



The Concept of Withholding Period and Pesticide Residue in Grain Storage

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Abstract

This review focuses on pesticides, their unquantifiable benefits to agriculture, pesticide residue, maximum pesticide residue limit, and withholding period in grain storage. It delved into the origin of synthetic pesticide and its introduction to Nigeria in the 1950s, it maintained that pesticide have posed major health and social challenges, and have had negative, unintended, catastrophic, fatal consequences to man, animals, and even the environment especially when instructions on their labels are not adhered to. Again, it maintained that withholding periods are often stipulated on the labels of genuine pesticides, it reiterated that not adhering to the stipulated withholding period can have catastrophic consequences on consumers of grain and grain products. Furthermore, it dwelt on the activities of Nigerian stored Products Research Institute (NSPRI) and National Food Drug Administration and Control (NAFDAC), their mandates and quest to nip pesticide poisoning in the bud. Finally, recommendations were put forward to check the seeming ignorance and dearth of information about pesticide residue limit and withholding period, and dangers that are concomitants of not adhering to these.

Keywords: Agrochemicals, Storage, Agriculture, Residue limits, Postharvest

Introduction

Pesticides are poisons; they are produced because they are toxic to one pests or the other. They are chemical substances that derived their name from the French word “peste” which means to pest or plague, and Latin word “caedere” which means to kill (Akunyili and Ivbijaro, 2006). Pesticides are an important management tool in agricultural enterprise; they increase yields and increase protection against insects at post-harvest and storage, and it has continued to be the bedrock of agriculture in modern times because of its unquantifiable benefits one of which include enhancement of shelf life of stored agricultural products (Olabode et al., 2011). Cooper and Dobson (2007) maintained that for every dollar spent on pesticide for crop yield and storage four dollars in crops is saved; since 10 billion dollars worth of agro-chemicals is used for crops globally

annually then 40 billion worth of crops is saved annually. Yet according to Paulsen (1998), between harvest and consumption over 20% of food harvested in the most technologically advanced country in the world (USA) is lost to pests and the case is worst in developing countries where the loss is as high as 80%. Despite timely harvest, proper drying, and the best hygienic conditions pest still infest harvested grains at one stage or another at post-harvest stage and insect pests are the main culprit for this. It is against this backdrop that man have devised agrochemicals in the form of pesticide (natural occurring and synthetic) to reverse this trend, however, pesticide and its concomitants have posed major health and social challenges, and have had negative, unintended, catastrophic, fatal consequences to man, animals, and even the environment.

A Glance at Pesticide and Its Introduction to Nigeria

According to Rao et al. (2007) pesticides have for long been used to protect crops; poisonous plants, smoky fire, and mud have been used as far back as 400 years ago as pests control for crops. The first types of modern pesticides were highly toxic compounds such as arsenic and hydrogen cyanide after this came synthetic pesticides. The first synthetic pesticide was dichlorodiphenyltrichloroethane (DDT) which was discovered in 1939. The production of synthetic pesticides took another dimension after the Second World War(1945), this period witnessed an increase production of these chemicals and their by products, however, the incidence of diseases and pest on cocoa farms can be rightly said to be the prelude of the long history of pesticides in Nigeria. According to Ogunjimi and Farinde (2012) pesticides use in Nigeria has been on the increase after it was introduced in the early 1950s and particularly in 1957 when Lindane was introduced and recommended for use in Nigeria. In the face of a growing human population, and increased urbanization in Nigeria, the demand for pesticide increased in the early 1960s after her Independence and the risk of pesticide whether real or perceived forced changes in the ways these chemicals are used. Banjo et al (2p010) corroborate Ogunjimi and Farinde (2012) position when he posits that the growth of synthetic pesticides took a foot hold in the 1940s with the discovery and introduction of DDT, BHC, Adrin, Chlorodane, and Parathion. Kemabonta and Odebisi (2005) alluded to these positions when they mentioned that since the 1940s, insect pest control has majorly relied on the use of synthetic insecticides. In the 21st century however, there has been rigorous campaigns for pesticides to be made in such away for it to persist for shorter periods in the environment and to be less dangerous than those of the early days of arsenic and DDT.

Withholding Period, Maximum Residue Levels, and Food Pesticide Contamination

Nigeria`s insect- related post-harvest food losses are estimated at around 30%, and from the 1950s onwards insects control have been by

the use of synthetic insecticides which have adverse effects on human health (Otitodun et al., 2012). The undesirable consequences of pesticides use on human health have become more evident from the 1950s onward (Morner et al., 2002). Recently, concern about the health effects of pesticides have increased over the past years considering the rates at which scholars have put into the study of the phenomenon. Most often than not scholars have written so much on the use of dangerous chemicals, banned pesticides, pesticide overdose, safe practices, and the like but little has been written on or said about withholding period also known as waiting period as the case may be. This dearth of scholarly information is inexcusable; scarce resources and time have often been channelled to investigate other causes of pesticide contamination in stored grains, and the silence on withholding period though pertinent leaves much to be desired, since this silence has had catastrophic consequences. For example, it was reported that 116 students of a school in Doma, Gombe State fell ill and were hospitalised after eating cowpea contaminated by pesticide. Also, Shaibu (2008) reported that two children died and 112 people were hospitalised after eating cowpea treated with pesticide in Cross rivers state. Again, in 2010 it was reported that 20 fast food outlets were closed in Nigeria because of fatalities traced to pesticide residue in their products (Chikwe, 2010). This is not surprising because grain is most often than not the base of majority of the food on the menu of these outlets. Udoh (1998) summed all that needs to be said thus: “it is possible that many do not know the concept of ‘waiting period’, (which is) highly dangerous”.

The withholding period is the maximum length of time that must elapse or a person must wait after applying pesticide on food crop before it is safe for consumption. It is the minimum length of time either days, weeks, or months stated on the chemical product label that must elapse between the last application of pesticide and consumption of agricultural products. According to Shirestha et al. (2010), waiting period is the duration after which grains treated with pesticide can be consumed or used. Storage withholding periods are calculated on the basis of residue decline trials, and this

represents the time after which a merchant can be sure that residue levels in their crop will have declined to a level well below the maximum residue limits, thereby allowing their crop to be sold or consumed, in this case grains treated with pesticide. Generally, waiting period for bio-pesticides are shorter compared with synthetic pesticides. Waiting period for grains treated with pesticide (liquid or dust applied to newly harvested grains intended for short or long term storage) usually have a 90 days waiting period. Every standard pesticide have the withholding period written on their labels but failure to abide by the stipulated withholding period on pesticide label may result in high residue in your produce and a breach in maximum residue limits which sometimes vary from one country to the other, and from state to state for country like the United States of America.

Everybody in the modern world no matter where they live or what they eat have pesticide residues in their bodies (Paulsen, 1998). Recently, attention has been focused on pesticide residues in food crops; this refers to the pesticides that may remain on or in foods after they are applied to food crops, the accepted level of these residues is often stipulated by a regulatory body in most countries. Pesticide residues in Nigeria are analysed and monitored in an IAEA accredited dedicated laboratory at National Food Directorate and Control (Keri, 2009). However, it should be noted that pesticide residue results when pesticide is deliberately applied to a crop, and this differentiates residue from pesticide contamination which is always unintentional. Many of these pesticide residues build up to harmful levels in the body as well as in the environment, the World Health Organization (WHO) sees pesticide residue as any substance or mixture of substances in food for man or animals resulting from the use of a pesticide and includes any specified derivatives, such as degradation and conversion products and impurities that are considered to be of toxicological significance; pesticide residue definitions are established for maximum residue limits enforcement purposes and for products exposure assessment.

Maximum residue limits (MRLs) is the maximum concentration of a pesticide residue

on commodity, recommended or permitted by a national authority (it is the maximum concentration of pesticide on stored agricultural products which is healthy and legally permitted). The concentration is expressed in milligrams of pesticide residue per kilogram of commodity. Thus the residue of legally registered pesticides found in food should not exceed the maximum residue limits as established by a country. The MRL set for each pesticide- crop combination are set at levels well below the amount that could pose a health risk. Fundamentally, an MRL applies to the identified raw agricultural food commodity as well as to processed food product that contains it. As part of the assessment process, before the registration of a pesticide in Nigeria, the National Agency for Food and Drug Administration and Control (NAFDAC) must determine whether the consumption of the maximum amount of residues that are expected to remain on the food products when the pesticide is used according to label direction will not be a risk to human health. NAFDAC, however, does not set MRLs but adapt the codex limits and when necessary that of the importing country, before allowing the use of a pesticide on food crops, NAFDAC will check for the tolerance or the maximum residue limit of the pesticide allowed remaining in or on each treated crop. The tolerance level or maximum residue limit is the limit that calls for enforcement action i.e. if residues are found above the level, the commodity is not deemed fit or safe for consumption. According to the United States Environmental Protection Agency the following factors are put into consideration when setting the maximum residue limits:

- The toxicity of the pesticide and its breakdown products.
- How much of the pesticide is applied and how often.
- How much of the pesticide residue remains in or on food by the time it is marketed or consumed.

Halliday et al. (1988) maintained that the most likely source of significant levels of pesticide residue in food grains in post-harvest application is contact pesticides i.e. contact pesticides are applied at levels designed to protect the commodity from attack over much

of storage period as much as possible. Though there is a paucity of data in Nigeria regarding pesticide residue in grains, the United States Department of Agriculture's pesticide Data Program (2004) gives the following as pesticide residue found in wheat in the United States of America in 2004/2005: propanil 1.5%, Cyfluthrin 1.2%, Cyhalothrin 1.1%, Chlorpyrifos 0.6%, Trifurain 0.3%, Carbofuran 0.1%, Difenconazole 0.1%, Imazalil 0.1%, Melathion 63%, Chlorpyrifos Methyl 16.7%, Methoxychlor P.P 4.2%, Methoprene 2.7%, Piperonylbutoxide 2.3%, Atrazane 1.9%, and Primiphos Methyl 1.6%.

NSPRI the Arbiter, NAFDAC the Enforcer

The Nigerian Stored Products Research Institute (NSPRI) was set up in 1954 to conduct research in all aspects of post-harvest handling of agricultural crops and their products. Most importantly, it was tasked with pesticide residue analysis and mycotoxins surveys on food throughout Nigeria. NSPRI in the quest to carrying out these duties have developed bio-pesticides for food storage (Otitodun et al., 2012). It has also developed pesticidal waxes, it has from time to time when asked for providing consultancy in areas of pest control, and tested for efficiency and efficacy of pesticides. It has carried out studies on insecticides that can be used to control insect infestation; it starts with trials of insecticide and when such is found to be promising, big time trials are done on large fields, stores, and silos (Adesuyi, 1978). It liaises with other research bodies on detection of pesticide residue; it carries out related surveys of mycotoxin and concomitants. Also, NSPRI carry out large scale trials of pesticide which is followed by search to know the rate of breakdown of such pesticide and also to know its permissible residue level. Furthermore, studies are carried out to know the effect of pesticide on conditions of storage on food constituents, and other parameters and after this gives recommendations on insect pest control measures and best practices in pesticide application and management. The institute in tandem with its extension department, apart from holding seminars, workshop, trainings, symposium and the likes have for long and as a matter of duty carried mass enlightenment campaigns on issues related to pesticide,

pesticide residue, maximum residue limit, misuse and abuse of pesticide, withholding period, safe handling and disposal of pesticide, and other related salient concomitant topics.

The National Agency for Food and Drug Administration and Control (NAFDAC) established in 1993 is the Nigerian government regulatory body that oversees the regulation and control of food products in Nigeria, no food item may be imported, manufactured, advertised, sold, or distributed in Nigeria unless it has been registered by the agency. The NAFDAC's formation was spurred by a 1988 World Health Assembly resolution that sought for countries help in arresting the threat posed by fake and counterfeit pharmaceuticals, it replaced a hitherto body known as the Directorate of Food and Drug Administration and control which was seen as being ineffective. According to the requirement of its enabling decree the agency has the function among many others to conduct appropriate test and ensure compliance with standard specifications designated and approved by the council for the effective control of chemical pesticides inclusive, it deals with pesticide and contaminant, residue limits and mycotoxin. Agricultural produce imported into the country must meet NAFDAC assessment of food safety and such must be free from radioactive contents and meet the maximum residue limit for approval of pesticide. It also gives a comprehensive list of approved pesticide, its mandate also includes the registration, coordination, and evaluations of pesticides to ensure that safe and effective pesticide are available to the public among others. The laboratory service directorate deals with quality and safety of agro-chemicals, there is the chemical import unit, and chemical monitoring unit and also the directorate responsible for the control of agricultural chemicals and pesticides. It also has a duty to enlighten farmers on good agricultural practices (Keri, 2009). In summary, NAFDAC regulates and controls the importation and exportation of pesticide formulations and chemicals, it undertakes the registration of pesticide formulations, it runs the general purpose "Technical Committee of the National Codex committee, it sees to the issues of pesticide residues and it has a dedicated pesticide formulation and pesticide residue

laboratory. There is interplay between the activities of NSPRI, NAFDAC, and other regulatory bodies, however, while NAFDAC has the power to enforce and prosecute those who have ran afoul of its stipulations NSPRI does not.

Conclusion

From the foregoing it is imperative for stakeholders in the agrochemical sector, farmers, merchants, the general public, and government agencies to synergise and act to bring to the know these salient factors/concepts that are brought to the fore in this review and which are often downplayed. There should be drive for enforcement, enlightenment, campaigns, and awareness in changing the heart and minds of stakeholders especially grain handlers and merchants to use pesticide in a manner that is consistent with the label or as define by regulatory bodies e.g. NAFDAC. Furthermore, there should be a study on these phenomena, data, and information generated from such research should be considered with a view to disseminating such, and awareness should be heightened on the negative impact of pesticide residue and not heeding to withholding period on pesticide, such studies also should look into solutions to causes of the phenomenon. Extension should play an important role in educating merchants and handlers about chemical residue, maximum residue limits, and withholding period in grain storage. Lastly, awareness and training activities should be done regularly and systematically on these phenomena in order to consolidate gains gotten from such awareness, campaigns, and trainings.

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