PESTICIDE HANDLING AND ASSOCIATED HEALTH RISKS AMONG AGROCHEMICAL RETAILERS IN OSUN STATE, NIGERIA

[1]Mosudi B. Sosan, [1]Olufunmilayo Oni and [2]Dayo O. Folorunso

[1]Department of Crop Production and Protection, Obafemi Awolowo University, Ile-Ife, Nigeria.

[2]Entomology Division,

Nigeria Agricultural Quarantine Service, P.M.B. 12026, Lagos, Nigeria.

ABSTRACT

This paper assessed the knowledge, attitude and practice (KAP) of agrochemical retailers with respect to pesticides handling and practices that might potentially expose them to chemical hazards in Osun State, Nigeria. Using a purposive sampling procedure, structured questionnaire was used to collect quantitative information from selected agrochemical retailers and this was supplemented with oral interviews. Information collected included the respondents' background, training and experience in agrochemical trade, their perceived awareness on the hazardous nature of products they sell and health complaints and symptoms of exposure experienced.

Results show that majority (71%) of the respondents were in the age range of 20-39 years. Pesticides of different brands including organochlorines, organophosphates, carbamates, pyrethroids and fumigants were stocked for sale by the retailers with herbicides being the most highly demanded (50%), followed by insecticides (31%). Most of the retailers had never attended training on pesticide handling and management and about half claimed to have experienced unusual health feelings since they were into the business. Various symptoms experienced by some of the retailers included feeling dizzy or dazed (33%), severe headache (26%), feeling weak (23%), nausea (20%) restlessness (20%) among others are all indicators of possible poisoning due to exposure to organophosphate pesticides.

Findings from this study show that retailers were likely to have been exposed to pesticide mainly through inhalation as a result of continuous exposure to these chemicals in the course of running their businesses. Being an important link in pesticide distribution chain, it is suggested that the existing legislation on pesticide registration in Nigeria should be enforced and regular training of the retailers on pesticide handling and management by chemical companies should also be emphasized and monitored. Regular biological monitoring studies to ascertain the exposure level and possible health effects on the retailers should be given great attention.

Key words: Pesticides, agrochemical retailers, exposure, occupational hazards

INTRODUCTION

In Nigeria, agriculture is essentially confined to rural areas, providing revenue for rural farm households and agricultural field workers. In order to maintain or improve crop yield on both small and large scale farms, agrochemicals were introduced, adopted and extensively used. Despite the fact that pesticide applications minimize potential crop yield losses due to pests, they may also pose potential hazards to human health when handled inappropriately (Ajayi and Akinnifesi, 2007). According to Food and Agricultural Organization of the United Nations (FAO, 2010), the cost of pesticide importation in Nigeria was estimated to have risen steadily from about 28 million dollars in 2003 to 82 million dollars in 2008 with insecticides, herbicides and fungicides constituting the major pesticide imported. Pesticdes are mainly sourced through retail markets in many developing countries and hence access is uncontrollable with associated adverse health effects derived from chronic exposure such as immuotoxicity, neurotoxicity, carcinogenesis, endocrine alterations and adverse effects on reproductive health (Maroni & Fait 1993; Sultatos, 1994; Alvanja et al., 2004; Colborn, 2006; Blanco-Munoz et al., 2010).

In Nigeria, the distribution of pesticides for agricultural purposes is mainly through the retail shops and this makes such retailers and shopkeepers exposed to mixture of pesticides. The exposure to toxic pesticides on a continuous basis for many years have been reported to often lead to adverse health conditions in pesticide retailers (Dasgupta et al., 2005). Pesticide retail shops that market insecticides, herbicides, fungicides, nematicides, rodenticides and acaricides are domiciled in the urban areas and cater for the growing demand of rural farmers and other urban population for both farm and household use. Unfortunately, the retailers, who themselves might not be educated on the health and environmental risks of pesticides are regarded as important sources of information on the potential health risks of pesticides to farmers particularly in developing countries where access to such information may often be concentrated in relatively few hands (Crissman et al., 1994; Dung and Dung, 2003; Dasgupta et al., 2005). The information on potential health hazards is important for use and safe handling of pesticides for both farmers and retailers, who without a sufficient understanding of the risks involved, may not take appropriate protective measures, leading most likely to unfavourable outcome, including death (Pimental et al., 1992)

Most studies on pesticides handling and usage have not taken into consideration the knowledge and attitude of the agrochemical retailers that serve as link between the chemical companies and their customers. Rather, the focus has been on the end-users who are mostly farmers. This study was therefore designed to assess the knowledge, attitude and practice of agrochemical retailers in Osun State, Nigeria with respect to pesticides handling, exposure and the associated health risks

Materials and Methods

The study was conducted between March and August, 2007. A purposive sampling based on the ready availability of the agrochemical retailers was used in selecting the respondents. The selected towns were also known to be purely agrarian, with the concentration of large volume of agrochemicals retailing. These towns were Ile-Ife, Modakeke, Iwo, Ilobu, Ikirun, Ilesa, Osogbo, Ede and Ejigbo in Osun state, southwestern Nigeria A structured questionnaire was used to collect quantitative data from the retailers and supplemented with oral interviews. The questionnaire was administered to respondents who were either shop owners or store managers/clerks in agrochemicals shops who agreed to respond honestly and as accurate as possible.

The survey sought information related to respondents background for example, location, age, education, and marital status; training and experience in agrochemical trade and viability of the business; sources, types and methods of transportation and storage; information on the awareness of the hazardous nature of products they were selling; health complaints and symptoms of exposure experienced in the course of the business. The questions were presented in a multiple-choice format for the respondents to give the appropriate answer or multiple answers as applicable. Table 1 shows the distribution of questionnaire administered and vendors that responded in the Local Government Areas (LGAs) and the towns surveyed. Data from the questionnaire were coded and fed into SAS Software, 2008 statistical package and analyzed using descriptive statistical analysis including frequency distribution, percentages, means, and

Results

Table 2 shows the demographic information of agrochemical retailers. Majority (71%) of the respondents were in the age range of 20 and 39 years. Only 10% were 50 years and above. Approximately 64% of the retailers/shopkeepers had secondary education while 26% possessed a post-secondary educational qualification. More than half (62%) of the respondents were males and about 67% were married. Only 15% had been in the agrochemical business for >20 years while 28% had been in the business for between five and nine years.

The training and experience in agrochemical business and usage by the retailers and shopkeepers are shown in Table 3. Sixty-one percent of the respondents had formal training in pesticide handling while majority (72%) agreed that the business is highly economically viable. Only 25% indicated that they had ever attended training workshop on agrochemicals usage and 16% of those in this category did occasionally while 7% did attend on yearly basis. Almost all the respondents (92%) indicated that they always read pesticide labels which they considered very useful.

The data on sources, types and methods of transportation and storage of pesticides by agrochemical retailers are presented in Table 4. Majority of the retailers source their stock from the distributors (82%) while 25% procure their stock through pesticide company sales agents and 3% sourced directly from the pesticide companies. Sixty-two percent of the respondent indicated that new pesticide are introduced into the market yearly and 13% indicated that new pesticides are introduced occasionally. Majority (86%) identify various categories of pesticides mainly through the pesticide label that contains detail information about the pesticide. More than half (58%) of the respondents packed their stocks separately during transportation and about 41% packed them in their booths with other items. Only 3% transported their pesticide stock in the same vehicle with food items. More than half (54%) of the respondents stored pesticide on shelf in shops while 39% stored them in separate stores. About 12% stored pesticides in their shop with other items. Almost all (93%) indicated that they sold pesticide to customers in original form (as supplied by the manufacturer) while 61% also dispensed these chemicals into small containers.

Table 5 shows the awareness of the hazardous nature of pesticide and other probable indicative factors of exposure by the respondents. Almost all (95%) of the respondents were aware of the hazardous nature of the products they sold. Also, the majority (85%) were aware that the products could cause adverse health problems. Less than half (33%) indicated that they had experienced pesticide spillage in the course of their business while about 20% experienced it often. Twenty-six percent did wash hands with soap and water immediately they had any spillage while only 5% washed immediately with water. About 26% of the respondents have had unusual feeling since in the business and the

symptoms experienced by them include feeling dizzy/dazed (33%), severe headache (26%), feeling weak or unnecessarily tired (23%). Excessive sweating was only experienced by 2% of the respondents.

The data on the advisory role being played by the retailers to their customers are presented in Table 6. Majority (87%) indicated that they do usually give talks to their customers on how best to handle the products being sold to them. While about 59% of the retailers do this every time the customers come for purchase, only 15% do this when requested by the customer. When new pesticide products are being introduced to the market, 13% of retailers claimed that they do educate the customers on the use, handling and hazardous effects.

Table 7 shows the pesticide inventory of some of the agrochemical shops. The insecticide groups comprised organochlorines, organophosphates and pyrethroids. Endosulfan with trade name Endocel© or Endocot© was the only organochlorine insecticide available in most of the shops. The organophosphates include diazinon, chlorpyrifos and dichlorvos while the pyrethroids are cypermethrin, deltamethrin, lambda-cyhalothrin and cypermethrin+dimethoate sold under the trade name Cyper-diforce©. The World Health Organization (WHO) classification for the insecticides ranged from moderate to highly hazardous. The most common herbicide groups were paraquat sold under the various trade name such as Gramoxone©, Weed crusher©, Weed burner© and Maxiquat©, followed by Glyphosate with the trade name such as Round-up©, Force-up©, Sarosate©, Mulsate©, Glysate©, Bush fire© and Rhonosate©. Among the herbicides group, only Paraquat was moderately hazardous, Atrazine was slightly hazardous while others are unlikely to present acute hazard in normal use. Other groups were Fungicides, Fumigants and Rodenticide. The formulation of the various pesticide groups include Emulsifibale Concentrate (EC), Soluble Concentrate (SC), Wettable powder (WP) and Dustable powder (DP).

Fig. 1 shows the pesticide product demand by the customers. Herbicides were the highly demanded (50%), followed by insecticides (31%), fungicides (16%) while the least demanded product was rodenticides (3%).

Discussion

Results from this study show that agrochemical retailers were not adequately knowledgeable about the product they were handling although majority of them had secondary school leaving certificate and one would expect this to reflect in their conduct as a retailer or shopkeeper. This is not so as their knowledge with the attitude showed during the study on understanding and observing safety precautions, access to Material Safety Data Sheets (MSDSs) and pesticide labels, knowledge and understanding of risk associated with exposure to most of the products being sold. The age range of the majority was between 20 and 39 years which indicate that the group consists of young people that are likely amenable to change with respect to training and new innovations in pesticide handling and management.

Pesticides of different brands comprising organochlorines, organophosphates, carbamtes, pyrethroids, fumigants were stocked for sale in most of the shops which had only one entrance point. Majority of the retailers did not have a separate office space to attend to customers or space for storage of some of the highly hazardous pesticides. They also put pesticide on the same shelf with the crop seeds for planting. Some displayed their products on tables in an open space. Apart from the fact that most of the retailers ate in the shops, it was also observed during interview that some of the retailers exhibited personal habits like chewing kolanut and cigarette smoking in these shops. This observation was also made by Kesavachandran et al. (2009) who observed alcohol consumption, cigarette smoking, tobacco

chewing, pan chewing among retail shop keepers in India. The main absorption path for pesticides is through skin and the respiratory system (Faria et al., 2007) and the use of appropriate clothes, masks and gloves is important to prevent body contamination. Unfortunately, it was noted in this study that Personal Protective Equipments (PPE) were not commonly used by the retailers which make them to be continually exposed mainly through inhalation and dermal contact. However, ingestion through mouth could also occur when hands are not properly washed before eating food. Most of the pesticide formulations were in one litre container and this made it affordable and convenient for average customer to buy thus reducing repackaging into unlabelled or inappropriate containers by the retailers and this may likely reduce dermal exposure.

The retailers were asked if they had received training from the manufacturing or supplying companies in order to enable them to provide advice about the product and whether they gave any advice to customers regarding application of pesticides. Some agreed that the companies occasionally organise 'training' but usually for a day or half a day only to discuss their products. Thus, these retailers had limited access to information on proper handling of pesticides and could not provide detailed guidance on protection to their customers. It was also interesting to note that the retailers on their part were mainly concerned on how to sell their product and make profit. The attitude of the retailers observed in this study is similar to that noted in China, Indonesia and Pakistan on survey of availability of personal protective clothing when purchasing paraquat and failures to meet the standards of the Code of Conduct in these countries (Dinham et al., 2007)

Herbicides were the most demanded pesticide and among the group, paraquat under different trade name like Gramoxone©, Paraforce©, Weed crusher©, Weed burner© and Maxiquat© was the most demanded. In Trinidad and Tobago, pesticide sale was highest for this herbicide ((Pinto-Pereira et al., 2007). The tremendous demand and sale of herbicides as indicated by the retailers may be due to the non-availability or shortage of labourers and the increased awareness of the farmers on the economic use of herbicides in curbing weed menace in agricultural production. However, the most common herbicide, the paraquat has been reported to cause a range of unpleasant symptoms, which includes localised skin damage (dermatitis and burns), eye injuries, finger and toenail damage, nose bleeds, excessive sweating, nausea and vomiting (Wesseling et al., 2001; Insering, 2006) and damage to the lungs may occur if absorbed over time, and long-term exposure is associated with Parkinson's disease (Thiruchelvan et al., 2000). In the US, all paraquat formulations are classified as a 'restricted use' product, which means that it can only be legally used by a certified pesticide applicator or under the direct supervision of a certified applicator (USEPA, 1997).

The various symptoms experienced by some of the retailers include feeling dizzy or dazed, severe headache, feeling weak, nausea and sweating which are all are good indicators of possible poisoning due to exposure to organophosphate pesticides. Similar health symptoms were observed among cocoa farmers in Southwestern Nigeria (Sosan and Akingbohungbe, 2009). In India, nervous system abnormalities like headache, fatigue, change in smell/taste, forgetfulness, tremors and musculo-skeletal disorders like painful joints, pain in the body, muscle twitching and weakness in arms and legs were also observed among pesticide shopkeepers (Kesavachandran et al., 2009) and the prevalence of significantly higher gastro-intestinal problems, neurological, ocular, cardiovascular and musculo-skeletal symptoms common among pesticide shopkeepers in Bangdalesh (Dasgupta et al., 2005).

Conclusion

The present study describes the knowledge, attitude and practice (KAP) of agrochemical retailers with respect to pesticide handling and management. The evidence from this study shows that the retailers were likely to have been exposed to pesticides mainly through inhalation as a result of continuous exposure to these pesticides in the course of running their businesses. Being an important link in pesticide distribution chain, the lack of adequate knowledge of retailers of the hazardous nature of the various groups of pesticide being sold calls for serious concern. Thus, the existing legislation on pesticide registration in Nigeria should be enforced to control the marketing strategies by pesticide companies that promote inappropriate purchasing and distribution and the companies also be legislated to train the retailers on proper handling of agrochemicals as their contribution to the industry and users population. Also, a National Policy on Chemical Safety that would control the handling of all kinds of chemicals used for different applications in the country is proposed. It is hoped that this policy among others will ensure environmentally sound chemical management in Nigeria. Lastly, regular biological monitoring studies to ascertain the exposure level and possible health effects on the retailers are strongly advocated.

Acknowledgement

The Senior author is grateful to Tertiary Education Trust Fund (TETFUND) for granting him a fellowship in 2010 that was utilized at the University of Cape Town, South Africa where literature search was conducted to write up this article.

REFERENCES

Ajayi, O.C. and Akinnifesi, F.K. (2007). Farmers' understanding of pesticide safety labels and field spraying practices: a case study of cotton farmers in northern Côte d'Ivoire. *Scientific Research and Essay* 2 (6): 204-210,

Alavanja MC, Hoppin JA, Kamel F. 2004. Health effects of chronic pesticide exposure: cancer and neurotoxicity. *Ann. Rev Public Health* 25:155–197.

Blanco-Munoz, J., Morales, M.M., Lacasana, M., Aguilar-Garduno, C., Bassol, S., and Cebrian, M.E. (2010). Exposure to organophosphate pesticides and male hormone profile in floriculturist of the state of Morelos, Mexico. *Human Reproduction,* 25(7) 1787-1795.

Colborn T. A case for revisiting the safety of pesticides: a closer look at neurodevelopment. *Environ Health Perspect.* 2006;114:10–17.

Crissman, C.C., D. C. Cole and F. Carpio (1994), 'Pesticide Use and Farmer Worker Health in Ecuadorian Potato Production', *Am. Journal of Agricultural Economics* 76: 418-430.

Dasgupta, S., Meisner, C. and Mamingi, N. (2005). Pesticide Traders' Perception of Health Risks: Evidence from Bangladesh World Bank Policy Research Working Paper 3777, 22pp

Dinham, B., Jing, S., Rossana, D. R., Pertiwi, G., Yasin, A.M. and Sanjh, L. (2007). Pesticide users at risk: Survey of availability of personal protective clothing when purchasing paraquat in China, Indonesia and Pakistan and failures to meet the standards of the Code of Conduct. A report submitted to Berne Declaration, Switzerland,Pesticide Action Network Asia and the Pacific Pesticide Eco-Alternatives Center, China. 19pp

Dung, N.H and T. T. T. Dung (2003) 'Economic and Health Consequences of

PesticideUse in Paddy Production in the Mekong Delta, Vietnam', EEPSEA Research Reports, 39p, http://203.116.43.77/publications/research1/ACF124.html

FAO, (2010). FAOSTAT Statistical Database. Food and Agricultural Organization, Rome. Available http://faostat.fao.org (accessed 30 November, 2010)

Faria, N.M.X., Fassa, A.G. and Facchini, L.A. (2007). Pesticides poisoning in Brazil: the official notification system and challenges to conducting epidemiological studies. *Cien Saude Colet* 12:25–38.

Isenring, R. (2006). Paraquat: Unacceptable health risks for users, Berne Declaration, Pesticide Action Network (PAN) Asia and the Pacific, PAN UK, 2nd edition, September 2006. http://www.evb.ch/en/p10285.html (Accessed 30 November, 2010)

Kesavachandra, C., Pathak, M.K., Fareed, M., Bihari, V., Mathur, N. and Srivastava, A.K. (2009). Health risks of employees working in pesticide retail shops: An exploratory study. *Indian J. Occup.* And Environ. Med. 13(3):121-126.

Maroni, M. & Fait, A. 1993, "Health effects in man from long-term exposure to pesticides. A review of the 1975-1991 literature", *Toxicology,* vol. 78, no. 1-3, pp. 1-180.

Pimental, D., Acquay, H. and Biltonen, M.(1992). 'Environmental and Economic Costs of Pesticide Use', *Bioscience* 42, 750-60.

Pinto-Pereira, L.M., Boysielal, K. and Siung-Chang, A. (2007). Pesticide regulation, utilization, and retailers' selling practices in Trinidad and Tobago, West Indies: current situation and needed changes *Pan Am J Public Health* 22(2): 83-90

SAS (2008). SAS/STAT Users Guide@ Release V9.1, SAS institute, Cary, North Carolina, USA.

Sosan, M.B. and Akingbohungbe, A.E. (2009). Occupational insecticide exposure and perception of safety measures among cacao farmers in Southwestern Nigeria. *Arch. Occup. Environ. Health.*;64(3): 185–193.

Sultatos, L.G. (1994). Mammalian toxicology of organophosphorus pesticides. *J. Toxicol. Environ. Health.* 43:271-289

Thiruchelvam, M., Richfield, E.K., Baggs, R.B., Tank, A.W. and Cory-Slechta, D.A. (2000). The Nigrostriatal Dopaminergic System as a Preferential Target of Repeated Exposures to Combined Paraquat and Maneb: Implications for Parkinson's Disease, *J. Neuroscience* 20(24):9207-9214

USEPA (1997). FACTS, Paraquat Dichloride, Prevention, Pesticides and Toxic Substances (7508W), US Environmental Protection Agency, USEPA-738-F-96-018.

Wesseling, C., van Wendel de Joode , B., Ruepert, C., León, C., Monge, P., Hermosilla, H and Partanen, T. (2001). Paraquat in developing countries. Int. *J.of Occup. Health* 7(4), 275-286.

Table 1: Number of Questionnaires administered and Distribution of Agrochemicalretailers' responses from Towns and Local Government Areas (LGAs) surveyed.

Local Government Area (LGA)	Town	Number of Questionnaires administered	Number of respondents
Ede North	Ede	10	05
Ede South	Ede	10	04
Olorunda	Osogbo	10	05
Osogbo	Osogbo	10	05
Iwo	Iwo	08	04
Ejigbo	Ejigbo	10	07
Irepodun	Ilobu	08	05
Ifelodun	Ikirun	10	07
Ilesa West	Ilesa	10	06
Ilesa East	Ilesa	08	04
Ife Central	Ile-Ife	10	06
Ife East	Modakeke	06	03
		110	61

Table 2 Personal Characteristics and background information of Agrochemical retailers in Osun State, Nigeria(N=61)

	No of respondents	Relative frequency (%)
Age (Years)		
20 – 29	21	34.4
30 – 39	23	37.7
40 – 49	11	18.0
50 – 59	04	6.6
60 and above	02	3.3
Educational Attainment		
No formal education	02	3.3
Koranic school	01	1.6
Primary school	03	4.9
Secondary school	39	63.9
Tertiary	16	26.2
Sex		
Male	38	62.3
Female	23	37.7
Marital Status		
Single	20	32.8
Married	41	67.2
Experience in agrochemical business (years)		
< 5	17	27.9
5 – 9	17	27.9
10 – 14	13	21.3
15 – 19	05	8.2
20 and above	09	14.8

Table 3: Training and experience in agrochemical business, handling and usage by agrochemical retailers in Osun State Nigeria (*N=61)

Item	No. of respondents	Relative frequency (%)
Acquisition of special training on agrochemical retailing business?		
Yes	37	60.7
No	24	39.3
Viability of business?		
Highly viable	44	72.1
Moderately viable	17	27.9
Participation in Training/workshop on agrochemicals?		
Yes	15	24.6
No	46	75.4
Frequency of participation in training of agrochemicals		
Yearly	04	6.6
Once in 3 years	01	1.6
Occasionally	10	16.4
Duration of training (Days)		
1-2	03	4.9
3-5	09	14.7
5-7	03	4.9
Reading instruction labels		
Yes	56	91.8
No	05	8.2
Usefulness of instruction label		
Very useful	51	83.6
Fairly useful	03	4.9
Not considered useful	02	3.3

*Multiple responses

Table 4: Sources, types and methods of transportation and storage of pe sticide by agrochemicals retailers in Osun State, Nigeria (N=61)

Item	No. of responses (*N=61)	Relative frequency (%)
Where are the sources of pesticides?		
Direct from the companies/Sales Agent	17	27.9
Distributors	50	82.0
How often are new pesticides introduced into the market?		
Yearly	38	62.3
Once in every 3 years	13	21.3
Occasionally	08	13.1
Don't know	02	3.3
How do you identify the various categories of pesticides?		
From the manufacturer	02	3.3
On pesticide label	54	88.5
From sales agent	05	8.2
How are the pesticides transported?		
In the vehicle booth with other items	25	41.0
Packed separately	34	55.7
In the same vehicle with food items	02	3.3
Where are the pesticides stored?		
On shelf in shops	33	54.1
In separate store	24	39.3
In shop with other items	07	11.5
How do you sell to customers?		
As supplied by the manufacturers	57	93.4
Dispensed into small containers	37	60.7

*Multiple responses

Table 5: Awareness on the hazardous nature of pesticides and symptoms suggestive of pesticide exposure by agrochemical retailers in Osun State, Nigeria (N=61)

Questions addressed	No. of responses (*N=61)	Relative Frequency (%)
Are you aware that the pesticides being handled are hazardous?		
Yes	58	95.1
No	03	4.9
Are you aware that pesticides can cause adverse health effects?		
Yes	52	85.2
No	09	14.8
Have you ever experienced any pesticide spillage?		
Yes	20	32.8
No	41	67.2
If yes, how many times?		
1-2 times	06	9.8
3-5 times	02	3.3
Several times	12	19.7
What immediate steps/action did you take to reduce the effects of the chemicals?		
Wash immediately with water	03	4.9
Wash with soap and water	16	26.2
No action taken	01	1.6
Have you ever had any unusual feeling since you were into the business?		
Yes	26	42.6
No	35	57.4
If yes, what are the symptoms experienced?		
Severe headache	16	26.2
Feeling dizzy/dazed	20	32.8
Feeling weak or unusually tired	14	23.0
Vomiting	07	11.5
Nausea	12	19.7
Restlessness	12	19.7
Stomach ache	07	11.5
Diarrhoea	02	3.3
Excessive sweating	01	1.6

*Multiple responses

Table 6: Advisory role on pesticides usage to prospective customers by agrochemical retailers in Osun State, Nigeria (N=61)

Questions addressed	No. of responses (*N=61)	Rel. Frequency (%)
Do you give talk to your customers/farmers on how best to handle pesticides being sold to them?		
Yes	53	86.9
No	08	13.1
If yes, how often?		
Every time they come for purchase	36	59.0
When requested for by the farmers	09	14.8
When new pesticide products are being introduced	08	13.1
Have you ever received any negative news or information from your customers resulting from pesticide use?		
Yes	04	6.6
No	57	93.4

***Multiple responses**

Table 7: Pesticide inventory of some of Agrochemical shops in Osun State, Nigeria

Group	Trade Name	Active ingredient	Chemical Class	Formulation	WHO Acute Hazard Classification[a]	Price/Litre (₦)
Insecticide	Endocel/ Endocot 35EC	Endosulfan	OC	EC	II	1,200
	Basudin 600EC	Diazinon	OP	EC	II	1,400
	Termifos/ Perfect Killer20EC	Chlorpyrifos	OP	EC	II	1,000-1,200
	Pestoff/ DD Force 100EC	Dichlorvos DDVP	OP	EC	Ib	500-1,200
	Cypercot/ Cymbush 10EC	Cypermethrin	Pyrethroid	EC	II	1,200
	Deltaforce 12.5EC	Deltamethrin	Pyrethroid	EC	II	1,200
	Karate 2.5EC	Lambda-cyhalothrin	Pyrethroid	EC	II	1,200
	Cyper-Diforce	Cypermethrin+ Dimethoate	Pyrethroid	EC	II	1,200
Herbicides	Gramoxone/ Paraforce / Weed Crusher / Weed Burner / Maxiquat	Paraquat dichloride	Bipyridylium	SC	II	1,000-1,250
	Unicorn/ Atraforce 80WP	Atrazine	Triazine	WP	III	1,100-1,200
	Round up /Force up /Sarosate /Mulsate /Glysate /Bush fire /Rhonasate /	Glyphosate isopropylamine	Phosphono-glycine	SC	U	1,200-1,300
	Force-Uron	Diuron	Urea	SC	U	1,500
Fungicides	Forcelet 50WP	Carbendazim	Benzimidazole	WP	U	1,000/0.5kg
	Z-Force 80WP	Mancozeb	Dithio-carbamate	WP	U	1,600/kg
	Champ DP	Copper hydroxide	Inorganic copper	DP	III	180/50g satchet
	Dress force	Metalaxyl+ Tebuconazole	Xylylalanine +Azole	WP	III	100/10g satchet
	Seed Plus	Imidacloprid+metalaxyl + Carbendazim	Neonicotinoid+ Xylylalanine+ Benzimidazole	DP	III	100/10g satchet
Fumigant	Force-Toxic	Aluminum phosphide	Inorganic	Tablet	Ib	150/10 tablets
Rodenticide	Zinc phosphide	Zinc phosphide	Inorganic Zinc	Powder	Ib	20/1g satchet

Key to Table 7

aBased on LD50 for the rat: **Ia** = extremely hazardous, **Ib** = Highly hazardous **II** = Moderately hazardous, **III** = Slightly hazardous, **U** = Unlikely to present acute hazard in normal use

OC = Organochlorine, **OP** = Organophosphate

EC = Emulsifiable Concentrate, **SC** = Soluble Concentrate, **WP** = Wettable Powder, **DS** = Dustable Powder

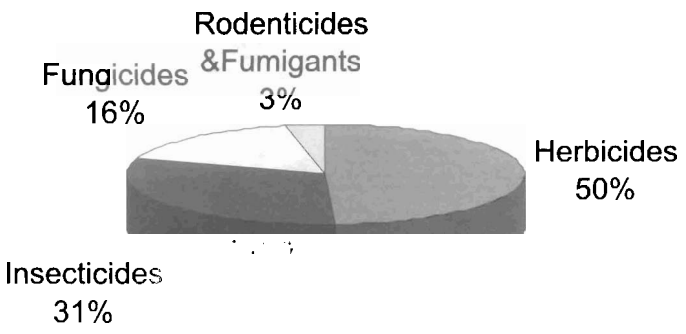

Fig. 1: Pie Chart showing the demand of pesticide products by customers