney, 2001). A sizable proportion (40%) of the farmers took no precautions during insecticide application hence endangering their health. At greater risk are farmers who use brooms to apply/sprinkle insecticides since they are usually not safely clothed. In a study conducted by Horna et al., (2008), about 68.25% of farmers wore long sleeves, trousers or overall and nearly half (46.5%) wear boots, one quarter use gloves while wearing goggles is rare (11.8%). The knapsack was the most commonly used spraying equipment. In this study, it was observed that most of the spraying activities were done by young men and in about five instances teenagers of not more than 17 years were helping in spraying activities. Most of the farmers/people that undertook spraying activities were inadequately clothed (did not wear protective clothing).

Farmers complained about their inability to continue using 'effective' insecticides that they had hitherto been using because the suppliers had run out of stock. Cost of insecticides was a marginal reason, implying that provided they reap their money's worth in terms of good harvest (via effective pest control) and fair market prices; they are willing to make the requisite financial input.

Most farmers stored insecticides at home due to security concerns (Clarke, 2008). The storage

of insecticides in barns (10%) is a very disturbing trend since there is the possibility of them contaminating food stores. Storing insecticides in unlabelled, poorly/wrongly labeled and drink bottles may result in accidental poisoning (Clarke, 2008).

The sale of used insecticide containers is risky since none knows where they eventually end up and what they may be used for. Also associated with this is the use of empty insecticide containers for storage purposes. According to Williamson (2003), the re-use and resale of empty pesticide containers is a hazardous practice especially when they are used to store food and drinking water. Over 75% of poisoning cases recorded by PAN Africa partners in the cotton zones of Benin and Senegal have been the result of food and drink contamination (Williamson, 2003). Information on insect pest control practices was from years of cultivation, other farmers, GCC, extension officers and the media. There is the need to educate farmers who grow both vegetables and other cash crops to desist from using non-recommended insecticides on vegetables.

5. Conclusion

Management of insect pest through the use of synthetic insecticides is the norm among farmers in the areas surveyed. Though most farmers used the recommended dose rate, insecticide application frequency was high. The farmers engaged in hazardous storage and disposal methods of insecticides. Of worry is the sale of insecticide containers, since none knows where they eventually end up. The availability of perceived 'effective' insecticides could curtail the frequent change of insecticides. However, this could be a blessing in disguise since its absence results in rotation of insecticides use and may slow down the development of resistance. The concept of Integrated Pest Management (IPM) needs to be advanced to these farmers through the regular organization of Farmer Fields School since their major sources of insect pest management practices are from experience and other farmers. To prevent farmers from arbitrarily applying insecticides, there is the need to establish economic threshold limits to guide them in their spraying activities. Farmers must also be educated on the various classes of insecticides that they use so that they can make an informed decision when spraying.

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