Insecticide use pattern on tomatoes produced at Yonso community in the Sekyere West District of Ashanti Region, Ghana

A. O. DANQUAH, A. K. EKOR & S. ASUMING-BREMPONG
(A. O. D. & A. K. E.: Home Science Department, University of Ghana, Legon, Accra, Ghana; S. A.-B.: Soil Science Department, University of Ghana, Legon, Accra, Ghana)

ABSTRACT

The study investigated the farming practices of tomato growers that might lead to insecticidal contamination of tomato fruits produced. An interview guide was used to collect data from 100 tomato growers, selected using the snowball non-probability sampling technique, at Yonso in the Sekyere West District of the Ashanti Region. The data were collected on the type of insecticide used, the rate of insecticide used in the spray mixture, the sources of insecticides, and the waiting period allowed after last insecticide application and harvest. The chi-square test was used to establish whether there was any relationship between education and insecticide usage. The study showed that more males (82%) than females (18%) were into tomato cultivation, and that about 58 per cent of the respondents, who had attained secondary/technical level of education, used the recommended insecticides (Karate, Diazinon, and Sumithion) to produce tomatoes. Such insecticides are known to be less persistent on the fruit and, thus, could degrade easily. However, 42 per cent of them used insecticides not recommended for vegetables. These included Polytrine, Delphos, Thiodan, Thionex, Cypercal, Dursban, and Fastac. The non-recommended insecticides were the persistent ones that did not degrade easily and, thus, might leave residues on the crops harvested. The farmers applied the insecticides when they detected pests (52%), when the appearance of the plant changed (20%), when infestation was more pronounced (18%), and during transplant (10%). However, most respondents who used the recommended insecticides (69%) did not use the recommended dosage in the spray mixture, and some did not abide by the pre-harvest intervals. However, this study did not determine the rate of breakdown of the insecticides. The study also showed that respondents relied on information on the choice and usage of insecticides from sources, such as agro-chemical sellers (44%), fellow farmers (35%) and personal discretion (8%), other than from extension officers (13%) who were the experts in the field.

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Introduction

Tomato is a good source of vitamin A and a fair source of ascorbic acid, thiamin, riboflavin, minerals, carbohydrates, and fibre (Kochhar, 1986; Norman, 1992). It is a major vegetable crop in Ghana and is used in almost every home. Most people eat it raw as in salads, or cooked as in soups and stews. It is also processed into juice, puree, and ketchups. Oil is extracted from the seed for human consumption and the residual seed cake is used as animal feed (Anon., 1983). Owing to the various uses, the need is to produce tomato fruits free of insecticide residue contamination to prevent food poisoning.

The main tomato-growing areas in Ghana include the Northern and Upper regions, Southern Volta Region, Greater Accra Region, and Akumadan and Wenchi districts of Ashanti and Brong Ahafo, respectively (Norman, 1992). Notwithstanding the paucity of information on total production, the total area planted in 2002 was 26,700 ha. Ghana exported 4,539 and 4,961 tonnes of tomato in 2001 and 2002, respectively (FAO, 2004). Pests, for example, tomato fruit worm and pinworm, and diseases, such as tomato spotted wilt and tomato yellow leaf curl, pose big problems in vegetable production. It has been reported that soil-borne pathogens and foliage diseases are the major limiting factor in tomato production. These, if not controlled, affect crop yield. Thus, the control of pests concerning production of high cosmetic quality fruits has led to the high use of insecticides on vegetables compared to other food crops (Kumar, 1984; Chan, 2000).

Insecticides have been found to be the main weapon used in controlling insect pests in agricultural production to minimize losses caused by the insects (Kumar, 1984). In Ghana, pesticides have been used to control and eradicate crop pests and diseases in vegetables for several years (Clarke *et al*., 1997; Dinham, 2003; Ntow *et al.*, 2006). Insecticides have short and long persistent effects on crops when applied (Chichester, 1965). The persistent ones, which do not degrade easily, include insecticides in the organochlorine group such as Endosulfan with trade names such as Thiodan, Thionex and Gamalin 20. They are among the restricted insecticides used on crops such as cotton and cocoa. Small amounts of such insecticides may enter the root of a rapidly transpiring plant, and may move to accumulate in the edible parts of food crops. Endosulfan has been known to cause central nervous system hyperstimulation (Sood, Yadav & Sood, 1994).

The less persistent ones include Diazinon, Dimethoate, and Sumithion in the organophosphate group, and Karate in the pyrethroid group. The organic-based pyrethroids are relatively low in mammalian toxicity. Synthetic pyrethroids, such as Polytrine and Cypercal, have cypermethrin as the main active ingredient. Such insecticides seldom discriminate between useful insects and pests (Hassall, 1982). Some useful insects include beetles, spiders, centipedes, and predatory mites. Polytrine and Cypercal are not recommended as insecticides for vegetables in Ghana. Similarly, Dursban ULV contains chlorpyrifos as the active ingredient that poses health risk on children, and has the potential to bioaccumulate. The less persistent ones are mostly recommended for use on vegetables and other food crops, because they degrade relatively quickly (PPRSD-MOFA, 2000). These, though, have to be used correctly because organophosphorus compounds, sometimes called “nerve poisons”, are known to combine with and completely inactivate acetylcholinesterase, an enzyme that functions in the activity of the nervous system. From 2 weeks before harvest, only pyrethroid insecticides that degrade easily should be used to spray vegetables on the field (FAO, 1988). Ten days or more waiting period has been recommended for the organophosphorus insecticides.

Insecticide residues on and in food may arise as a result of indiscriminate use of insecticides to protect crops against pest infestation. If used excessively or at a date too close to harvest, the residual level may be above the accepted limits and possibly be hazardous to human health. Work done in some farming communities in the Ashanti Region has confirmed that pesticide residues are present in vegetables, water, sediments, and even breast milk (Osafo & Frimpong, 1998; Ntow, 2001). Dikshith *et al*. (1992) and Matthews, Wiles & Baleguel (2003) also reported organochlorine insecticide residues in vegetables in India and in Cameroon, respectively. Most residues exceeded the maximum residue limit for consumption. However, excess residue can be prevented by restricting the use of persistent insecticides and encouraging the use of less persistent ones, and also adhering to the proper waiting period between the last insecticide application and harvest of crop (Bull, 1982; Anon., 2000). Bull (1982) reported that Sri Lanka's Agricultural Research Institute preferred a general waiting period of 2 to 3 weeks after last insecticide application and harvest. The PPRSD-MOFA (2000) gave 3 to 7 days' waiting period for Karate, 10 days for Diazinon, and 1 to 3 weeks for Sumithion.

The tomato growers in Yonso, a farming community in the Sekyere West District of the Ashanti Region, think that insecticides make tomato fruits firmer and prolong the shelf life. As a result, insecticides are used indiscriminately. Reports elsewhere have shown that many deaths occur as a result of the intake of poisoned food caused by inappropriate use of insecticides on farm produce (Ton, Tovignan & Vodouche, 2000).

The study was, therefore, aimed at investigating the use of insecticides by tomato growers at Yonso by finding out the type of insecticides used, quantities of insecticides used in the spray mixture, and the waiting period between the last insecticide application and harvest. It is anticipated that the results would guide policy makers in designing programmes to educate farmers on the safe use of insecticides.

Materials and methods

Study area

Yonso is a farming community 5 km East of Jamasi in the Sekyere West District of Ashanti Region. Jamasi lies within latitude 6° 43' 60 N and longitude 1° 31' 60W with an altitude of 292 m. The inhabitants of Yonso are mainly tomato farmers, which serves as their major source of income. Other crops produced in the area include plantain, cocoyam, maize, and cassava. The tomatoes produced in the area are sold to market women who come from Accra, Kumasi, and the surrounding towns, including Jamasi and Mampong.

Study population and sampling technique

Data were collected from tomato growers at Yonso in the Sekyere West District of the Ashanti Region. All the inhabitants were farmers, so the snowball non-probability sampling technique was used to select 100 tomato growers, because it was difficult identifying those who cultivated tomato. By the technique, some tomato growers were identified with the help of the Agricultural Extension Officer who lived in the study area. While collecting data, respondents were asked to name other tomato growers, who were also contacted and interviewed. The process was repeated until the number of tomato growers was 100.

Method of data collection

An interview schedule, containing closed and open-ended questions, was used to collect the following information:

a) Background information such as sex, age, educational level, and hectares of land cultivated;
b) Types of insecticides used by the growers and why they were used;
c) Rate of insecticide used in the spray mixture;
d) Source of information on insecticide purchase;
e) Source of information on insecticide usage; and
f) Pre-harvest interval allowed between last insecticide application and harvest.

Using the interview, the interviewer was sure the respondent had understood the question and purpose of the research, and could probe further when particular responses were met.

Observational study

An observational study, using a checklist, was applied to 10 tomato growers on the field to determine the farming practices on insecticide usage during the growing period. To prevent farmers from changing their farming practices, they were not informed of the visit beforehand. The number was used because all the farmers seemed to use the same chemicals that were sold in the chemical store visited.

Data analysis

The data were analyzed using the SPSS (Version 10). Presentation of results was mainly descriptive, using tables where appropriate. The chi-square statistic, at 5 per cent level of significance, was used to test whether there was any relationship between educational level of farmers and insecticide usage.

Results and discussion

Background information

Out of the 100 respondents interviewed, 82 per cent were males while the remaining 18 per cent were females, indicating that more males than females were involved in cultivating tomato (Table 1). About 72 per cent were aged between 25 and 44, which showed that most were in the stage of early adulthood and, thus, energetic. Seventy-six per cent had gone beyond primary school to SSS, Technical or Commercial school; 13 per cent had gone to primary level, and 11 per cent had no formal education (Table 1). This showed that most respondents could read instructions printed on the insecticide package. Studies by Ellis *et al.* (1998) showed that tomato is cultivated mainly by male youth with basic educational background.

TABLE 1

Gender, Age and Educational Level of Respondents

Parameter	*Frequency*	*Percentage*
Gender		
Male	82	82
Female	18	18
Total	100	100
Age		
15-24	7	7
25-34	30	30
35-44	42	42
> 45	21	21
Total	100	100
Educational level		
No education	11	11
Primary	13	13
Middle/JSS	63	63
Secondary/Tech./Com.	13	13
Total	100	100

Hectares of land cultivated by respondents

Eighty-five per cent cultivated about ½ ha of land with 15 per cent cultivating about 1 ha (Table 2). The respondents claimed tomato cultivation was labour-intensive and, therefore, could manage such small-sized farms efficiently for a good harvest. On the average, each farmer had worked on a tomato farm for over 5 years.

Types of insecticide used

All the respondents indicated that they had always applied insecticides on their farms to control pests and diseases as done elsewhere (Ntow, 1998; Dinham, 2003; Ntow *et al.*, 2006). Fifty-two per cent of the farmers sprayed their farms when they detected pests, 20 per cent sprayed only when the plant changed in appearance, 18 per cent sprayed when the pest infestation was pronounced, and the rest sprayed when transplanting. Ntow *et al.* (2006) reported similar practices by vegetable growers in their

TABLE 2

Size of Land Cultivated (hectares)

Size (ha)	*Frequency*	*Percentage*
0.5	85	85
1.0	15	15
Total	100	100

study. Research has also shown that the number of pesticides used in agriculture has risen rapidly over the past decade (Hodgson, 2003).

In this study, the farmers used 10 different types of insecticides out of which three were recommended for use on tomatoes and the rest for plants like cotton and cocoa (Kumar, 1984; PPRSD-MOFA, 2000). In Ghana, 43 pesticides have been found to be used in vegetable cultivation (Ntow *et al*., 2006). Farmers usually use these chemicals on trial basis because most of them are unable to identify the exact pests that damage their crops. This study showed that although the farmers sprayed their farms, they had no idea about the type of pests or diseases they were fighting against or both. They thought that the insecticides would control any infestation and make the fruits firmer; thus, prolonging the shelf life as reported by Thomas (2003). Such a practice is not the best because they may be using the wrong chemical to fight these pests and diseases. Studies by Amoah *et al*. (2006) showed that farmers in the forest zones in the Ashanti, Brong Ahafo, Western, and Eastern regions of Ghana used more pesticides than farmers in the other regions.

Fifty-eight per cent of the respondents used the recommended insecticides for tomatoes, while 42 per cent used insecticides not recommended for tomatoes (Table 3). Those who used the persistent insecticides claimed they were cheaper and recommended by the chemical sellers. It was also observed that those insecticides were not registered for use on crops in Ghana, but might have been smuggled into the country from neighbouring countries.

TABLE 3

Insecticides Used by Respondents for Tomato Production

Insecticide	*Frequency*	*Percentage*
Recommended		
Karate	53	53
Sumithion	4	4
Diazinon	1	1
Not recommended		
Polytrine	24	24
Delphos	6	6
Thiodan	4	4
Cypercal	3	3
Thionex	2	2
Dursban ULV	2	2
Fastac	1	1
Total	100	100

Chi-square analysis showed a significant relationship between education and the use of recommended insecticides ($\chi^2 = 5.3$, df = 3, $P<0.05$). Most farmers who used the recommended insecticides (76%) had some form of education and could probably make better judgement. The recommended ones are less persistent and degrade easily on the tomato fruit. The use of persistent insecticides might lead to the production of tomato fruits contaminated with their residues that might not degrade at the time of harvest. Null & Savitri (1989) studied the use of pesticides on vegetables and found that farmers used pesticides that were not recommended for the target crops. Using dangerous insecticides on vegetables is likely to produce crops contaminated with insecticide residue (Anon., 2000). Studies have reported the detection of several pesticides in water, sediments, crops, and human fluids in a farming community in Ghana (Osafo & Frimpong, 1998; Ntow, 2001). Bakore, John & Batnagar (2002) also reported that some locally marketed vegetables in Jaipur City, Rajasthan in India, contained residues of organochlorine insecticides. Ton *et al*. (2000) reported that endosulfan used on vegetables resulted in several deaths of those who consumed such treated vegetables.

Rate of insecticide used in the spray mixture

The respondents used varying amounts of insecticide in the spray mixture (Tables 4 and 5). For spraying, most of them (85%) used a knapsack sprayer, mostly rented, while the rest used bundles of leaves. For those who used the recommended insecticides, 59 per cent used levels below the recommended dosage, while 31 per cent used the recommended dosage as prescribed by Ghana/CIDA Grains Development Project (1991) (Table 4). The rest used levels above the recommended dosage.

Null & Savitri (1989) reported that farmers used pesticide mixtures without realizing the possible consequences of mixing, and also sprayed insecticides in concentrations that were inadequate. The low dosage may be ineffective in controlling insects. Thus, farmers may continue to apply insecticides without allowing the breakdown of previous spray before subsequent ones, resulting in the build-up of insecticide residues on the fruits. This could also lead to developing resistant strains of pests. Again, it was realized that those with higher education used the recommended dosage. Bull (1982) reported that ineffective or excessive use of pesticides on crops led to residues being accumulated in and on food. Table 5 shows the levels of insecticides not recommended but used by respondents. Probably the use of these insecticides might result in producing fruits contaminated with insecticide residues that could be hazardous to health.

Source of information on insecticide purchased and dosage used

The results indicated that respondents relied on agro-chemical sellers (44%), fellow farmers (35%), Extension Officers (13%), and personal discretion (8%) for information on type of

TABLE 4

Dosage of Recommended Insecticides Used by Respondents in 15 l of Water

Dosage (ml)	*Frequency*	*Percentage*
Karate (50 g a.i/l)		
15-29	32	55
* 30-45	16	28
46-60	5	8
Sumilthion (500 g a.i/l)		
10	1	2
* 30	2	3
40	1	2
Diazinon (450 g a.i/l)		
10	1	2
* 15-30	0	0
Total	58	100

* Recommended dosages (Ghana/CIDA Grain Development Project, 1991)

TABLE 5

Dosage of Insecticides Not Recommended But Used by Respondents in 15 l of Water

Dosage (ml)	*Frequency*	*Percentage*
Polytrine (300 g a.i/l)		
5-20	10	23.8
30-50	14	33.3
Delphos (30 g a.i/l)		
5-20	6	14.3
Thiodan (35 g a.i/l)		
5-20	4	9.5
Cypercal (50 g a.i/l)		
5-20	3	7.1
Thionex (350 g a.i/l)		
5-20	1	2.4
30-50	1	2.4
Dursban ULV (450 g a.i/l)		
5-20	2	4.8
Fastac (300 g a.i/l)		
5-20	1	2.4
Total	42	100.0

insecticide purchased and amount used (Table 6). Most farmers (87%) relied on sources other than the Extension Officers who had more knowledge in the area. It was realized that those who sought information from the Extension Officers (13%) used the recommended insecticides. Tetteh (2001) found out that farmers who relied on other sources of information lacked the best advice on the type of insecticide used. About 96 per cent of respondents did not read the instructions on the insecticide package; either because they received information from other farmers, or bought insecticides that were not in the original containers. It was also observed that some instructions were written in languages other than English such as French, Chinese, and Arabic.

TABLE 6

Sources of Information on Insecticide Used by Respondents

Source of information	*Frequency*	*Percentage*
Agro-chemical sellers	44	44
Fellow farmers	35	35
Extension officers	13	13
Own discretion	8	8
Total	100	100

Pre-harvest interval (waiting period) allowed

Table 7 shows the number of days respondents allowed between last insecticide application and harvest. Most respondents who used the recommended insecticides maintained the required waiting period before harvesting fruits, as recommended by PPRSD-MOFA (2000). The PPRSD-MOFA (2000) recommended 3 to 7 days for Karate, 10 days for Diazinon, and 1 to 3 weeks for Sumithion. Bull (1982) stated that Sri Lanka's Agricultural Research Institute preferred general waiting period of 2 to 3 weeks for vegetables to be free of insecticide residues. Thus, the longer the days allowed, the safer the fruits for consumption. Those who used insecticides not recommended for vegetables used their own judgement on when to harvest their crops (Table 7). The withholding period might not have been long enough, indicating that the crops might be contaminated with insecticide residues. These persistent insecticides needed over 4 weeks to degrade. Tejada *et al.* (1995) reported that vegetables such as tomatoes harvested 3 to 5 days after insecticide application would have insecticide residues in them exceeding the maximum residue limits set by the Food and Agriculture Organization and World Health Organization. Ueno *et al.* (2000) detected pesticide residues in vegetables sold in the market in Japan. Gan, Chon-Yee & Yee (2000) used environmentally friendly conditions in producing pesticide-free vegetables in Malaysia, which need to be encouraged.

TABLE 7

Waiting Period Allowed by Respondents Before Harvest

Waiting period (days)		*Frequency*	*Percentage*
Recommended			
Karate	3-21	53	53
Sumithion	7	4	4
Diazinon	21	1	1
Not recommended			
Polytrine	3-21	24	24
Delphos	7-21	6	6
Thiodan	7-14	4	4
Thionex	7-14	2	2
Cypercal	5-7	3	3
Dursban ULV	7	2	2
Fastac	21	1	1
Total		100	100

Conclusion

The study showed that some tomato growers used insecticides not meant for vegetables in the production of their crops. Thus, they may not have adhered to the recommended dosage of insecticide in the spray mixture and the waiting period. Some farmers who used the recommended ones also did not adhere to the recommended dosage. Such practices may lead to the production of contaminated tomato fruits, which when consumed, may result in ill-health. Most respondents did not seek information from qualified Extension Officers. Further work is required to determine the rate of breakdown of the insecticides and the amount of insecticide residues on the tomatoes to find out whether it is within acceptable limits. Also, more education is recommended on the use of insecticides on vegetables.

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