Nova Explore Publications
Nova Journal of Engineering and Applied Sciences
Vol 2(2), 2014: 1-8
www.novaexplore.com

Research Article

Potential Hazards Due To Misuse Of Aluminium Phosphide In Kaduna State, Nigeria

Adejumo I.O.[1*], Ologhobo A.D.[2], Alabi O.O.[1], Bamiro O.M.[3]

[1] Department of Animal Science, Landmark University, P.M.B. 1001, Omu-Aran, Nigeria
2 Department of Animal Science, University of Ibadan, Ibadan, Nigeria
3 Department of Agricultural Economic and Extension, Landmark University,Omu-Aran, Nigeria

Corresponding Author: Adejumo I.O. *Department of Animal Science, Landmark University, P.M.B. 1001, Omu-Aran, Nigeria.*
E-mail: smogisaac@gmail.com

Received 17 Dec 2013; Revised 27 Dec 2013; Accepted 16 Jan 2014

Abstract

Maize is a staple food in most African countries. One major factor mitigating against food production in Nigeria is pest infestation. Post-harvest losses pose critical constraint on food security. Insect pests are one of the major organisms that are responsible for reduction in quality, germination potential and quantity of maize grains/seeds in storage. The study was conducted in Kaduna State of Nigeria. Four local government areas (Giwa, Igabi, Kudan and Kaura) were selected at random from the state and from the each local government areas, two villages were selected at random. Fifty respondents were chosen at random from the two villages to make a total of 200 respondents in all. Information on the most commonly used maize preservative chemicals were obtained through structured questionnaires. The result of the survey indicated that the mean age ranged between 36-52%, modal age (42-60%), respondents with no formal education (8-44%), those with primary school education, quaranic education, secondary school and tertiary education ranged between 22-50%, 0-17%, 0-30%, and 20-25% respectively. Majority of the respondents are male (78-90%). The most commonly used maize storage pesticide was aluminium phosphide. Misuse of aluminium phosphide, a restricted pesticide in the study areas as case study seemed to be a serious issue since agricultural use of pesticides is left in the hands of illiterates.
Key words: aluminium phosphide, maize, Nigeria, questionnaire, survey

Introduction

Maize is an important food security crops. It is a staple food in most African countries, as well as forming the larger proportion of animal feeds, particularly poultry and swine. Post-harvest losses are one of the critical constraints to food security among farmers across Africa [1] [2]. Olakojo and Akinlosotu [3] noted that insect pests are one of the major organisms that are responsible for reduction in quality, germination potential and quantity of maize grains/seeds in storage. The most important stored cereal pests in Africa are larger grain borers (LGB), *Prostephanus truncatus,* grain weevils (*Sitophilus spp.),* and Angoumois grain moth (*Sitotroga cerealella)* [4] [5]. The report of the study conducted by Denning *et al.* [6] indicated 40-100% losses of agricultural produce without

chemical treatment at household levels in Malawi. Safeguarding agricultural produce from such enormous losses then becomes a necessary step towards ensuring food security [7]. Also, Tijani [8] reported a potential loss of about 45% of the total production of rice and cocoa without the use of pesticides. Synthetic pesticides have been reported to provide effective control when used correctly [7]. There are many chemical classes of pesticides in existence, but the major chemical classes are organochlorines, carbamates, pyrethroids, and organophosphates [9]. The importance of pesticides cannot be overemphasized since there is a need to improve crop production in order to meet up with the rising demand of food. Pesticides are required for stored produce. This will not only keep off the pests but also assist to keep the quality of the produce. Olabode *et al.* [10] observed that use of agrochemicals is a mainstay of agriculture across the globe as a result of the benefits it offers. The benefits include reduction of drudgery, timely and efficient weed control, effective pest control and enhancement of the shelf life of agricultural produce. Pesticides are chemicals used in agriculture to protect crops against destructive pests with the aim of increasing crop production. Pesticides are also used in public health as well as in other areas for the control of pests and disease vectors [9]. Pesticides use in Nigeria has become an indispensable tool in combating damage from pests as well as in ensuring sustainable food production. However, use of pesticides often leads to residue in foods. When used, pesticides could contaminate the environment and accumulate in the food chain [9], thereby posing a potential threat to human health as well as the environment when not properly used [11]. In developing countries, more than 3 million people have suffered severe acute pesticide poisoning [12] [13], warranting the increasing concern about misuse of pesticides in such countries. Despite this increasing concern, few studies have been carried out on the subject to investigate pesticide sustainability [14] as well as the potential effects this could have on non-target organisms. This study was conducted to assess the most commonly used maize preservative pesticides as well as assess the potential risk associated with its use.

Methods

Location of the study

The study was conducted in Kaduna State of Nigeria. Kaduna State is a state in central northern Nigeria. It lies between latitude 90 and 140 North of the equator with a time of one hour ahead of the Greenwich Mean Time. It has vast expanse of fertile land growing both food and cash crops aside from animal husbandry. The people of the state are predominantly occupied in agriculture during the rainy season which lasts for about six months from May to October, while they engage in hunting and petty trading during the dry season. The state has 23 local government areas.

Methodology

Four local government areas (Giwa, Igabi, Kudan and Kaura) were selected at random from the state and from the each local government areas, two villages were selected at random. Fifty respondents were chosen at random from the two villages to make a total of 200 respondents in all. Information on the most commonly used maize preservative chemicals were obtained through structured questionnaires.

The questionnaires were designed in English but the interview was conducted for majority of the respondents in Hausa due to the high rate of illiteracy among the sampled respondents. Willingness of the majority of the respondents and the involvement of Hausa-speaking assistants facilitated the success of the study. Each interview took about 20 minutes. The structured questionnaires were designed to collect information on commonly used maize storage chemicals, frequency of use, level of education, attitude to chemical labels and challenges to the use of storage chemicals. The questionnaire was designed under the following headings:

General biodata

This section was used to obtain information on respondent's biodata such as age, sex, level of education and major occupation.

Pesticide use and frequency

This was used to obtain information about the commonly used maize storage chemicals, use and period of use of chemically-treated grains, attitudes to storage chemical labels, and storage of chemically-treated grains. In order to avoid being bias in response to the question being asked, the questionnaires used were design to avoid leading questions. For example, 'what do you do with chemically-treated grains?' was asked in order to find out whether the respondent sells, consumes or feeds chemically-treated grains to animals immediately. Data obtained were analysed using descriptive statistics including frequency, charts and tables.

Results

Kudan Local Government Area of Kaduna State

The mean and modal ages of the respondents were 36 and 42 years respectively. 90.0% of the respondents were male. 8 percent of the respondents had no former education, 33% had primary school education, 17% had secondary school education, 17% had quranic education, while 25% had tertiary education (Table 1). The most commonly used was maize storage chemical was phostoxin tablet (46%), followed by actellic dust (8%), DDVP (8%) and store force (8%) (Table 2). Of the 60% users of maize storage chemicals, 40 percent were frequent users, 20% were occasional users, while 40% used none (Figure 3).

Kaura Local Government Area of Kaduna State

Majority of the respondents (90%) in the study area were male. The mean and modal ages for the respondents were 46 and 45 years respectively. 50% of the respondents had primary school education, 30% had secondary school education, while 20% had tertiary education (Table 1). The most commonly used was maize storage chemical was phostoxin tablet (32%), followed by Apron star (16%), while the least used was DDVP (5%) (Table 4). Forty-five percent were frequent users, 18% were occasional users, while 36% used none (Figure 4).

Table 1. Demographic information of respondents in Kaduna State, Nigeria

Local Government Area	Mean Age	Modal Age	No Formal Education (%)	Primary school education (%)	Secondary school education (%)	Quaranic education (%)	Tertiary education (%)	Male (%)	Female (%)
Giwa	47.00	60.00	40.00	30.00	0.00	5.00	25.00	85.00	15.00
Igabi	52.00	50.00	44.00	22.00	11.00	0.00	22.00	78.00	22.00
Kudan	36.00	42.00	8.00	33.00	17.00	17.00	25.00	90.00	10.00
Kaura	46.00	45.00	0.00	50.00	30.00	0.00	20.00	90.00	10.00

Table 2. Maize storage chemicals commonly used in Kudan and Kaura Local Government of Kaduna State, Nigeria

Trade name	Common name	Active ingredients	Proportion
	Kudan LGA		
Storeforce	Store force	Pirimiphos-methyl 25% EC	8%
Phostoxin, Gastoxin, Fumitoxin	Phostoxin	Aluminum phosphide	46%
Actellic	Actelic dust	Pirimiphos-methyl	8%
Pestoff	DDVP	dichlorvos	8%
Nil	NA	NA	31%
	Kaura LGA		
Phostoxin, Gastoxin, Fumitoxin	Phostoxin	Aluminum phosphide	32%
Actellic	Actelic dust	Pirimiphos-methyl	11%
Pestoff	DDVP	dichlorvos	5%
Apron XL	Apron star	Mefenoxam	16%
Aldrin, Aldrex	Aldrin	Aldrin	5%
Rambo	Rambo-Rambo	Permethrin	11%
Nil	NA	NA	21%

NA = not applicable

Table 3. Maize storage chemicals commonly used in Giwa and Igabi Local Government of Kaduna State, Nigeria

Trade name	Common name	Active ingredients	Proportion
Giwa LGA			
Storeforce	Store force	Pirimiphos-methyl 25% EC	13%
Phostoxin, Gastoxin, Fumitoxin	Phostoxin	Aluminum phosphide	45%
Actellic	Actelic dust	Pirimiphos-methyl	19%
Pestoff	DDVP	dichlorvos	6%
Name not known	NA	NA	6%
Nil	NA	NA	10%
Igabi LGA			
Storeforce	Store force	Pirimiphos-methyl 25% EC	10%
Phostoxin, Gastoxin, Fumitoxin	Phostoxin	Aluminum phosphide	48%
Actellic	Actelic dust	Pirimiphos-methyl	10%
Pestoff	DDVP	dichlorvos	14%
Apron XL	Apron star	Mefenoxam	5%
Devec	NA	NA	10%
Rambo	Rambo-Rambo	Permethrin	5%

NA = not applicable

Giwa Local Government Area of Kaduna State

Eighty-five per cent of the respondents were male. The mean and modal ages for the respondents were 47 and 60 years respectively, while 40% of the respondents had no former education, 30% had primary school education, 5% had quaranic education while 25% had tertiary education (Table 1). In terms of frequency of use of maize storage chemicals, 65% were frequent users, 20% were occasional users, while 15% used none (Figure 1). Of all the maize storage chemicals used by the respondents in the study area, the most commonly used was phostoxin tablet (45%), followed by actellic dust (19%). Six percent of the respondents did not know the name of the storage chemical they used (Table 3).

Igabi Local Government Area of Kaduna State

The majority (78%) of the farmers and traders interviewed in Igabi Local Government Area were male. The mean and modal ages for the respondents were 52 and 50 years respectively. Of all the respondents 44 percent of the respondents had no former education, 22% had primary school education, while 11% of the respondents had secondary school, while 22% had tertiary education each (Table 1). Phostoxin tablet (48%) was the most commonly used maize storage chemicals used by the respondents in the study area, followed by DDVP (14%) (Table 3). Of the 82% user of maize storage chemicals in the study area, 67% were frequent users of storage chemicals while 25% were occasional users, while 8% were non-users (Figure 2).

Discussion

The results of the study revealed that larger percentage of the maize farmers in the study areas were male, with little or no formal education. Misuse of pesticides in Nigeria using the study areas as case study seems to be inevitable, since agricultural use of pesticides is left in the hands of illiterates. Okoedo-Okojie and Onomolease [15] earlier reported that education has a significant role to play on the promotion, transfer, and adoption of knowledge that boost agriculture. However, misuse of pesticides is not limited to only pesticide applicators, as respondents indicated adulteration of chemicals as one major constraint to their use of pesticides. The result of the study showed that some of the respondents did not even know the name of the storage chemicals they used, some sold the

chemically-treated grains immediately or whenever they needed money to buy farm inputs, while some fed them to cattle and horses. Vast majority of the farmers and traders indicated that they stored chemically-treated grains in their residential houses, where children and other innocent family members could be exposed to pesticide hazards, bearing in mind that the most commonly indicated storage chemical (aluminium phosphide) is a restricted pesticide. This confirms that pesticide application and regulation policy in the study areas are poorly implemented. Majority of the respondents indicated that they did not obtain instruction regarding the use of pesticide from agricultural change agents.

Aluminium phosphide (AlP) is a colourless and flammable pesticide [16]. It is considered toxic in various organs like heart, liver and kidney of mammals [17]. AlP is known to produce phosphine gas when it reacts with water or acid. Phosphine gas is a highly toxic gas, a mitochondrial poison that could interfere with oxidative phosphorylation and protein synthesis [18]. AlP has been reported to produce chromosome damage in agricultural workers [19] [20].

Conclusion

Misuse of aluminium phosphide by maize farmers and merchants in the study area is inevitable because most of the farmers and merchants are illiterate, most of the respondents could not even identify the name of the pesticides they use to preserve maize grains which they feed from or are sold whenever they need money to buy farm inputs. This potential misuse poses a serious threat to the health of the farmers, their relations as well as well as consumers (animals and human beings) who depend on grains from the northern part of Nigeria.

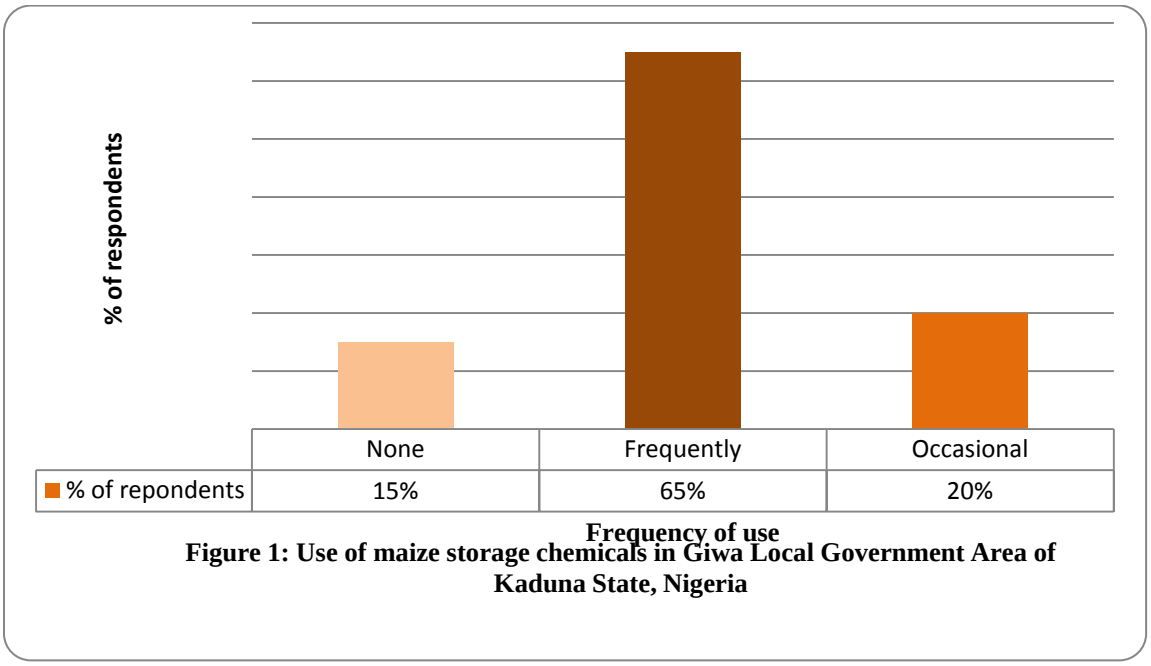

Figure 1: Use of maize storage chemicals in Giwa Local Government Area of Kaduna State, Nigeria

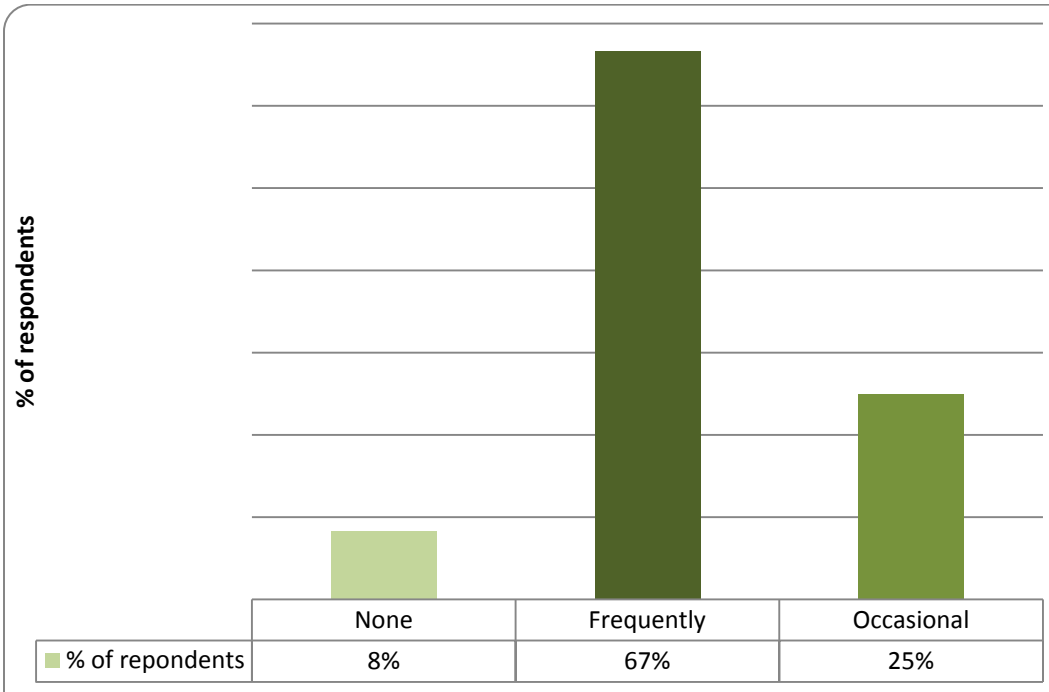

Figure 2: Use of maize storage chemicals in Igabi Local Government Area of Kaduna State, Nigeria

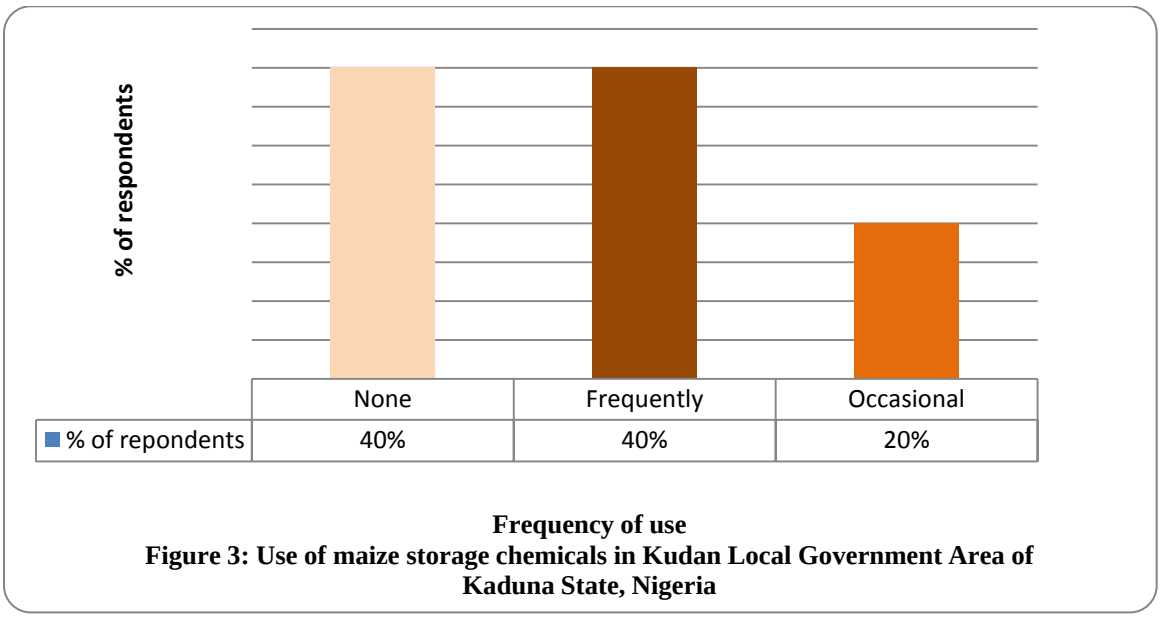

Figure 3: Use of maize storage chemicals in Kudan Local Government Area of Kaduna State, Nigeria

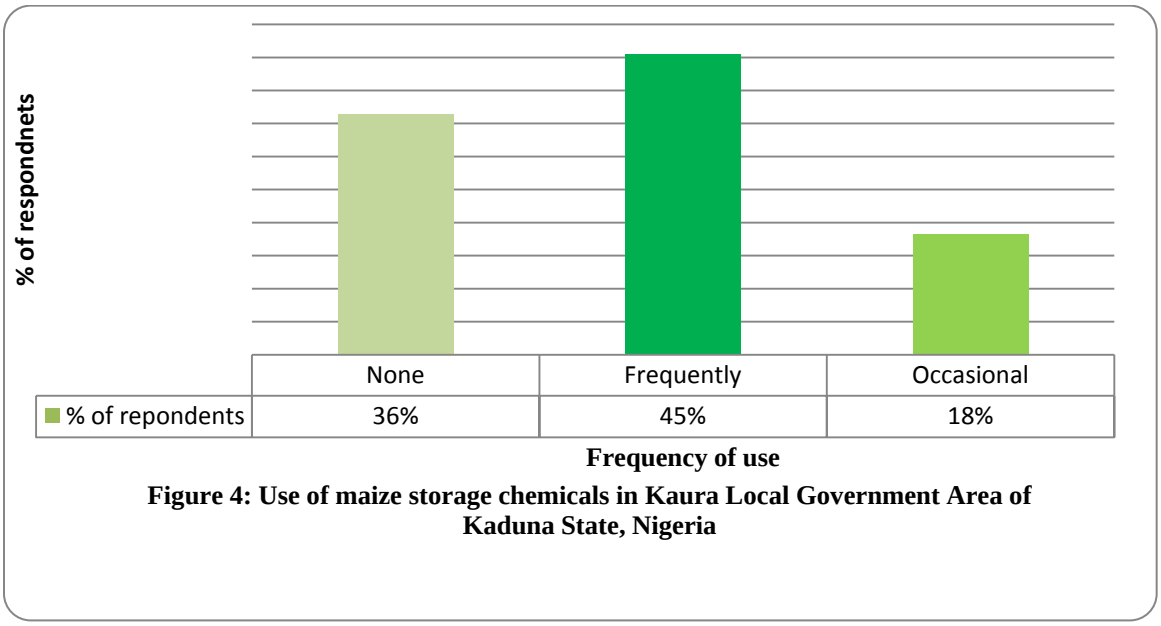

Figure 4: Use of maize storage chemicals in Kaura Local Government Area of Kaduna State, Nigeria

References

[1] Owusu EO. Effect of some Ghanian plant components on control of two stored product insect pests of cereals. J. Stored Prod Res., 2001;37:85-91

[2] Owusu EO, Osafo WK, Nutsukpuli ER. Bioactivities of candlewood, *Zanthoxylum xanthoxyloides* (Lam) solvent extracts against tow stored-product insect pest. Afr. J. Sci. Technol., 2007;8:17-21

[3] Olakojo SA, Akinlosotu TA. Comparative study of storage methods of maize grains in South Western Nigeria. Africa Journal of Biotechnology, 2004;3(7):362-365

[4] Phiri NA, Otieno G. Managing pests of stored maize in Kenya, Malawi and Tanzania. Survey report. The MDG Centre East and Southern Africa. Nairobi Kenya, 2008, p82

[5] Abate T, van Huis A, Ampofo JKO. Pest management strategies in traditional agriculture: an African perspective. Annu. Rev. Entomol. 2000;45:631-659

[6] Denning G, Kabambe P, Sanchez P, Malik A, Flor R, et al. Input Subsidies to Improve Smallholder Maize Productivity in Malawi: Toward an African Green Revolution. PLoS Biol., 2009;7(1): e1000023. doi:10.1371/journal.pbio.1000023

[7] Kamanula J, Gudeta W Sileshi, Steven R Belmain, Phosiso Sola, Brighton M Mvumi, Greenwell KC Nyirenda, Stephen P Nyirenda, Philip C Stevenson. Farmers' insect pest management practices and pesticidal plant use in the protection of stored maize and beans in Southern Africa, International Journal of Pest Management, 2011; 57 (1):41-49 (doi:10.1080/09670874.2010.522264)

[8] Tijani AA. Pesticide use and safety issues: the case of cocoa farmers in Ondo State, Nigeria. Journal of Human Ecology, 2006;19:183-190

[9] Ogah CO, Coker HB. Quantification of organophosphate and carbamate pesticide residues in maize. Journal of Applied Pharmaceutical Science, 2012;2(9):93-97. DOI: 107324/JAPS.20122919

[10] Olabode OS, Adesina GO, Olapeju TR. A survey of agricultural chemicals available to farmers in South Western Nigeria, International Journal of Agricultural Economics and Rural Development, 2011;4(1):12-18

[11] Kishi M. The health impacts of pesticides: what do we know? In: Pretty J. (ed.) The Pesticide Detox: towards a more sustainable agriculture, 2005;23-38, London

[12] Larson B. Hygiene and health in developing countries: defining priorities through cost-benefit assessment. International Journal of Environmental Health Research, 2003;13:37-46

[13] World Health Organization. The WHO Recommended Classification of Pesticide by Hazard and Guidelines to Classification. WHO, Geneva, 2000.

[14] Oluwole O, Cheke RA. Health and environmental impacts of pesticide use practices: a case study of farmers in Ekiti State, Nigeria. International Journal of Agricultural Sustainability, 2009;7(3):153-163

[15] Okoedo-Okojie DU, Onomolease EA. Factors affecting the adoption of yam storage technologies in the Northern ecological zone of Edo State, Nigeria. Journal of Human Ecology, 2009;27(2):155-160

[16] Turkey H, Togar B. Aluminium phosphide-induced genetic and oxidative damages in vitro: attenuation by *Laurus nobilis L.* leaf extract. Indian Journal of Pharmacology, 2013;45:71-75

[17] Okolie NP, Aligbe JU, Osakue EE. Phostoxin-induced biochemical and pathomorphological changes in rabbits. Indian Journal of Experimental Biology, 2004;42:1096-9
[18] Goswami M, Bindal M, Sen P, Gupta SK, Avasthi R, Ram BK. Fat and oil inhibit phosphine release from aluminium phosphide – its clinical implication. Indian Journal of Experimental Biology, 1994;32:647-9
[19] JL Perez Navero, I Ibarra de la Rosa, MA Fr´ıas Perez, MJ Arroyo Mar´ın, P Perez Jorge. Intoxicaci´on letal por inhalaci´on accidental de fosfuro alum´ınico. An Pediatr (Barc). 2009;71(5):427–431
[20] Tucker JD, Moore DH, Ramsey MJ, Kato P, Langlois RG, Burroughs B *et al.* Multi-endpoint biological monitoring of phosphine workers. Mutat. Res., 2003;536:7-14