

Assessment of Farmer's Knowledge, Safe Handling Practices of Pesticide and Toxicity Using *Rattus Rattus*, Kwara State, Nigeria

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*Abstract- This study assessed farmer's knowledge, safe handling practices of pesticide and toxicity using *Rattus rattus*. It examined farmer's knowledge on the use of pesticides, investigated common practices by farmers in the use of pesticides, identified different pesticides used, and practically experimented potential toxicity of pesticide on farmers using *Rattus rattus*. Sample was based on the population of Kwara State using stratified, proportional and purposive sampling techniques. Data were collected and analyzed using frequency count and percentage, nominal scale, Pearson correlation, chi-square, graph representation with bar and pie charts, while Graph Pad Prism V was used to analyze blood haematological parameters of *Rattus rattus*, followed by Turkey post Hoc Test. The results revealed that, more male 278 (76.6%) respondents participated in the study than female 85 (23.4%). Majority of these farmers, 185 (51%) were youth in the age bracket of 31 – 40 years. Two hundred and sixty-five 265 (73.0%) respondents were full-time farmers, where 324 (89.3%) out of the total 363 practiced commercial farming and 191 (52.6%) cultivated on 1.5 and above hectares of land. Cyperforce, a pesticide with active ingredient cypermethrin was commonly used (21%) amongst the farmers in the study area. Contrary to the hypotheses, majority of the farmers relied upon information received and employed unhealthy practices in the use of pesticides. It was also observed that, respondents spray pesticides before planting, after planting, during both seasons (rainy and dry) and even occasionally which affected their level of exposure and potential toxicity. The study found that, exposure of experimental rats to pesticide (Cyperforce) at 0.002 ml - 0.01ml had toxic effects on haematological parameters by lowering the concentration of red blood cell, mean corpuscular volume, haemoglobin, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, haematocrite, white blood cell, lymphocyte and platelet. However, there was a recovery in immunological parameters (white blood cell and lymphocyte) and clotting factor (platelets) at the last two higher concentrations. It is recommended that, farmers should be enlightened more about the toxic effects of pesticides exposure as well as self protective literacy on pesticide application in order to protect themselves from pesticide exposure associated degenerative diseases.*

Keywords – Knowledge, Practice, Safe handling, Pesticide, Toxicity

I. INTRODUCTION

A pesticide is any compound or combination of substances used to control, eradicate, or repel pests (USEPA, 2018). These pests include weeds, animals, insects, and even microbes. The chemicals that farmers use to stop pests from negatively affecting the development and yield of agricultural crops are known as agricultural pesticides.

The Food and Agriculture Organization (2017) further defined a pesticide as any substance or combination of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, undesirable species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products, or animal feedstuffs, or substances that may cause reproductive harm.

Pesticides are used in agriculture to kill pests that damage crops and in public health to kill disease vectors like mosquitoes. According to the World Health Organization (WHO, 2018), pesticides are chemical substances that are used to get rid of pests like weeds, insects, rodents, and fungi. Pesticides must be handled carefully and disposed of correctly since they have the potential to be harmful to humans and other species due to their inherent qualities.

Farmers have increased the usage of pesticides and fertilizers in order to increase crop productivity in order to satisfy the government's targets for food sufficiency. Today, farmers completely rely on pesticides to boost agricultural productivity worldwide and safeguard plantations from various insects, pests, and illnesses. Only 20% of pesticides

are used globally in developing nations, but they have very high rates of pesticide poisoning-related deaths (Chittrakul et al., 2021).

According to research by Muhammad *et al.* (2019), the majority of farmers (87.2%) depend on farming for their livelihood, whereas 2.1% are traders. Only 16.4% of respondents have a land area larger than 12 hectares, and more than half (51.8%) of respondents have tiny landholdings with an extent of 4–8 hectares or less. The findings also show that the majority of respondents got their information from private sources, with only approximately a third (34.4%) getting it from the Department of Agriculture (Extension). In the new paradigm, the internet has emerged as an efficient and trustworthy source of information, yet only 14.4% of respondents use it as information tool/medium. The findings also revealed that the farmers employ unhealthy and poor practices by not following the recommendations regarding the safe usage of pesticides. The report also finds that roughly 48.2% of farmers do not follow the rules, and that 54.4% of farmers adopt improper storage procedures on their farms. According to Muhammad *et al.* (2019), improper application of pesticides can have a negative impact on human health. To prevent these consequences, safety precautions must be taken. Due to the high rate of illiteracy in the area, farmers frequently consult their fellow farmers for guidance since they are unaware of the bio-safety concerns. The knowledge level of farmers on the safe use of pesticides is greatly influenced by factors including education level, land ownership, total area of land, and trainings on safe pesticide usage.

According to Ojo (2016), just 25% of the pesticides produced worldwide are used in underdeveloped nations like Nigeria, where 99% of pesticide-related deaths occur. Lack of adequate information, knowledge, and awareness of the inherent dangers of pesticides; lack of training on proper handling of pesticides at home; poor legislation and lack of enforcement of existing legislation; problems with correct, effective, and safe applications of pesticides; use of the less expensive but deadliest types of pesticides (in terms of persistence and toxicity).

In their 2019 study, Kumar *et al.* looked into the haematological and biochemical changes caused by pesticide use among agricultural labourers. To assess haematological and biochemical changes in blood, a cross-sectional study involving 51 agricultural

workers and 54 non-exposed participants was conducted. Individuals exposed to pesticides have experienced negative clinical consequences such as tingling, muscle soreness, headaches, skin conditions, etc.

Inhaling a local Nigerian insecticide called dichlorvos on rats caused haematological and biochemical alterations that were studied by Kanu, Solomon, and Odudu (2016). The rats were divided into two groups at random: a control group that simply received food and water, and a test group that, in addition to receiving food and water, was exposed to the pesticide for four hours each day for 28 days before ceasing exposure for seven days. Five animals were sacrificed from each group on days 1, 7, 14, 21, 28 and 35, and blood was collected by cardiac puncture for haematological, biochemical and antioxidant analysis. Results obtained showed lowered values of red blood cell count (RBC), packed cell volume (PCV), haemoglobin, mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) ($p < 0.05$) with increased white blood cell count (WBC) and platelet counts after day 14 when compared to the control group. It was concluded that, inhalation of the local insecticide is toxic to the blood, liver and kidney of laboratory rats and may be deleterious to human health following long-term exposure.

A high level of contamination and poisoning of pesticide users, agricultural workers, and bystanders has been shown to occur on an unnecessary and intolerable basis worldwide. These pesticide residue-related public health and food safety issues have become more urgent in recent years. The increased consumer demand for safe food, not just in rich nations but also increasingly in developing countries, may be partially responsible for the increase in reporting of these issues (USEPA, 2022).

An enormous number of people worldwide die every year as a result of pesticide exposure due to acute pesticide poisoning which is a major short-term problem (Hailay *et al.*, 2016). Particularly on vulnerable groups, there are observed long-term health impacts, including carcinogenic and endocrine disrupting qualities. Previous research found that improper knowledge, non-use or inappropriate use of personal protective equipment (PPE), improper pesticide storage at home, a negative attitude toward pesticides, and inappropriate practices all contributed

to the morbidity and mortality of pesticide exposure (Christopher *et al.*, 2021).

Pesticides can enter the body of a human either orally, dermally, or by inhalation. Those who handle agricultural chemicals are especially at risk if their clothing is inadequate or if their equipment is damaged and leaking. The majority of regular people who are harmed by pesticide exposure consume the pesticide in the ways outlined above (Muhammad *et al.*, 2019). Pesticide exposure impairs immunity, results in blood and liver illnesses, depression, asthma, and nerve damage, as well as headaches, blurred vision, nausea, and abdominal pain. The problem with these effects is that they could take some time to manifest after ingestion, making it challenging to link the symptoms to the herbicide. Since the flu can mimic many of the symptoms, they are frequently not effectively treated. The liver and brain system are also seriously at risk from inert substances like chloroform. Animals that live near streams where pesticides collect can also experience these impacts. Because they are not easily soluble, pesticides bio-accumulate within animals. When an animal is eaten by another, the pesticide then biomagnifies and reaches larger concentrations as it goes up the food chain (Christopher *et al.*, 2021; NPIC, 2022).

Education is the most effective strategy to stop the spread of agricultural pesticides and excessive exposure to them. If more farmers, particularly those in developing nations, were aware of the dangers associated with these pesticides, they would use them more cautiously and use protective gear when spraying.

II. STATEMENT OF THE PROBLEM

All over the world, the use of pesticides is increasing because of the need to feed the world's ever-expanding population while the amount of land available for food production is diminishing. The increase in the use of pesticides has increased both the hazards to human health and the pollution of the environment. However, evidence over the past few decades has demonstrated that pesticides may also be harmful to human health and the ecosystem, despite their benefit to agricultural productivity (Gebru *et al.*, 2018).

Despite the fact that agriculture is the economic backbone of West Africa and employs up to 70% of the population, there is almost little study on the health impacts of acute and chronic pesticide exposure in this population in this sub-region. In order to produce and preserve an abundance of high-quality food, modern farming uses a variety of chemicals, including pesticides, fertilizers, and crop preservatives (Adekunle *et al.*, 2017). The production and productivity of agriculture have increased as a result of the use of chemical inputs like pesticides. As a result, productivity and quality of the produce can be improved, even in terms of cosmetic appeal, which is frequently essential to consumers. Pesticides are widely employed in most areas of agricultural production to avoid or reduce losses caused by pests (Adekunle *et al.*, 2017).

Pesticides can be seen as an economical, labor-saving, and effective tool for pest management that is widely used in the majority of agricultural production sectors. To decrease losses due to pests and illnesses, crop growers use a variety of insecticides at various concentrations. The health risks associated with exposure when mixing and applying pesticides, working in treated fields, and residues on food and in drinking water for the general population have been raised, despite the fact that pesticides are popular and widely used by farm households. These practices have resulted in a number of unintentional occupational poisonings, mortality, morbidity, and even the routine application of pesticides can pose substantial short- and long-term health concerns to farmers while also harming the environment (WHO, 2020; EPA, 2021).

Farmers in developing nations face significant exposure risks because of the use of hazardous substances that are prohibited or restricted in other nations, improper application methods, outdated or completely inappropriate spraying equipment, poor storage procedures, and frequently the reuse of old pesticide containers for the storage of food and water (WHO, 2018). Exposure to pesticides is known to have a number of negative health effects, including both short-term acute effects like abdominal pain, headaches, nausea, and vomiting, as well as long-term conditions like cancer, reproductive and developmental disorders. It is also typical to experience effects on the central nervous system (CNS), such as agitation, memory loss, convulsions, and coma. Additionally, effects on the

parasympathetic and sympathetic nervous systems, including deadly respiratory paralysis, have been commonly reported (US EPA, 2017).

The influence of pesticides on public health, and in particular the health of farm workers, has increased as a result of improperly regulated and unsafe use of pesticides and a lack of suitable education (Adekunle *et al.*, 2017). Education is the most effective strategy to stop the spread of agricultural pesticides and excessive exposure to them. If more farmers, particularly those in developing nations, were aware of the dangers associated with these pesticides, they would use them more cautiously and use protective gear when spraying. This is due to the terrible health effects that pesticide exposure has on farmers, especially on female farmers' ability to reproduce. The developing world needs special consideration since, in addition to having lower health, they are typically more dependent on agriculture as their primary economic and source of income. It is necessary to investigate farmers' knowledge, practices, and potential toxicity associated with pesticide use in selected farm settlements in Kwara State, Nigeria, in light of the negative health effects of pesticide exposure for farmers who account for a larger workforce in West Africa's economy and Nigeria in particular.

III. OBJECTIVES OF THE STUDY

The objectives of this study include the following:

- To examine the level of awareness in safe pesticide handling,
- to investigate safe handling practices of pesticide and,
- to practically experiment potential toxicity of pesticide on farmers using *Rattus rattus*.

Research Questions

- What are the sources of information on safe handling practices of pesticides available to farmers?
- Do the safe handling practices by farmers in the use of pesticides affect their level of exposure?

Research Hypotheses

- There is no significant relationship between level of awareness and safe handling of pesticides by farmers.

- There is no significant relationship between safe handling practices by farmers in the use of pesticides and level of exposure.

IV. SIGNIFICANCE OF THE STUDY

This study is important in investigating farmer's knowledge, practices and potential toxicity associated with pesticide use in selected farm settlements in Kwara State, Nigeria. The findings of this research work will play an important role to the policy makers such as Ministry of Environment, Ministry of Health, Environmental Health Officers Registration Council of Nigeria, State and National House of assembly, Federal and State Government in formulating, reviewing and implementing the existing laws guiding the production, transportation, usage and storing of pesticides. The study will go a long way in identifying pesticides that are toxic to human health, thereby discouraging their use. More so, the findings from this result will enlighten farmers who account for about 70% of total workforce in West Africa on the dangers exposure to pesticides pose on their health. Knowledge, attitude, taken precautions and how important usage of personal protective equipment during all stages of pesticides handling will be strengthened. The findings of this research work will also enable policy makers and the general public to be aware of the current trend in diseases occurrence that are related to pesticides exposure. The finding will also awaken the Ministry of Environment including the environmental health officers in dedicating, committing and hardworking in sensitizing producers, farmers and the general public at large on the dangers of pesticides exposure if incorrectly use. Finally, the findings of this research work will educate the researcher in knowing more in the area of environmental health particularly when it comes to safe pesticides usage and danger associated with exposure if incorrectly use.

V. MATERIALS AND METHODS

Study Area

The study area includes farm settlements across Kwara State, Nigeria where the populace are predominantly farmers. Kwara is a State in Nigeria, located within the North-Central geopolitical zone, commonly referred to as the Middle Belt. Its capital is Ilorin. The primary ethnic group is Yoruba, with significant Nupe, Bariba, and Fulani minorities. Islam and Christianity are the major religions in the

State. As of 2006, the population of Kwara was 2.37 million based on the Nigeria 2006 Census. This population size constitutes about 1.69% of the Nation's total population having relied upon immigration for population growth and socioeconomic development (NPC, 2006). Kwara is one of the least densely populated regions in the country. Residents of the State are sometimes referred to as Kwarans. Kwara State is located on latitude 8.9848° N, and longitude 4.5624° E. It is bounded in the north by Niger State, in the south by Oyo, Osun and Ekiti States, in the east by Kogi State and in the west by Benin Republic. Because of its unique geographical position, the State is referred to

as the "gateway" between the north and the south of the country. Kwara State is divided into three senatorial districts with sixteen local governments in total. Kwara consists mostly of wooded savannah, but there are forested regions in the south. Agriculture is the main source of the economy, yams, cassava, corn (maize), sorghum, millet, onions, and beans are the most important staple crops; rice and sugarcane are significant cash crops in the Niger floodplains. Cotton and tobacco are grown, and cotton weaving, pottery making, and the making of raffia mats are the traditional crafts (KWSG, 2019). The map of Kwara State is shown in fig 1 below.

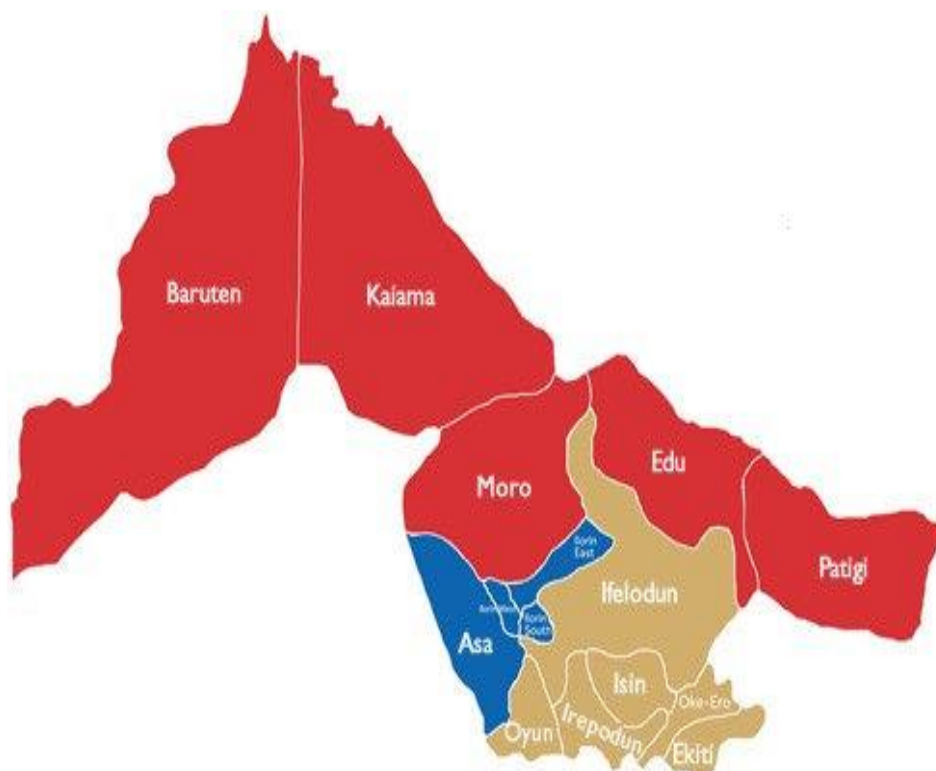


Figure 1: Map of Kwara State

Source: KWSG (2019)

Research Design

A cross sectional descriptive study was adopted for this research since the study cut across farm settlements in the study area. This was supported by experimental research where *Rattus rattus* were exposed to common pesticide identified being used by farmers in the study area. Acclimatization of *Rattus rattus* (45 males and 45 female) to laboratory room condition for twenty-one (21) days was done, after which they were divided into two groups for acute and chronic tests. Rats for acute experiment were divided into five groups (1 – V) in different cages according to the concentration they were

exposed to, while those for chronic experiment were divided into six, experimental groups (II – VI) and the control group (I). The test groups excluding the control group were exposed to common pesticide identified, dermally, orally and through inhalation.

Population

A population is the entire group of items/elements which the researcher wishes to study and generalized about. It is the sum total of sampling unit (Babajide, 2011). The population for this study comprises all the residents in the study area, Kwara State.

Target Population

Out of all the residents in the study area, those that are in the farm settlements who work and spray pesticides on their farm land were targeted.

Sample Size

The sample size from the target population for this study was determined using a formula proposed by Yamane in 1967. A 95% confidence level and $P = 0.05$ was assumed. The selected sample size is arrived at by the following formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

N: is the population size

e: The desired level of Precision/ level of accuracy

$e = 0.05$ is assumed.

$$n = \frac{2,365,353}{1 + 2,365,353(0.05)^2}$$

$$n = \frac{2,365,353}{5914.3825}$$

$$= 399.9 \quad \text{Approximately} = 400$$

Attrition factor was considered by adding ten percent (10%) of the calculated sample size which is $400 + 40 = 440$

Sampling Technique

For this study, stratified, proportionate and purposive sampling methods were adopted. Kwara State was stratified into senatorial districts, which are Kwara Central, North and South. Predominance of farmers and farm settlements in the study area determined the Local Government Areas that constituted the sample and selected farm settlements for the study.

Data collection

Data were collected through face-to-face interviews, using a questionnaire. The questionnaire is designed in English language and translated into the local language that is understood by majority of the farmers with the help of research assistant(s). The questionnaire have closed ended questions which were formulated and arranged in a choice format that made the respondents select only the appropriate answers that they thought best described their opinion or attitude on a particular issue. The questionnaire contains two main sections. The first section is

designed to collect bio-data of the respondent (sex, age, marital status, senatorial district, education level, occupation, total land size, type of farming, type of crops cultivated, respondent's experience in using pesticides and annual income). The second section focuses on questions raised in the study which include farmer's knowledge on safe handling of pesticides, common practices by farmers in the handling of pesticides, and different pesticides in use by farmers.

Validity of Instrument

To validate the instrument, the contents of the questionnaire was examined for language difficulty as well as to determine whether or not the items of the questionnaire will elicit desire responses that will be relevant to the study. After necessary and scholarly corrections, the questionnaire was tested and administered on farmers outside the sampled areas of the two local governments. The result collected and analysis which affirmed its validity.

Data Analysis

Collected data was analysed using frequency count and percentage, nominal scale, chi-square and Pearson Correlation statistical tools through the use of Special Package for Social Science (SPSS) software. Frequency count and percentage was used to analyse information on socio-economic demographics of respondents. Data received from farmer's knowledge on the use of pesticide were calculated and analysed using Pearson Correlation at $p < 0.05$ level significance. Nominal Scale; where Always =3, Sometimes =2 and Never =1 was adopted in analysing information receives on common practices by respondents in the use of pesticides. Potential toxicity of the most commonly used pesticide by farmers in the study area was observed with haematological parameters of the collected blood samples of exposed *Rattus rattus*.

Comparative Analysis of Pesticide Exposure

Results from the selected farm settlements was compared. This is to ascertain which Senatorial district farmers are more exposed to pesticides toxicity based on knowledge and practices in the use of pesticides. More so, result of haematological analysis of exposed *Rattus rattus* to the common pesticide used in the study area was determined. To ascertain this, results of haematological analysis was compared between the test and control groups. Also, between the male and female rats, which determined

the hazardous rate of pesticides exposure in male and female farmers.

Toxicity Test

One hundred and thirty (130) healthy albino rats (*Rattus rattus*), Sixty-five (65) males and Sixty-five (65) females aged 15 - 16 weeks and weighed between 200 -220g were procured from a reputable animal or Anatomy laboratory. The animals were housed in polycarbonate (plastic) cages (32 X 40 X 18 cm) under control temperature ($26 \pm 2^{\circ}\text{C}$), in a 12-hour light and 12-hour dark schedule. During experiment, all the rats had free access to water and fed daily on a commercial pelleted diet purchased from a recognized local company. The diet provided essential nutrients (proteins, fats, carbohydrates, calcium, and phosphorus) to meet the requirements of breeding animals. The rats were acclimatized for three weeks in the constructed animal house, before using them for experimentation. The handling procedures of the rats was conducted in strict conformation with the guidelines and welfare regarding animal protection approved by World Health Organization.

Experimental Design

Thirty rats (15males and 15 females) were used in the acute experiment while sixty (30 males and 30 females) experimented for chronic. All the test rats were provided with commercial pelleted feed and different concentrations (mixture of pesticide and water) during the study period, while the control group rats fed with commercial pelleted feed and water instead of concentrate.

The rats tested for lethal dose (acute) were divided into five groups with 3 males and 3 females in each group. Groups I – 5 administered with different concentrations of pesticide mixture.

For the sub-lethal dose (chronic), sixty rats were divided into six groups, group 1 served as control while groups II, III, IV, V and VI as experimental respectively. Each group contained 10 rats (5 males and females each), doses in different concentrations (ml) of the identified commonly used pesticide by the farmers in the study area were administered on the rats orally (drinking), dermally and inhalation (from the scent/smell of the concentrate) for two weeks. Adequate dilutions made by dissolving different concentrations in millilitres (ml) of the commonly

used pesticide in one thousand (1000) millilitres (ml) of water respectively.

Behavioural and Toxicological Symptoms

Physical parameters of general behaviour assessed daily. Behavioural responses such as activeness, agility, movement, staggering, reduction and loss of appetite for food, and covering from the concentrates were observed and recorded.

All the rats (control and experimental) were observed closely during the study period for appearance of toxicological symptoms. The nature, degree, and time of occurrence of toxic symptoms were carefully recorded which included change in skin colour, eye ball, blindness, static movement and mortality rate.

Blood and Haematological Analyses

After fourteen days, all the rats experimented for sub-lethal (chronic) were anaesthetized by keeping them in an inverted glass jar containing large piece of cotton soaked in anaesthetic diethyl ether or chloroform. Cardiac puncture method was used in collecting blood samples using heparinized hypodermic syringe for haematological analysis.

Ethical Consideration

Ethical consideration sought from relevant ministries, departments, agencies and association for the permission of this work, which includes Kwara State Ministries of Agriculture, Environment, Health and Local Government Area Council. Also, the permission of relevant farmers association in the study area was not be left out.

Inclusion and Exclusion Criteria

All farmers (both male and female) using pesticides on their farmlands in the study area were included in this study, while farmers outside the study area not be included.

VI. RESULTS

Demographic Data

The following categories were used to group the relevant demographic data: sex, age, marital status, senatorial district, educational attainment, total land area, types of farming, respondents' prior pesticide use experience, and annual income.

According to Table 1, 278 (76.6%) of the 363 respondent farmers sampled for this study were men,

while the remaining 85 (23.4%) were women. 141 (75.4%) of the 187 sampled respondents in the Kwara North Senatorial district's Edu Local Government Area were men, while the remaining 46 (24.6%) were women. Additionally, it shows that 137 (77.8%) of the 176 respondents sampled for this research study in Ekiti LGA, Kwara South Senatorial district, were men and 39 (22.2%) were women.

women, for a total of 90 (24.8%) who were between the ages of 20 and 30; 85 (23.4%) were men and 10 (2.8%) were women, for a total of 95 (26.2%) who were between the ages of 31 and 40. Of the 84 (23.1%) responders between the ages of 41 and 50, 70 (19.3%) were men and the remaining 14 (3.9%) were women. Of the 94 (25.9%) respondents who were 51 years of age or older, 63 (17.4%) were men and the remaining 31 (8.5%) were women.

Table 2 shows that of the 363 respondents in this study, 60 (16.5%) were men and 30 (8.3%) were

Table 1: Sex Distribution

| Sex | Number | Percentage |
|----------------------|--------|------------|
| Male | 278 | 76.6 |
| Female | 85 | 23.4 |
| Total | 363 | 100.0 |
| Edu LGA Respondent | | |
| Sex | Number | Percentage |
| Male | 141 | 75.4 |
| Female | 46 | 24.6 |
| Total | 187 | 100.0 |
| Ekiti LGA Respondent | | |
| Sex | Number | Percentage |
| Male | 137 | 77.8 |
| Female | 39 | 22.2 |
| Total | 176 | 100.0 |

Table 2 Age Distribution of Respondents

| Age | Sex Distribution | | | | Total | |
|--------------------|------------------|------|--------|------|-------|-------|
| | Male | % | Female | % | Total | % |
| 20 – 30 years | 60 | 16.5 | 30 | 8.3 | 90 | 24.8 |
| 31 – 40 years | 85 | 23.4 | 10 | 2.8 | 95 | 26.2 |
| 41 – 50 years | 70 | 19.3 | 14 | 3.9 | 84 | 23.1 |
| 51 years and above | 63 | 17.4 | 31 | 8.5 | 94 | 25.9 |
| Total | 278 | 76.6 | 85 | 23.4 | 363 | 100.0 |

The results given in table 3 shows that, out of the total of 363 respondents sampled for the research study, 28 (7.7%) of them were male and 11 (3.0%) were female which making a total of 39 (10.7%) were into subsistence farming while 250 (68.9%) male and 74 (20.4%) female which also make a total of 324 (89.3%) were commercial farmers.

Table 3: Type of Farming

| Type of Farming | Respondent's Sex | | | | Total | |
|-----------------|------------------|------|--------|------|-------|-------|
| | Male | % | Female | % | Total | % |
| Subsistence | 28 | 7.7 | 11 | 3.0 | 39 | 10.7 |
| Commercial | 250 | 68.9 | 74 | 20.4 | 324 | 89.3 |
| Total | 278 | 76.6 | 85 | 23.4 | 363 | 100.0 |

From the pie chart in figure 2, it could be discovered that out 100% of respondents surveyed for this research study for the commonly used pesticides by farmers, (20.6%) of the respondents Dominator, 10.4% use Paraforce, 21% use Cyperforce, 8.7% use DDforce, 10% use Realsate, 10.1% use Boom, 9.9% use greentoxic and 9.5% us Laraforce. From the chart it could be discovered that the most commonly use pesticide by respondents is Cyperforce and followed by Dominator.

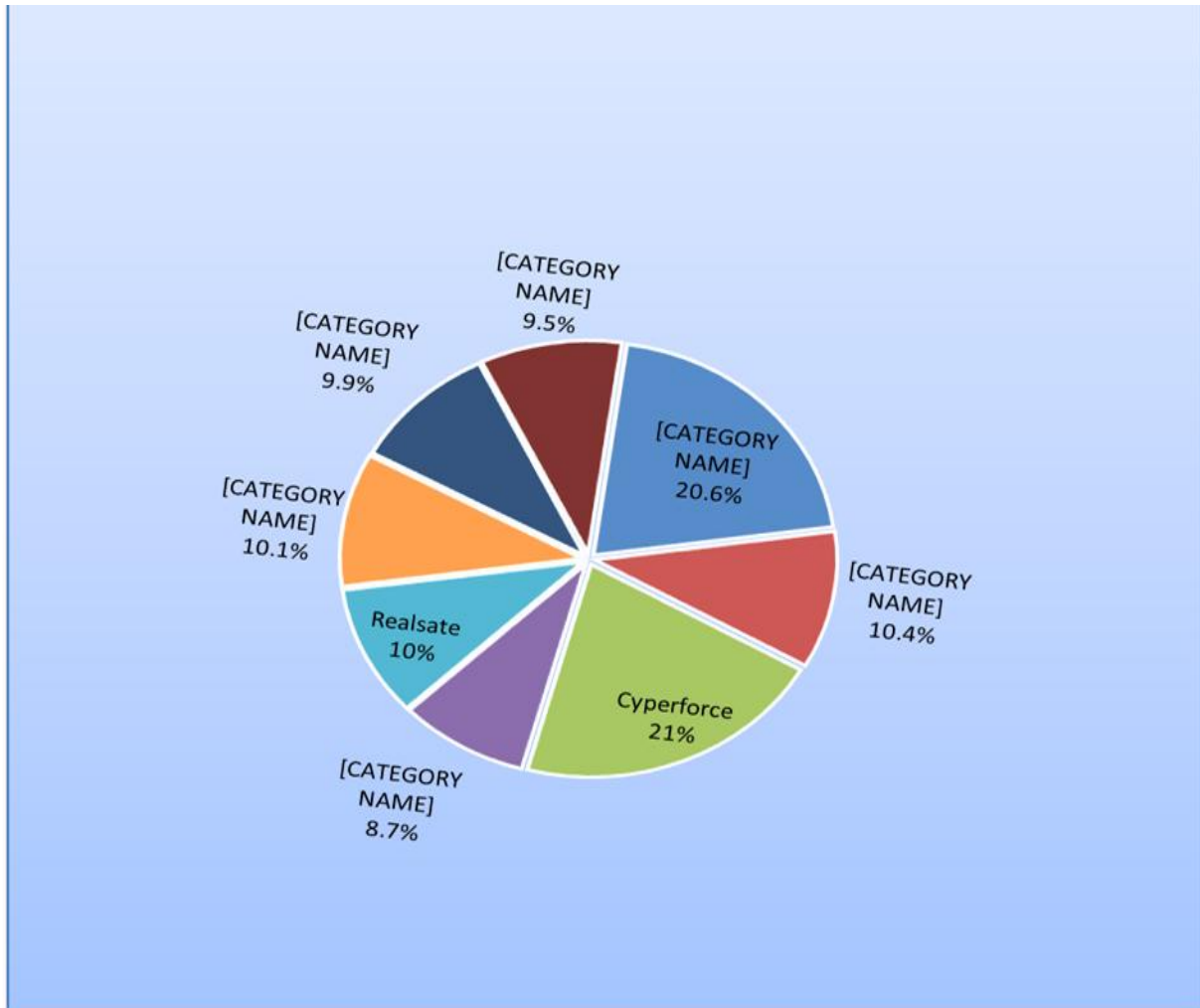


Figure 2. Percentage of common pesticides use by respondents in Edu LGA and Ekiti LGA Kwara State.

Hypotheses Testing

H0₁: There is no significant relationship between level of awareness and safe handling of pesticides.

Table 4. Level of awareness and safe handling of pesticides by farmers.

| | | A | B | c | D | e | f | G |
|---|---------------------|--------|---------|--------|--------|---------|--------|--------|
| a - Information on safe pesticide usage was gotten from extension workers from the department of Agriculture either from state or local governments | Pearson Correlation | 1 | -.151** | .003 | .669** | .741** | .807** | .777** |
| | Sig. (2-tailed) | | .004 | .951 | .000 | .000 | .000 | .000 |
| | N | 363 | 363 | 363 | 363 | 363 | 363 | 363 |
| | Pearson Correlation | - | 1 | .699** | -.010 | -.216** | -.075 | -.113* |
| | | .151** | | | | | | |

| | | | | | | | | |
|--|---------------------|--------|---------|--------|--------|--------|--------|--------|
| b - Rely on information regarding safe pesticide usage by fellow farmers | Sig. (2-tailed) | .004 | .000 | .844 | .000 | .155 | .032 | |
| | N | 363 | 363 | 363 | 363 | 363 | 363 | |
| c - Depend on information regarding pesticide usage given by retailers when buying products from them | Pearson Correlation | .003 | .699** | 1 | .155** | -.058 | .082 | .042 |
| | Sig. (2-tailed) | .951 | .000 | .003 | .268 | .118 | .426 | |
| d - Receive and follow instructions on safe pesticide usage made available by the agents/representatives | N | 363 | 363 | 363 | 363 | 363 | 363 | |
| | Pearson Correlation | .669** | -.010 | .155** | 1 | .566** | .828** | .714** |
| e - Receive information on safe pesticide usage from radio and television | Sig. (2-tailed) | .000 | .844 | .003 | .000 | .000 | .000 | |
| | N | 363 | 363 | 363 | 363 | 363 | 363 | |
| f - Follow safe pesticide usage information receive from literature | Pearson Correlation | .741** | -.216** | -.058 | .566** | 1 | .683** | .761** |
| | Sig. (2-tailed) | .000 | .000 | .268 | .000 | .000 | .000 | |
| g - Obtain information(latest) regarding safe pesticide usage from internet | N | 363 | 363 | 363 | 363 | 363 | 363 | |
| | Pearson Correlation | .807** | -.075 | .082 | .828** | .683** | 1 | .757** |
| h - Receive information on safe pesticide usage from radio and television | Sig. (2-tailed) | .000 | .155 | .118 | .000 | .000 | .000 | |
| | N | 363 | 363 | 363 | 363 | 363 | 363 | |
| i - Obtain information(latest) regarding safe pesticide usage from internet | Pearson Correlation | .777** | -.113* | .042 | .714** | .761** | .757** | 1 |
| | Sig. (2-tailed) | .000 | .032 | .426 | .000 | .000 | .000 | |
| j - Obtain information(latest) regarding safe pesticide usage from internet | N | 363 | 363 | 363 | 363 | 363 | 363 | |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

HO₂: There is no significant relationship between safe handling practices by farmers and level of exposure.

Table 5. Safe handling practices by farmers and level of exposure.

| Respondents' practices regarding safe pesticide usage | Always | % | Sometimes | % | Never | % | Total |
|--|--------|------|-----------|------|-------|------|-------|
| a - Read the instructions written on the container | 60 | 16.5 | 49 | 13.5 | 254 | 70 | 363 |
| b - Mix in the right proportion according to instruction | 81 | 22.3 | 272 | 74.9 | 10 | 2.8 | 363 |
| c - Mix with naked hands | 77 | 21.2 | 169 | 46.6 | 117 | 32.2 | 363 |
| d - Use stick or acceptable means for mixing | 49 | 13.5 | 213 | 58.7 | 101 | 27.8 | 363 |
| e - Wear gloves before using hand for mixing | 49 | 13.5 | 237 | 65.3 | 77 | 21.2 | 363 |
| f - Wear long dress only before starting a spray | 154 | 42.4 | 152 | 41.9 | 57 | 15.7 | 363 |
| g - Wear long dress and boot before starting a spray | 84 | 23.1 | 91 | 25.1 | 188 | 51.8 | 363 |
| h - Wear gloves and mask to protect hand and face | 43 | 11.8 | 161 | 44.4 | 159 | 43.8 | 363 |
| i - Smoke during pesticide applications | 31 | 8.5 | 119 | 32.8 | 213 | 58.7 | 363 |

| | | | | | | | |
|---|------|------|------|------|------|------|-----|
| j - Eat and drink during applications | 31 | 8.5 | 187 | 51.5 | 145 | 40.0 | 363 |
| k - Eat and drink after washing hand with soap and clean water | 71 | 19.6 | 241 | 66.4 | 51 | 14 | 363 |
| l - Use small wire to remove blockage | 63 | 17.4 | 265 | 73 | 35 | 9.6 | 363 |
| m -If the nozzle gets blocked, I blow it with my mouth to clog out | 54 | 14.9 | 254 | 70 | 55 | 15.2 | 363 |
| n - Wash contaminated clothes in a separate load | 98 | 27 | 218 | 60.1 | 47 | 12.9 | 363 |
| o - Take bath after completing the application | 142 | 39.1 | 202 | 55.6 | 19 | 5.2 | 363 |
| p - Dispose-off empty container according to the prescription | 34 | 9.4 | 109 | 30 | 220 | 60.6 | 363 |
| q - Use empty container as an utensil for other purposes in the house | 33 | 9.1 | 246 | 67.8 | 84 | 23.1 | 363 |
| r - Pesticides purchased only sufficient for one season | 95 | 26.2 | 235 | 64.7 | 33 | 9.1 | 363 |
| s - Pesticides can be stored in the animal shelter but in a separate room | 65 | 17.9 | 229 | 63.1 | 69 | 19 | 363 |
| t - Pesticides stored at home in a separate room | 49 | 13.5 | 270 | 74.4 | 44 | 12.1 | 363 |
| Total | 1363 | 19 | 3919 | 54% | 1978 | 27% | |

VII. HAEMATOLOGICAL ANALYSIS

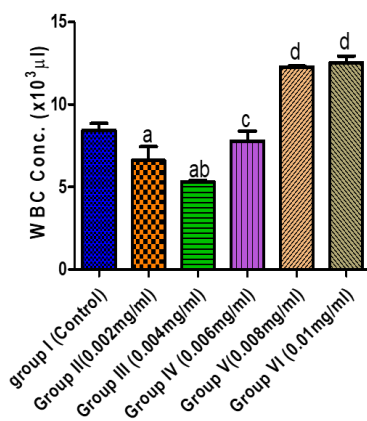


Figure 3. Effect of Cyperforce on White Blood Cell concentration in male rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group

'a' represents significant decrease when compared with control

'b' represents significant decrease when compared with Group II(0.002mg/ml)

'c' represents significant increase when compared with group III (0.004mg/ml)

'd' represents significant increase when compared with control and other groups

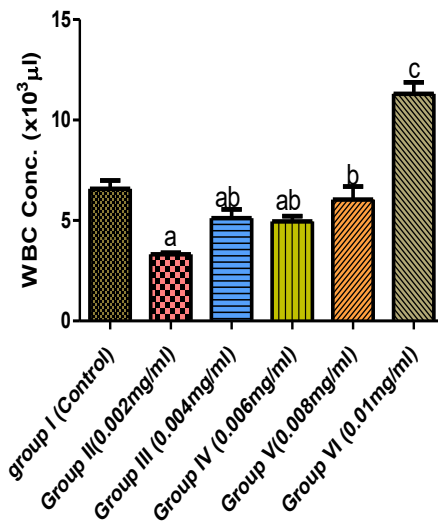


Figure 4. Effect of Cyperforce on White Blood Cell concentration in female rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group

'a' represents significant decrease when compared with control

'b' represents significant increase when compared with Group II(0.002mg/ml)

'c' represents significant increase when compared with control and other groups

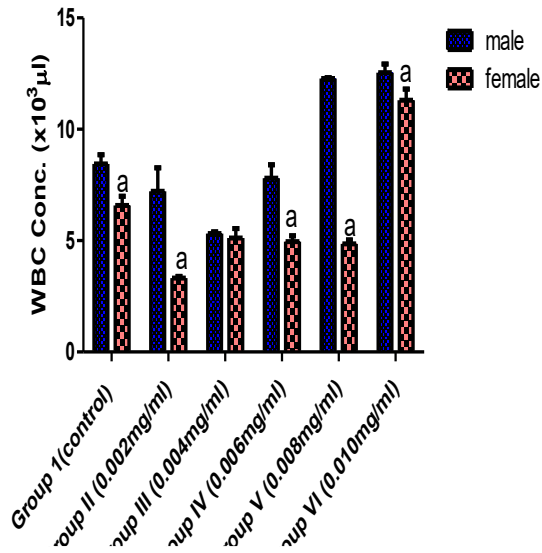


Figure 5. Comparison of effect of Cyperform on White Blood Cell concentration in male and female rats of the same dose

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with male groups

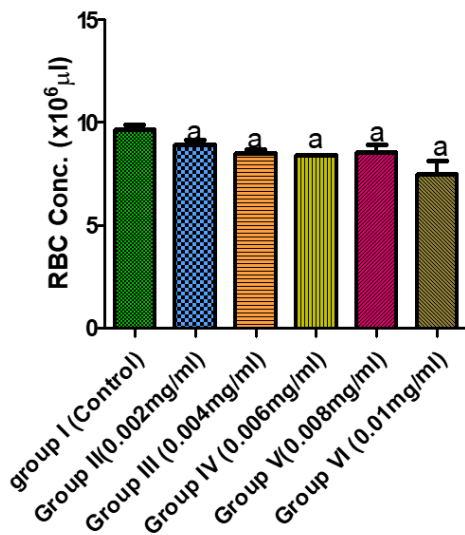


Figure 6. Effect of Cyperform on red blood cell concentration in male rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with control

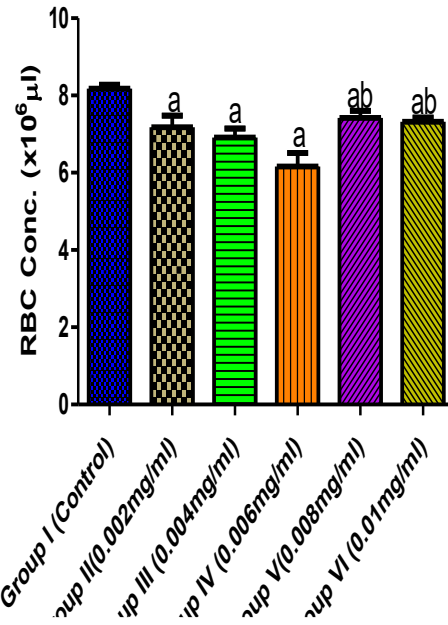


Figure 7. Effect of Cyperform on red blood cell concentration in female rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with control
 'b' represents significant increase when compared with Group IV(0.006mg/ml)

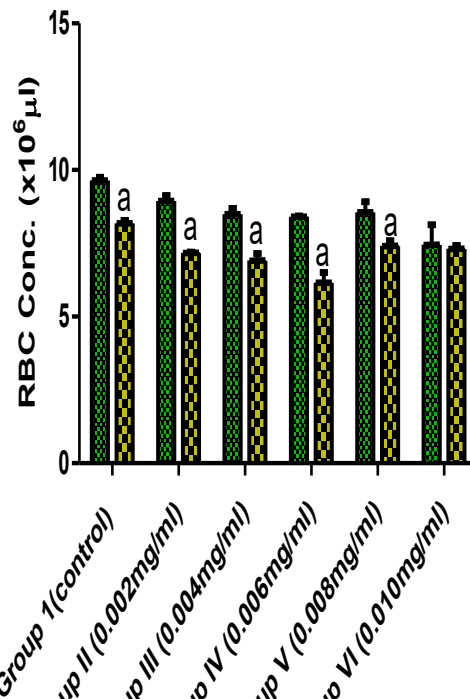


Figure 8. Comparison of effect of Cyperform on red blood cell concentration in male and female rats of the same dose

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with male rats

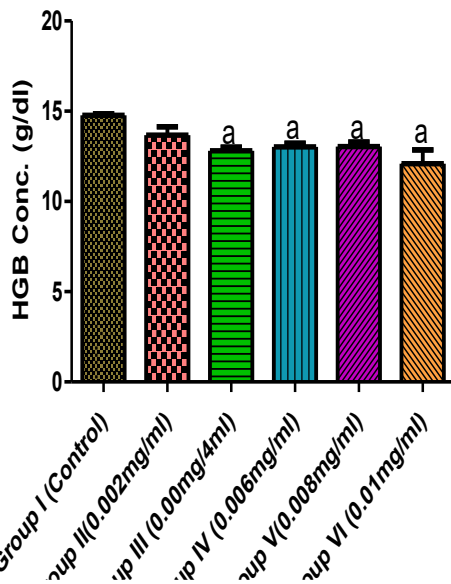


Figure 9. Effect of Cyperforce on haemoglobin concentration in male rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with control rats

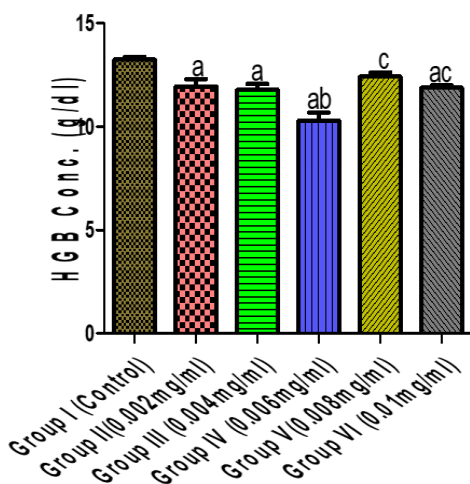


Figure 10. Effect of Cyperforce on haemoglobin concentration in female rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with control

'b' represents significant decrease when compared with Group II and group III
 'c' represents significant increase when compared with groups IV

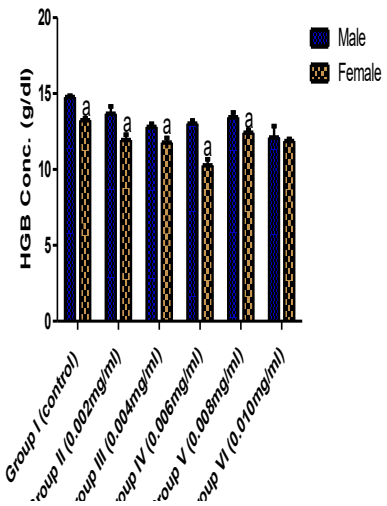


Figure 11. Comparison of effect of Cyperforce on haemoglobin concentration in male and female rats of the same dose

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with male rats

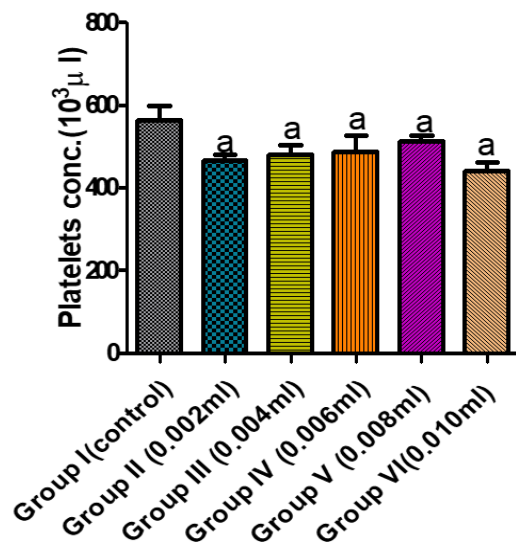


Figure 12. Effect of Cyperforce on platelet concentration in male rats of various treatment groups

Level of significance was taken at ($P < 0.05$) for five rats per group
 'a' represents significant decrease when compared with control

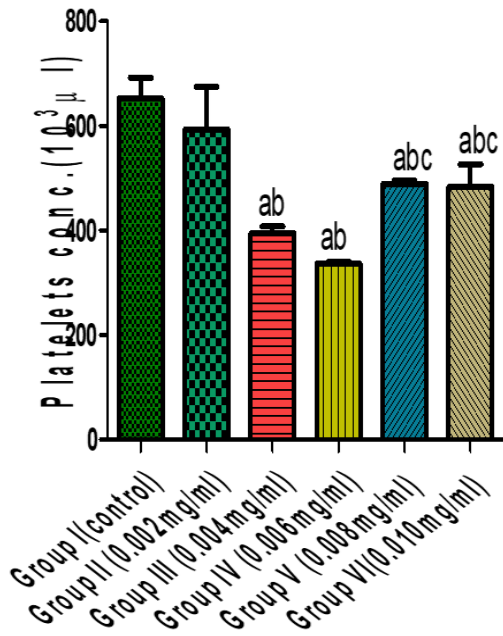


Figure 13. Effect of Cyperforce on platelet concentration in various treatment groups of female

Level of significance was taken at ($P < 0.05$) for five rats per group

‘a’ represents significant decrease when compared with control

‘b’ represents significant decrease when compared with group II

‘c’ represents significant decrease when compared with group III and Group IV

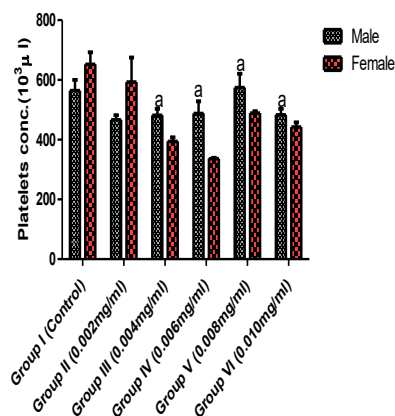


Figure 14. Comparison of effect of Cyperforce on platelet concentration in male and female groups of the same dose

Level of significance was taken at ($P < 0.05$) for five rats per group

‘a’ represents significant increase when compared with female group

VIII. DISCUSSION OF FINDINGS

This study's gender distribution is notable. 278 (76.6%) of the 363 responders were men and 85 (23.4%) were women. This large gender disparity implies that finding a more varied group of volunteers was difficult for the study. Cultural traditions, vocational variations, or the particular demography of certain places are some of the potential causes of this gender gap. Because pesticide exposure and toxicity might affect people differently depending on their gender due to differences in occupational exposure, family duties, and susceptibility, gender differences in the study's participant pool may have an impact on the study's findings. This result is consistent with the Minnikanti et al. (2019) study, which revealed a gender gap of 118 men and 53 women.

The findings also offer important insights into the distribution of age and gender among the participants in the study. Interestingly, there is a consistent trend showing a higher number of male respondents across all age categories, which reflects the overall gender distribution in the research. Age is a significant demographic element to examine when investigating pesticide toxicity. Different age groups may experience varying degrees of exposure to pesticides due to factors such as their jobs, lifestyles, and responsibilities. For example, younger individuals (aged 20 to 30) might be more engaged in agricultural work, leading to greater exposure to pesticides. While age is taken into account, it is essential to recognize that the earlier noted gender disparities persist within each age group. The reasons behind these disparities may be complex and could involve societal and cultural factors, such as variations in occupational choices or participation in the study. Understanding the age and gender distribution of respondents can inform policies and interventions related to pesticide use and safety. Tailoring educational programs and safety measures to specific demographic groups may be necessary to address the unique needs and risks associated with pesticide exposure.

265 respondents, or 73.0% of the total, said they were full-time farmers. Because of their line of work, this group is probably heavily exposed to pesticides. Of the respondents, 47 (12.9%) said they engaged in trading in addition to their main job. This implies that some people have several sources of income, and their exposure to pesticides may vary. Of the

respondents, 35 (9.6%) said they were employed, usually in non-agricultural capacities. Compared to full-time farmers, these people might be less directly exposed to pesticides. A smaller percentage of respondents—16, or 4.4%—identified themselves as artisans, suggesting that they work in jobs requiring manual labor and craftsmanship. They might not be as exposed to pesticides as farmers are. When researching pesticide toxicity, the respondents' varied occupations are essential. Due to their direct involvement in pesticide-related agricultural activities, full-time farmers are probably more vulnerable to pesticide exposure. Assessing respondents' risk levels can be aided by knowing their primary occupation. The complexity of livelihoods in the study area is indicated by the presence of traders and people with multiple sources of income. The nature of their varied occupations may have an impact on these people's varying patterns of pesticide exposure. Employed people, who may have less direct exposure to pesticides, are also included in the data. They might still be indirectly impacted, though, by the use of pesticides in their neighborhoods or, if relevant, by their agricultural pursuits. Depending on the particular crafts they work in, artisans may have distinct patterns of pesticide exposure due to their line of work. The results were consistent with those of Adekunle et al. (2017) and Adesuyi et al. (2018), whose respective studies included full-time farmers.

The positive correlation coefficient of 0.699 indicates a strong positive relationship between the information received from pesticides retailers and both farmers' knowledge and their level of exposure to pesticide use. In other words, as the information received from retailers increases, both farmers' knowledge and exposure tend to increase as well. This correlation highlights that there is a significant information flow from pesticides retailers to farmers in these farm settlements. Not only does this information contribute to farmers' knowledge, but it also appears to influence their actual practices and exposure to pesticides. The positive correlation between information and both knowledge and exposure suggest that well-informed farmers are not only more knowledgeable but also potentially more cautious in their pesticide use. This could have a positive impact on reducing the risks associated with pesticide exposure, including health hazards. A better-informed and safer pesticide application practices among farmers can lead to improved agricultural productivity. When farmers have a good

understanding of the toxicity of pesticides and their safe usage, they are more likely to use these chemicals effectively and efficiently. This correlation underscores the vital role of pesticides retailers as intermediaries between agricultural knowledge and the farming community. Retailers should be encouraged to provide comprehensive and accurate information about pesticide use, emphasizing safety measures and toxicity concerns. Based on these findings, there may be a need for educational initiatives and regulations that promote responsible pesticide retailing practices. These could include training programs for retailers and the development of educational materials to accompany pesticide sales. Given that safer pesticide practices can reduce the negative impact on the health of farmers and the environment, these findings have implications not only for individual farmers but also for the broader community and the sustainability of agriculture in the region.

However, Pearson correlation result of -0.151 between the information received from fellow farmers and agricultural extension workers suggests a weak negative correlation between these two sources of information in the context of agriculture. The correlation coefficient of -0.151 is close to zero, indicating a weak negative relationship. This means that as the amount of information received from fellow farmers increases, the amount of information received from agricultural extension workers tends to decrease slightly, or vice versa. This result doesn't support that of Minnikanti et al., (2019). However, the correlation is not strong, suggesting that there isn't a significant or clear pattern. This result suggests that farmers may not rely equally on these two sources of information. They might lean more towards one source while decreasing their reliance on the other. The negative correlation indicates an inverse relationship, where an increase in information from one source is associated with a decrease in the other. There could be various reasons for this weak negative correlation. Farmers may choose to rely on fellow farmers when seeking practical, field-tested advice and turn to agricultural extension workers when seeking more formal or technical information. Additionally, factors like accessibility, trust, or regional variations might influence which source of information farmers prefer. Agricultural extension services may need to consider their approach to delivering information and adapt to the preferences and needs of local farmers.

The correlation coefficient of 0.741 indicates a reasonably strong positive relationship between the information received from extension workers and the information obtained from radio and television. This means that as the extent of information obtained from extension workers increases, the extent of information from radio and television also tends to increase, and vice versa. This positive correlation suggests that farmers or individuals in the agricultural sector tend to use both extension workers and mass media like radio and television as complementary sources of information. They likely find value in the diversity of information provided by these sources. The correlation highlights the effectiveness of using mass media (radio and television) alongside personal interactions with extension workers to disseminate agricultural information and knowledge. This combination may reach a broader audience and cater to various learning preferences. Information from radio and television can help raise awareness about agricultural practices, while extension workers can offer more personalized advice and assistance. Together, they can contribute to improved agricultural practices, sustainability, and crop yields. It suggests that both personal interactions and mass media campaigns can be valuable components of agricultural extension programs.

The correlation coefficient of 0.699 indicates a reasonably strong positive relationship between the information received from fellow farmers and the information obtained from retailers. This means that as the extent of information obtained from fellow farmers increases, the extent of information from retailers also tends to increase, and vice versa. This positive correlation implies that farmers often use both fellow farmers and retailers as complementary sources of information. It suggests that they value the input and knowledge shared by their peers as well as the professional advice and products offered by retailers. The strong correlation underscores the importance of knowledge sharing and peer-to-peer learning within the farming community. Fellow farmers can offer practical insights based on their experiences, while retailers can provide access to a variety of agricultural products and services. This correlation may have implications for consumer behaviour and decision-making in agriculture. It suggests that farmers consider both the recommendations of their peers and the availability of products and services from retailers when making choices related to farming practices.

Information received from sales representatives and that obtained from literature revealed Pearson correlation result of 0.828 which indicates a strong positive correlation between these two sources of information in the context of agriculture. The correlation coefficient suggests a strong and positive relationship between the information obtained from sales representatives and that obtained from literature. In other words, as the extent of information received from sales representatives increases, the extent of information from literature also tends to increase, and vice versa. This strong correlation implies that farmers or individuals in the agricultural sector often use both sales representatives and literature as complementary sources of information. They recognize the value of professional advice from sales representatives and the knowledge contained in agricultural literature. Farmers appear to strike a balance between the expertise and product knowledge provided by sales representatives and the formal, documented information available in agricultural literature. This combination allows them to access a wide range of information. The strong correlation highlights the role of sales representatives as intermediaries for disseminating information contained in literature to farmers. Sales representatives can bridge the gap between academic or technical knowledge and its practical application in the field. Agricultural literature, such as manuals, research papers, and guides, can serve as valuable educational resources for farmers.

Pearson correlation coefficient of 0.757 indicates a reasonably strong positive relationship between the information derived from literature and information gathered from the internet. In other words, as the extent of information obtained from literature increases, the extent of information from the internet also tends to increase, and vice versa. This positive correlation suggests that individuals in the agricultural sector often use both traditional literature sources (such as books, research papers, and manuals) and online resources to access information. These sources likely complement each other, offering a diverse range of agricultural knowledge. Farmers and agricultural enthusiasts are leveraging the internet to access a wealth of agricultural information, including research studies, online courses, forums, and expert advice. The correlation with literature highlights the continued relevance of printed or formal agricultural documentation. The internet provides real-time access to the latest

agricultural research and trends, while literature may serve as a foundational resource. This combination allows individuals to stay updated while benefiting from established knowledge. Agricultural literature and internet-based resources serve as valuable educational tools.

The information correlation underlines the importance of harnessing both these mediums for knowledge dissemination and agricultural practices. Consequently, there is correlation between information gotten from fellow farmers, agents / representatives, internet, retailers and the use of pesticides by farmers at p 0.05 level of significance. The results of this study are consistent with those of Adesuyi *et al.* (2018), and Benjamin *et al.* (2019), who found that farmers' lack of information, understanding, and awareness of the risks linked with pesticide use is concerning. Hence, hypothesis that there is no significant relationship between sources of information available and use of pesticides by farmers is rejected.

The results of the farmers' practices in the use of pesticides, as revealed in this research raise several important concerns. A significant majority of farmers, 70%, did not read the instructions on pesticide labels before usage. This is alarming as not following proper instructions can lead to incorrect application and potential harm to the environment, crops, and the farmers themselves. Nearly 47% of the respondents admitted to sometimes mixing pesticides using bare hands. This practice is hazardous as it can result in skin exposure and potential health risks. While a substantial portion of the farmers sometimes mixed pesticides in the right proportions (75%), the fact that 27.8% never used acceptable means of mixing indicates room for improvement in safe pesticide handling practices. A significant number of farmers, 21.2%, never wore gloves, and 43.8% never wore gloves and masks for protection during pesticide application while majority did not wear personal protective equipment (PPE) during pesticide application. This puts them at risk of direct exposure to toxic chemicals. Some farmers admitted to risky behaviours such as eating during pesticide application (32.8%) and using their mouths to clear nozzle blockages (70%). These practices can lead to pesticide ingestion and inhalation, posing serious health risks. A concerning finding is that 60.6% of farmers never disposed of pesticide containers according to prescription. This can result in

environmental contamination and harm to the community. According to Mohanty *et al.* (2013) and Lekei *et al.* (2014), unsafe disposal of both undesired pesticides and empty pesticide containers could put the general community at higher risk. This result supports their conclusions. 67.8% of respondents sometimes or always use pesticide containers for other purposes. This raises concerns about cross-contamination and unintended exposure. A significant number of farmers (74.4%) sometimes store pesticides at home. This practice is risky, as it can lead to accidental exposure for family members and pets. All these unhealthy practices employed by farmers make them susceptible and put them at high risk of pesticide exposure thereby endangering their health. The research results by Okoffo *et al.* (2016), Ojo (2016), Adesuyi *et al.* (2018), Muhammad *et al.* (2019), Benjamin *et al.* (2019), and Minnikanti *et al.* (2019) are in congruent with these findings. Therefore, hypothesis that there is no significant relationship between farmers' practices in the use of pesticides and level of exposure is rejected. This research results on farmers' practices highlight the urgent need for comprehensive pesticide safety education and training among farmers in Kwara State. It is crucial to raise awareness about the potential risks associated with improper pesticide use and to promote safe handling practices. Government agencies, agricultural extension services, and non-governmental organizations can play a vital role in providing guidance and resources to improve safe pesticide handling and reduce the associated health and environmental risks in farming communities.

Exposure of rats (*Rattus rattus*) to Cyperforce, a commonly identified pesticide used by farmers in the study area was done in lethal and sub-lethal doses. It contains an active component Cypermethrin, which is typically used to reduce pests and improve agricultural output. Exposed rats to lethal doses at different concentrations (0.5, 0.6, 0.7, 0.8, 0.9 mls) exhibited robust behavioral responses by stacking sawdust and covering the pesticide container while avoiding the chemical. Additionally, it was noted that the animals began to stutter and staggered, eyeballs began to seem slightly dim, discolored and ragged skin, which are toxicological symptoms observed. One hundred percent mortality was later recorded which demonstrated that Cyperforce, at the high supplied quantities, adversely altered the animals' physiological environments through the metabolism of Cypermethrin, an active component of Cyperforce

that was fatal to the animals. Cypermethrin or its metabolite might have elicited various Biochemical pathways resulting in the toxicological effects on the rats which resulted in their Mortality. The result of finding is in congruent with Karashdeep and Rupinder (2018); Riaz (2020), who reported that pesticide exposure has been linked to problems of the neurological, endocrine, and reproductive systems which may lead to mortality.

A sub-lethal dose is one that does not contain quite enough of a toxicant or toxic chemicals to kill an organism. On another set of experimental rats, the effects of Cyperforce administration at various concentrations of 0.002ml, 0.004ml, 0.006ml, 0.008ml, and 0.010ml were evaluated. The rats showed symptoms of reduced mobility and agility on days 1 and 2 after receiving sub-lethal doses of Cyperforce, as well as a diminished reaction to food and drink. However, no deaths were noted, and the rodents' skin appeared normal. In addition, Cyperforce administration at the aforementioned concentrations from days 3 to 9 revealed that the rats stopped exhibiting a minimal reactivity to pesticides, restored their agility, and responded to food and water. Additionally, the animals' skin appeared to be unaffected and in normal condition. Since no animal deaths were seen during the sub-lethal toxicity tests, the concentrations of Cyperforce at 0.002, 0.004, 0.006, 0.008 and 0.010 are only to be used in experiments. This finding is in consistent with Palaniswamy, *et al.* (2021) who observed that low concentration of Cypermethrin is not toxic, hence not harmful to effect mortality.

Haematological analyses were done on some blood parameters which include white blood cell, red blood cell, haemoglobin, and platelet of the exposed rats to Cyperforce at sub-lethal concentrations.

White blood cells (WBC) protect the body of the organism from infectious diseases and foreign invaders and are crucial for both innate and humoral immune responses (Khameal *et al.*, 2018, Tigner *et al.*, 2022). In groups II, III, and IV of figure 1–3, Cyperforce caused a non-dose dependent significant decrease in WBC concentration when compared to the control group; however, groups IV and V of both male and female rats showed a significant increase in WBC concentration when compared to the control and other treated groups. It might be assumed that the active ingredient in Cyperforce, Cypermethrine, has a direct toxic effect on the bone marrow, which could

negatively disrupt the process of erythropoiesis and lead to the decreased WBC shown in groups II, III, and IV. The higher concentration of cyperforce, however, may have caused the immune system and group V and VI's elevated WBC to become activated. This outcome is consistent with earlier reports by Tigner *et al.* (2022), which described similar effects in experimental rats given pesticides. WBC concentrations in the female groups were considerably lower than those in the male groups in all treatment groups, which may be explained by differences in gender in the experimental animals. This observation is in harmony with Palaniswamy *et al.* (2021), who observed increase in WBC in male experimental rats when compared to females after been exposed to pesticide.

According to reports of Doig and Zhang, (2017) and Riaz, (2020), the correlation between hemoglobin concentration and RBC count is the outcome of these blood parameters' synergistic interactions. The effects of pesticide on the concentration of red blood cells (RBC) and hemoglobin (HGB)% in male and female rats were discovered. In both sexes, Cyperforce was found to dramatically lower the concentrations of RBC and HGB. RBC and HGB declines did not exhibit dosage dependency. According to reports, pesticide toxicity manifests as a decrease in RBC and hemoglobin content. RBC and HGB(%) were significantly higher in male than female animals of the same dose, which may be attributed to a number of factors related to bone marrow-derived hemoglobin production as well as the direct stimulation effects of androgen in humans on bone marrow in conjunction with erythropoietin, as previously reported by Kumar *et al.* (2019). Th is decrease could be attributed to Cypermethrin or one or more of its metabolites blocking one or more of the many synthetic stages involved in erythropoiesis from the bone marrow. This outcome is consistent with other studies conducted by Karashdeep and Rupinder (2018), Riaz (2020).

Platelet concentrations when compared to the control group, the results obtained demonstrate a considerable drop in platelet counts in groups III, IV, V, and VI, which may be due to the harmful effects of cypermethrin on blood production. However, group V and VI displayed higher platelet concentrations compared to group III and IV; this indicates that the animals responded normally to the higher concentration of pesticide supplied, possibly by being

stimulated to produce more red blood cells by erythropoietin. The earlier report by Tigner et al. (2022) is consistent with this. Additionally, group II exhibited a substantial rise in female animals treated with the same concentration of pesticide, while groups III, IV, and V in male rats showed a significant increase in platelet concentration in comparison to female animals administered the same concentration of pesticide.

IX. CONCLUSION

The study provided an overview of the use of pesticides and investigated the toxicity of Cyperforce in selected farm settlements in Kwara state, which revealed several significant findings. It encompassed a diverse group of respondents, with a majority of male participants, a significant portion of illiterate farmers, and a wide range of ages and farming experience. These demographics highlight the need for tailored education and awareness campaigns on safe pesticide practices, especially among less-educated farmers. Contrary to the hypothesis, the research found that farmers rely on information from various sources for pesticide usage. This emphasizes the importance of promoting accurate and safe practices through these information channels to minimize exposure risks. The study identified several unsafe practices among farmers, including inadequate personal protective equipment (PPE) usage, improper handling of pesticides, and indiscriminate disposal of containers. These practices increase the risk of exposure and underline the necessity of promoting safe handling and disposal techniques. Cyperforce emerged as the predominant pesticide used in the study area. This highlights the importance of assessing the toxicity and safety of specific pesticides commonly employed by farmers to protect both the environment and public health. The study demonstrated that Cyperforce has severe toxic effects on rats, resulting in 100% mortality at certain doses. Moreover, haematological analyses revealed significant changes in various blood parameters, indicating potential health risks associated with pesticide exposure. The interaction of Cyperforce or its metabolites with cellular constituents brought about significant changes in haematological parameters. These alterations may be rapid or slow and often cause a change in structure and function of the affected tissues. Therefore, assessment of haematological indices can be diagnostic of adverse effects of foreign

compounds on the blood constituents since such haematological alterations have high predictive value for human toxicity when the data are interpreted from animal studies. In light of these findings, it is evident that there is an urgent need for comprehensive pesticide management and education programs in the study area. These programs should aim to raise awareness, promote safe handling practices, and reduce the health and environmental risks associated with pesticide usage. Additionally, regulatory authorities and agricultural extension services should work together to ensure that farmers have access to safer alternatives and are well-informed about the potential hazards of using pesticides. Ultimately, this research provides a crucial foundation for addressing pesticide-related challenges in Kwara State and can serve as a guide for policy development and intervention strategies in the future.

X. RECOMMENDATION

Based on the findings, the following recommendations were made;

- i. In order to protect themselves from pesticide exposure-related degenerative diseases, farmers should be more informed on the toxic effects of pesticide exposure as well as self-protective literacy on pesticide application.
- ii. It would be useful to regularly organize behavior modification programs on safety measures when applying pesticides, which would help to promote farmer health and eliminate or reduce the hazardous pesticide residues in the environment and food. This can be accomplished by educating farmers and providing them with training on how to use pesticides safely.
- iii. It is important to support additional studies on higher-order controls to lessen pesticide exposure, understand the rationale behind using personal protective equipment (PPE) correctly, and find efficient teaching techniques.
- iv. Adequate and comprehensive environmental studies should concentrate on educating workers on pesticide safety and protection standards in order to reduce health risks. This is due to their lack of awareness of the negative effects of pesticide exposure and the fact that farmers and farm workers in Nigeria rarely take precautions when using pesticides.
- v. Governments, tertiary institutions, and research institutes should introduce, make available, and promote alternative pest management methods

like the use of bio-pesticides. This would lessen the need for chemical pesticides and the damaging effects they have on the environment and human health.

Contribution to Knowledge

Pesticide Toxicity Evaluation: This research offers essential insights into the profile and harmfulness of frequently utilized pesticides in agricultural practices in Kwara State. By assessing the effects of pesticides on both human health and the environment, it enhances the understanding of the dangers linked to these chemicals.

Identification of High-Risk Pesticides: The study emphasizes particular pesticides that carry greater toxicity risks, aiding farmers and policymakers in making educated choices regarding their application. This data can inform the selection of safer alternatives or improve safety protocols.

Regional Differences: The research highlights the distinct challenges and practices present in Kwara State, which may vary from those in other areas. This regional insight is crucial for customizing pesticide regulations and recommendations to meet the specific needs of local farming communities.

Effects on Farmers: By analyzing the impact of pesticide exposure on farmers, the study aids in understanding the occupational health risks and safety protocols necessary in the agricultural industry. This information can guide labor policies and enhance working conditions.

Environmental Consequences: Evaluating the effects of pesticides on the local ecosystem, including soil, water, and non-target species, adds to our understanding of the long-term ecological impacts of pesticide application. This knowledge can promote more sustainable agricultural practices.

Risk Mitigation Strategies: The study probably offers suggestions for reducing the risks associated with pesticides, such as encouraging the use of protective gear, teaching farmers safer application techniques, or supporting the application of integrated pest management (IPM) techniques to lessen reliance on pesticides.

Public Health Awareness: By sharing research results, this study can raise public awareness of the

dangers of using pesticides and encourage safer behaviors. Farmers, consumers, and regulators may make more informed decisions as a result.

Policy Recommendations: The study may serve as a foundation for suggestions to state and local governments about pesticide laws, oversight, and enforcement. This is essential for protecting the environment and public health.

Baseline Data: The study probably creates a baseline of pesticide toxicity and usage in Qwara State, which can be used as a guide for upcoming studies and policy evaluations. To monitor changes over time, this historical data is crucial.

Community Engagement: By including nearby farmers, cooperatives, and agricultural extension services in conversations regarding pesticide use and safety, the study may promote community engagement. Collaborative efforts to address pesticide-related issues may result from this engagement.

Overall, this research contributes to a comprehensive understanding of the overview and toxicological aspects of pesticide use in Kwara State, ultimately aiming to improve the safety and sustainability of agricultural practices while protecting the well-being of farmers, farmworkers, and the environment.

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