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Title: Pesticide Use and Human Health in Northwestern Jamaica

Authors: Ncube, Ngqabutho[1]; **Bessler, Patricia** [2]; Jolly, Pauline, E.[3]; Tint, Kyaw[4]; Fogo, Christopher[5]; Binns, Alvin[6] and Jolly, Curtis, M.[7]

1.-3. Department of Epidemiology, University of Alabama at Birmingham, Birmingham, AL
4.-5. Westmoreland Health Department, Ministry of Health, Jamaica, West Indies
6. Cahaba Safeguard Administrator, Birmingham, Alabama
7. Department of Agricultural Economics and Rural Sociology, Auburn University, Auburn, AL

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PESTICIDE USE AND HUMAN HEALTH IN NORTHWESTERN JAMAICA

Ncube, Ngqabutho
Bessler, Patricia
Jolly, Pauline E.
Department of Epidemiology, University of Alabama at Birmingham, Birmingham, AL,

Tint, Kyaw
Fogo,Christopher
Westmoreland Health Department, Ministry of Health, Jamaica, West Indies,

Binns, Alvin
Cahaba Safeguard Administrator, Birmingham Alabama

Jolly, Curtis M.
Department of Agricultural Economics and Rural Sociology, Auburn University, Auburn, AL

ABSTRACT

A number of studies have detected high levels of pesticide residues in surface water and aquatic life in Jamaica and acute pesticide poisoning is believed to be widespread there. Despite efforts by the Jamaican government to create awareness of the dangers of pesticides and adopt safe a pesticide disposal method, many farmers still display poor pesticide handling and disposal practices. The objectives of this study were to 1) describe pesticide use by farmers in northwestern Jamaica including inappropriate methods in pesticides handling and disposal, and 2) determine whether farmers' perception of the mode of bodily entry of pesticides affects their method of disposal. Farmers in Westmoreland, St. James and Hanover were surveyed using an investigator-administered instrument. Although 96% of farmers had some form of formal education, 75% had received no training in the use of pesticides. Only about 15% thought that crop yields and quality could be maintained without the use of pesticides. Only 29% believed that pesticide use posed a health risk, while 91% thought that pesticide use was an environmental hazard. Less than 45% of farmers used safety gear (gloves, masks, goggles) in handling pesticides although 65% always used special clothing. A fair proportion of farmers burn, bury or dump unused pesticide or empty pesticide containers in the bushes. Farmers' disposal methods were influenced by their perception of the ways that pesticides enter the human body. Thus, a large percentage of farmers in these parishes use pesticides inappropriately and are exposed to pesticides in handling. Disposal of unused pesticides and empty pesticide containers pollute the environment and most likely expose others. Measures should be taken to educate farmers, to provide protective gear at an affordable price, and to implement a clear and consistent method for collection of unused pesticide and empty pesticide containers.

Keywords: Pesticide poisoning, Jamaica, Human health

INTRODUCTION

Pesticides are synthetic or organic poisons used to exterminate specific organisms by inhibiting certain vital functions (USEPA, 2007). They are applied predominantly to kill or control weeds, insect pests, nematodes, fungi and other organisms that attack agricultural plants and animals. An estimated 99% of human pesticide fatalities occur in developing countries, although these countries account for only 20 to 30% of pesticide use (WHO 1990; Wesseling et al. 1997; Dinham1993). In 1986 the World Health Organization (WHO) estimated that there were about one million cases of pesticide poisoning occurring annually. In Jamaica, a number of studies have detected high levels of residues of the organochlorine pesticide Endosulfan, used across the island to eradicate coffee pests, in

surface water and aquatic life (Robinson and Mansingh, 1999; Witter, et al., 1999). Detection of insecticide residues have been found in 14 of 17 rivers, 4 of 7 natural springs, and 8 of 13 wells in Jamaica in a study conducted by Robinson and Mansingh (1999). Besides endosulfan, residues of other pesticides such as DDT, aldrin, endrin and di-eldrin, which were used in the Rio Cobre Basin a few decades ago, have been detected in coastal waters and sediment of Kingston Harbour (Mansingh and Wilson, 1995). Diazinon from banana sprays has been also found in watersheds and the Wagwater River after rain falls.

Endosulfan has caused chronic and/acute toxicity to aquatic fauna. Lawrence et al., (1968a,b) have shown that dieldrin significantly affected the metabolic physiology of two species of shrimps found in Jamaican rivers. Nematicides used in Central America have been reported to cause of sterility in men (Pickering 2002). Studies have also shown a link between a variety of reproductive health problems such as increased incidence of miscarriages, stillbirths and delayed pregnancy among women agricultural workers and wives of men employed in pesticide mixing and spraying (Schettler, 2003). There is also evidence of increased risk of birth defects from parental exposure to pesticides, although the extent of this risk is uncertain (Dinham and Malik, 2003). Specific herbicides, such as 2,4-D and 2,4,5-T, disrupt estrogen cycles in women and can cause menstrual-cycle problems in animals (Ransom, 2002). Carbamate and organophosphate insecticides have been reported to increase premature birth and spontaneous abortion rates (Schettler, 2003). Other pesticides such as aldrin, dieldrin, chlordane and toxaphene can also disrupt reproductive hormonal cycles (Bretveld et al. 2006). Other recorded health effects from research with women in the field include acute effects such as dizziness, muscular pain, sneezing, itching, skin burns, blisters, difficulty breathing, nausea, changing nail colour and sore eyes (Ernst, 1998).

During application, pesticides enter the bodies of humans and other animals mainly through the oral, dermal or respiratory routes. Oral exposure occurs from ingestion of food, water or soil containing pesticides. Smoking can also transfer pesticide on the hands to the mouth resulting in oral exposure. Inhalation exposure can occur by breathing air containing pesticides as vapor, aerosol or on small particles (dust). Dermal exposure occurs when the skin comes into contact with pesticides. Protective eye wear, clothing, gloves and boots can prevent exposure to the eyes and other parts of the body when farmers mix or apply pesticides.

Schlosser (1999) reported that acute pesticide poisoning is widespread in Jamaica. The Jamaican government, in collaboration with international organizations, established "Pesticide Awareness Week" in 1999. The government uses this programme to provide the public with information on the dangers of pesticides and safe handling and storage of pesticide. The government has also collaborated with the Food and Agriculture Organization (FAO) in adopting safe pesticide disposal. Yet many farmers, especially the very poor, still do not comprehend the effects of poor pesticide handling on human health and the general effects on the environment. In this study we examined the pesticide handling and disposal practices by farmers in the northwestern region of Jamaica on human health and the environment.

OBJECTIVES:

The goals of the study were to examine the use of pesticides by Jamaican farmers in order to determine the extent of inappropriate use and its effects on human health, and to make recommendations for improved pesticide handling to minimize harmful health and environmental effects. The specific objectives were:

1. Describe the use (appropriate or inappropriate) of pesticides by farmers in northwestern Jamaica, and summarize inappropriate methods used in handling pesticides.
2. Evaluate the safety measures used by farmers to minimize health risks and environmental damage through pesticide use.
3. Determine whether perception of mode of bodily entry of pesticides affect the method of disposal of pesticides and pesticide containers.

METHODS

Location and Participation

The study was conducted in the parishes of Westmoreland, St. James and Hanover in northwestern Jamaica from June to August, 2006. Farm households were sampled. The sample was chosen based on those who agreed

to be interviewed and who declared that they used pesticides on their farms. Potential participants were defined as adults age 19 years and older who owned or managed a farm in the three parishes. The purpose of the study was explained to them and they were asked to voluntarily participate. Those who volunteered were asked to read and sign the informed consent form. If the potential participants were unable to read the consent form, the form was read to them by a member of the participating farm household, or a neighbour, and farmers were asked to make an X or give a thumb print indicating their consent. The Institutional Review Board (IRB) of the University of Alabama at Birmingham, the Advisory Panel on Ethics and Medico-Legal Affairs in the Ministry of Health, Jamaica, and the Western Regional Health Authority of Jamaica approved the study protocol prior to its implementation.

Sample Size

According to records from the different Parishes, there are approximately 5,000 farms in the Parish of St. James, 9,000 farms in the Parish of Westmoreland and 5,500 farms in the Parish of Hanover, giving a total of 19,500 farms that met the guidelines for participation in this study. However, there were no available data on the number of farmers who inappropriately use pesticides. Using Statcalc (Epi Info version 6) software, we assumed a worst-case scenario of 50% appropriate pesticide use. Therefore, based on a 95% confidence interval and a 5% margin of error, a sample size of 377 farmers was required for a population survey.

Data Collection

Following enrollment in the study, data were collected from participant surveys. Participant views were assessed utilizing an interviewer-administered questionnaire. The questionnaire covered the following topics: demographics; farm information including size, type of crops grown and purpose of crop (home consumption, local consumption or export); pesticide knowledge; pesticide application and storage practices; and pesticide-related illnesses and deaths among family members and farm workers.

Data entry and analysis: A trainee from the Minority Health International Research and Training (MHIRT) programme of the University of Alabama at Birmingham developed a data entry frame before leaving for the research site. This frame was used to enter the data at the end of each day or week after the completed survey instruments were reviewed. The data were cleaned and summary data analyses were conducted at the end of each month while the MHIRT trainee was on the field. Descriptive statistics were obtained using the statistical analytical system (SAS) programming software. Regression analysis was used to develop maximum likelihood logistic models to evaluate the factors influencing the different ways farmers disposed of the empty pesticide containers.

RESULTS

Socio-demographic characteristics of farmers

More than half of the farmers surveyed (54%) were over 50 years and 32% were = 60 years. Most farmers (96%) were literate or received some level of schooling. Of the 359 farmers interviewed only 4.0% indicated that they had no formal education, 25.1% had completed primary school, and 31.7% had some secondary or post-secondary type of education (Table 1). About 75.2% of farmers reported that they had not received any training in pesticide use or safety. Of those interviewed 94% were farm owners and about 80% had more than 10 years of farming experience. The farms operated were generally small, with 29% being less than 0.4 hectares in size, 23% were between 0.4 and 1.2 hectares and 49% were more than 1.2 hectares, but less than 4 hectares.

Pesticide use by farmers and equipment used for pesticide application

Majority of farmers stated that they used pesticides to improve the yield (85.2%), and quality (84.7%) of their crops. Farmers believed that pesticides were essential for the maintenance of crop yields and quality. About 14.7% of farmers thought that the crop yield would remain the same if they abandoned or did not use pesticide while 15.3% thought that they could maintain the same crop quality without the use of pesticides.

The pesticides used by farmers included a wide range of World Health Organization (WHO) class II (moderately hazardous) pesticides (Table 2). Paraquat was the pesticide used by the largest percentage of farmers (84.1%). Paraquat is sold under various trade names, the main product lines are Gramoxone and Diquat bromide. Glyphosate (33.98%) and 2,4D (18.1%) were also commonly used herbicides.

Slightly more than a quarter (29%) of the farmers believed that pesticides used by Jamaican farmers pose a health risk, and 91% thought that pesticides polluted the environment and entered the water supply down stream.

The most commonly used equipment for the application of pesticides was the backpack sprayer (Table 3). About 85 percent of farmers indicated that they used the backpack sprayer to apply pesticides. The second most commonly used equipment for pesticide application was the hand held sprayer (34%). Small percentages of farmers also used the band sprayer (1.72%), mist blower or fogger (3.6%) or the dust applicator (0.3%).

Safety gear used and precautions taken in pesticide application

Less than half of the farmers said they always used safety gear such as gloves (44.3%), masks (43.2%), and goggles (32.0%) when handling pesticides (Table 4). Most of the pesticides were stored in separate storehouses. The majority of farmers (94.7%) said that they did not use agricultural pesticides in the house to kill pests. Only 5.3% stated that they used agricultural pesticides against house pests. About 79% of farmers said they changed their clothes immediately after applying pesticides, while 91 % said they always bathed after applying pesticides (Table 4). Approximately 65% of farmers indicated that they always used special clothing or covering, 18.4% said they sometimes used special clothing or covering and 17% said they never used special clothing or covering when they apply pesticides. Ninety one percent reported that they always used special tools for mixing pesticides (Table 4).

Pesticide disposal

The methods used by farmers for disposal of pesticide containers are not recommended by government officials of Jamaica; 49% burn, 26% bury, and 18% dump the containers in the bushes. A backward stepwise logistic regression model was used to determine the factors influencing the methods employed by farmers for disposal of pesticide containers. Farmers' disposal of their pesticides containers were influenced by socio-demographic factors as well as by their perception of methods of pesticide entry into the human body (Table 5). If farmers read the instructions on the label they were 0.48 times less likely to burn pesticide containers. If they did not read the instructions they were 2.07 times more likely to burn the empty pesticide containers. If farmers believed that pesticide entered the body through the palm of the hands and read the instruction on the pesticide container they were 2.17 times more likely to dispose of pesticide containers by burning. However, if farmers stated that pesticides entered the body through the eyes and palm of the hand they were 0.44 times likely to burn empty pesticide containers. If farmers believed that it was true that pesticides entered the body through the mouth they were 3.7 times more likely to burn pesticide containers. Farmers were also 2.78 times more likely to burn containers if they were aware of "pesticide awareness week." If farmers believed that pesticide runoff pollutes the environment they were also 4.06 times more likely to burn empty pesticide containers. They were, however, 0.8 times less likely to burn their empty containers if they had some level of education and at the same time were aware of "pesticide awareness week". Farmers who believed that pesticides entered the body through the eyes and that pesticide runoff resulted in pollution were 2.14 times more likely to burn their empty pesticide containers (Table 5). Farmers who had some degree of education and believed that runoff of pesticide caused pollution were 0.60 less likely to burn their empty pesticide container.

Several factors influenced whether the farmers buried their empty pesticide containers. These were: 1) whether they thought that pesticides could enter their bodies through the skin, eyes and palm; 2) the interaction between whether farmers read the label instructions and their belief that pesticides enter the body through the skin; 3) farmers' level of education; 4) the interaction between level of education and the belief that pesticide enter the body through the eyes; 5) the interaction between education, pesticide awareness week; and whether farmers read the instruction on the label of the container, and 6) farmers' belief that pesticide run-off will cause them to become sick (Table 6). Farmers were 2.28 times more likely to bury empty pesticide containers if they believed that the pesticide entered the body through the skin. However, if they read the instructions and believed that pesticide entered the body through the skin they were 0.49 times less likely to bury empty pesticide containers. If farmers believed that pesticides enter the body through the eyes they were 24.7 times more likely to bury empty pesticide containers. Farmers who believed that pesticides enter the body through the palms and eyes were 2.1 times more likely to bury empty

pesticide containers. They were also 1.72 times more likely to bury empty containers if they had a high level of education. Those farmers who had some education and believed that pesticides enter the body through the eyes were 0.48 times less likely to bury the empty pesticide containers. Farmers were 1.52 times more likely to bury their containers if they were aware of "pesticide awareness week" and if they read the instructions on the pesticide label. If farmers believed that pesticide runoff could result in sickness they were 0.51 times less likely to bury the empty pesticide containers. Farmers were 0.49 times less likely to throw empty pesticide containers in the bushes if they read the instructions on the pesticide label and at the same time believed that pesticides entered the body through breathing. Farmers were also 0.43 times less likely to throw the empty pesticide containers in the bushes if they believed that pesticides enter the body through the mouth (Table 7).

DISCUSSION AND CONCLUSION

Farmers in Jamaica have grown dependent on the use of pesticides to maintain crop yields and a high quality of output. Though only 29% of the farmers reported that they did not believe that the use of pesticide polluted ground water, studies by Mansingh and Wilson (1995) indicated that there was run-off from heavy use of pesticides from coffee and banana plantations. A study on pesticide mobility on a hillside soil in St. Lucia found that two pesticides leached down to 0.4m in the soil. The study concluded that leaching of these pesticides may, in some circumstances, pollute surface and groundwater (McDonald et al, 1999). Though the farmers were generally well educated (~ 96% had received some primary school education or higher) compared to farmers in other developing countries such as Haiti where over 55% of the farmers had no formal education (Bayard, Jolly and Shannon, 2007), only a few had received training in pesticide handling. A study conducted in St. Lucia found that only about half of pesticide users had received more than "introductory" training in safe pesticide use (McDougall et al, 1993). This is of significance since a large percent of the chemicals used are considered highly toxic and dangerous to human health by the WHO and some of them are banned in the USA.

Only a small percentage of farmers had adequately protected themselves from toxic exposure to pesticides. The percent of farmers wearing masks, gloves and protective eyewear ranged from only 21-44 percent. Similar observations were made by Schlosser (1999) in an earlier study in Jamaica. Over 60% of pesticide users in St. Lucia reported that they never wore protective clothing when handing pesticides (McDougall et al, 1993).

The disposal of the empty pesticide containers was a problem to farmers. It is recommended that unused pesticide and containers be presented to the Pesticides Control Authority (PCA) for safe disposal (PCA Annual Report, 1999). Collecting empty pesticide containers from farmers in remote locations is costly and requires consistency by the PCA. To be more feasible, the programme could require collection of empty pesticide containers from farmers at participating pesticide retailers and pick-up by the PCA. The retailers would need to be provided with safe storage facilities for unused pesticides and empty pesticide containers until they are collected by the PCA.

A much higher percentage of farmers burned empty pesticide containers (49%) than the percentages who buried them (26%) or who just threw them in the bushes (18%). A number of farmers did not believe that the disposal of the containers was a health hazard. The disposal of the containers was associated to the farmers' belief of the way in which pesticides could enter their bodies and poison them. For instance, if the farmers believed that pesticides could enter the body through breathing they would be less prone to burn the empty containers. If the farmers believed that pesticides could enter the body orally, they were less prone to throw the empty containers in the bushes where there would be seepage to the water supply. Most farmers were aware of the modes of entry of pesticides into their system. The study conducted in St. Lucia found that many pesticide users were unaware that pesticides could be absorbed into the human body through the skin and eyes (McDougall et al, 1993).

The paper brings to light the problem faced by Jamaican farmers in the use and disposal of pesticides. Farmers are dependent on pesticides for improved crop quality and yield, but face health risks and environmental damage through improper pesticide handling and disposal practices. Farmers are aware of the dangers but need more training in the handling of pesticides. Policy makers should be aware of this problem and use the public media to educate the

population regarding safe practices. Government should take measures to make available protective gear and equipment to these farmers at an affordable price since most are not taking these precautionary measures. Most of all, a clear, safe, and consistent method of collection of unused pesticides and empty pesticide containers needs to be implemented in order to prevent current unsafe disposal practices.

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Table 1: Sociodemographic Characteristics of Farmers Surveyed (n=359) in Western Jamaica in 2006.

Characteristics	Number	Percentage
Parish		
Westmoreland	137	38.2
Hanover	64	17.8
St. James	158	44.0
Gender		
Male	312	86.9
Female	47	13.1
Age		
20-39	78	24.8
40-49	61	19.4
50-59	73	23.3
60-69	59	18.8
70-85	43	13.7
Education		
None	14	4.0
Some primary school	137	39.1
Completed primary school	88	25.1
Some secondary school	48	13.7
Completed secondary school	58	16.6
Post-secondary	5	1.4
Your Title		
Farm owner	337	94.1
Farm manager	4	1.1
Farm worker	17	4.8
Years of Experience in farming		
1 to 9	60	18.7
10 to 19	65	20.3
20 to 29	67	20.9
30 to 39	54	16.8
40 or more	75	23.7

Table 2: Pesticides Commonly Used by Farmers in Western Jamaica, 2006.

Pesticide	Chemical Family	WHO Hazard Class*	Type of Use	% of all pesticides
Methomyl	Carbamate	1b	Insecticide	0.8
DDVP	Organophosphates	1b	Insecticide	0.3
Paraquat	Bipyridiliums	2	Herbicide	84.1
2,4 D	Chlorophenoxy	2	Herbicide	18.1
Ioxynil	Hydroxybenzonitrile	2	Herbicide	4.2
Esgram	Bipyridiliums	2	Herbicide	0.3
Carbaryl	Carbamate	2	Insecticide	1.4
Cyhalothrin	Pyrethroids	2	Insecticide	12.5
Deltamethrin	Pyrethroids	2	Insecticide	4.7
Diazinon	Organophosphate	2	Insecticide	1.4
Fenpropathrin	Pyrethroids	2	Insecticide	0.3
Ametryin	Triazine	3	Herbicide	5.6
Malathion	Organophosphate	3	Insecticide	0.3
Copper hydroxide	Copper compounds	3	Fungicide	2.0
Mancozeb	Carbamate	U	Fungicide	0.8
Glyphosate	Unidentified	U	Herbicide	34.0
Terbutryn	Unidentified	U	Herbicide	2.2
Diafenthiuron	Unidentified	U	Insecticide	1.4
Diuron	Unidentified	U	Herbicide	0.3

*The WHO hazard classification refers to the formulated chemical products.
1a = extremely hazardous, 1b = highly hazardous, 2 = moderately hazardous, 3 = slightly hazardous, U= unlikely to present acute serious hazard in normal use.

Table 3: Equipment Used for Applying Pesticide by Farmers in Western Jamaica, 2006.

Do you use the following equipment?	Number	Percentage
Use backpack sprayer	304	84.7
Use the hand-held sprayer	123	34.3
Use mist blower or fogger	13	3.6
Use band sprayer	6	1.7
Use duster applicator	1	0.3
Use gas canister	0	0
Use pretreated seed	0	0

Table 4: Protection Measures Taken by Farmers in Western Jamaica against Pesticide Exposure.

Questions	Always	Sometimes	Never	Always	Sometimes	Never
	Number			Percentage		
Do you wear special clothing or covering when applying pesticides (no other use)?	233	66	60	64.9	18.4	16.7
Do you wear a mask/respirator when handling pesticides?	155	97	107	43.2	27.0	29.8
Do you use protective eyewear when applying pesticides?	115	81	163	21.0	22.6	45.4
Do you always wear special shoes (no other use) when applying pesticides?	322	13	24	89.7	10.3	6.7
Do you use special tools (no other use) to mix and apply pesticides?	328	16	15	91.4	4.5	4.2
Do you wear gloves when you apply pesticides?	159	117	83	44.3	35.6	23.1
	Yes		No	Yes		No
	Number			Percentage		
Do you change your clothes immediately after applying pesticides?	283		76	78.8		21.2
Have you ever used crop pesticides in the house to kill pests?	19		340	5.3		94.7
Do you always bathe after applying pesticides?	328		31	91.4		8.6

Table 5: Factors Influencing Whether Farmers Disposed of Pesticide Containers by Burning.

Parameter			DF	Estimate	Standard Error	Wald Chi-Square	OR	Pr > ChiSq
Intercept			1	-0.9695	0.8910	1.1842		0.2765
Instruct2	1		1	-0.7278*	0.2862	6.4649	0.48	0.0110
Eyes	T		1	-0.2052	0.4033	0.2588		0.6109
Palm	T		1	0.3139	0.2786	1.2689		0.2600
Instruct2*Palm	1	T	1	0.7754*	0.2886	7.2207	2.17	0.0072
Eyes*Palm	T	T	1	-0.8109*	0.3558	5.1944	0.44	0.0227
Mouth	T		1	1.3079*	0.4548	8.2722	3.70	0.0040
Education			1	0.3162	0.2300	1.8902		0.1692
Pestweek	1		1	1.0241*	0.4493	5.1963	2.78	0.0226
Education*pestweek	1		1	-0.2173*	0.1038	4.3813	0.80	0.0363
Pollute_runoff	1		1	1.4013**	0.8501	2.7172	4.06	0.0993
Eyes*Pollute_runoff	T	1	1	0.7588*	0.3472	4.7775	2.14	0.0288
Education*Pollute_ru	1		1	-0.5055*	0.2301	4.8263	0.60	0.0280

*Significant at p=0.05
**Significant at p=0.01
OR = odds ratio; T = true; Instruct2=farmers read the instructions; pestweek=farmers have heard about pesticide awareness week; Pollute_runoff=farmers believe that runoff of pesticide cause sickness.

Table 6: Factors Influencing Whether Farmers Disposed of Pesticide Containers by Burying

Parameter			DF	Estimate	Standard Error	Wald Chi-Square	OR	Pr > ChiSq
Intercept			1	-3.1063*	1.2797	5.8920		0.0152
Instruct2	1		1	0.3411	0.2762	1.5249		0.2169
Skin	T		1	0.8265*	0.3208	6.6381	2.28	0.0100
Instruct2*Skin	1	T	1	-0.7037*	0.2797	6.3312	0.49	0.0119
Eyes	T		1	3.2082*	1.2363	6.7347	24.73	0.0095
Palm	T		1	-0.3938	0.3667	1.1536		0.2828
Eyes*Palm	T	T	1	0.7200*	0.3524	4.1735	2.05	0.0411
Education			1	0.5399*	0.2763	3.8168	1.72	0.0507
Education*Eyes	T		1	-0.7420*	0.2783	7.1077	0.48	0.0077
Pestweek	1		1	-0.1422	0.1656	0.7379		0.3903
Instruct2*pestweek	1	1	1	0.4150*	0.1660	6.2476	1.51	0.0124
Sick_runoff	1		1	-0.6479*	0.2723	5.6606	0.52	0.0173

*Significant at p=0.05
OR = odds ratio; T = true; Instruct2=farmers read the instructions; pestweek=farmers have heard about “pest awareness week; Sick_runoff=farmers believe that pesticide run-off cause sickness.

Table 7: Factors Influencing Whether Farmers in Disposed of their Pesticide Containers by Throwing Them in the Bushes

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	OR	Pr > ChiSq
Intercept		1	-0.1032	0.3319	0.0966		0.7559
Instruct2	1	1	0.1650	0.2905	0.3226		0.5701
Breathe	T	1	-0.0455	0.3000	0.0230		0.8795
Instruct2*Breathe	1 T	1	-0.7180*	0.2910	6.0875	0.49	0.0136
Mouth	T	1	-0.8346*	0.2985	7.8157	0.43	0.0052

*Significant at p=0.05
OR = odds ratio; T = true; Instruct2=farmers read the instructions