

PESTICIDES RESIDUES: ECOLOGICAL INFLUENCE, COMPLICATIONS AND SUSTAINABLE SOLUTIONS

Abdulsalam A. A¹, Ogunbolude O. K², Oladele S. G³, Onyeka C. F⁴, Oyekanmi O. F⁵,
Falese T. T⁶, Awe A. A⁷, Suleiman J⁸

^{1,8}Department of Science Laboratory Technology, Kebbi State Polytechnic, Dakingari.

^{2,4,5,6,7}National Biotechnological Research and Development Agency (BIODEC), Ogbomoso, Oyo State.

³JMAC Lab Nigerian, Oko Erin, Ilorin, Kwara State

Corresponding authors' email: solidfoundationdkg@gmail.com

ABSTRACT

The quest for demand for pesticides has increased due the destruction of pest on crops, to improve the crop productivity, elimination of undesirable plants and get rids of crop pest. The utilization of the pesticides has a negative impact on the environment and resulted to the accumulation of residue which is linked to human health, contamination of food, farm soils and water. Pesticides residues in ecological environment has been a great concerned to the farmers, individuals and government agencies due to their potential implications for food safety and human health. Pesticides management practices needs to be adopted to minimize non-target effects on the environment as well as to promote accumulation of plant residue on the surface of the land for high adsorption and degradation. This review study the varieties of pesticides, the needs in agriculture to enhance crop yield and protection against pest. Moreso, reduction of the accumulation of residue in the environment, assessing their associated risk and mitigation strategies. However, wrong applications, inadequate post harvest intervals can constitutes accumulation of harmful residues in produce and pollution of ecological environment.

Keywords: Pesticides, Pesticides Residues, Human Health, Soil, Water.

1. INTRODUCTION

As the population is increasing around the world so as the demand for food increases progressively (Kumar,2020). The production of food has been affected by pest. In the process to combat the pest on crop production, application of chemical substances is required known as pesticides. Pesticides are substances which have a significant role to play in agriculture to enhance food yield and productivity. Common classification of pesticides are organochlorine, organophosphates, carbamates, and pyrethroids (Matow et al; 2020). They are commonly known as insecticides, fungicides, and herbicides (Hill et al; 2017). These chemical substances are capable of preventing, controlling any pest causing plant illness, harm to food crops, wood production and animal feeds, thereby boosting the yield of crops (kumar, 2022). They are potentially toxic to other non-target organisms in the environment.

The first generation pesticides includes sulphur and nicotine. They are toxic and ineffectiveness due to insect resistance. The introduction of second generation pesticides such as organochlorine, dieledrin, dichloro-diphenyl-trichloroethane (DDT) came to existence due to its effective, affordability and ease of application. Later the introduction of organophosphate, carbonates which are relatively cheap, affordable and effective compare to the second generation pesticides.

Organochlorine pesticides are used in agriculture which are absorbed by the plants, causes respiratory problems through inhalation, damage the skin and hormonal system (Muhammad et al., 2021). However, lindane is a pesticides also used in agriculture and apply on scabies and lice. Exposure of this pesticides leads to miscarriage in woman in addition to disturbances in normal level of estrogens, androgens and thyroid hormones in rodents (Silva et al., 2018). Organophosphates and carbamates are not persistent because they are degraded when exposed to sunlight, air and soil. Pyrethroids and neocotinids are systemic and have high affinity to soil, low volatility and bioaccumulation.

The persistence of pesticides in the environment is hazardous (Islam et al., 2022). The pesticides residues contaminate the environment due to the application of the pesticides and prone a great concerned around the world which has lead to damage to crops, water, soils, and causes health related issues (Stuar et al., 2023). Utilization of pesticides to the soil has rendered soil damage which has attracted attention of researchers, farmers and government agencies. Application of pesticides can remain in the soil as residues. Excessive accumulation into the soil can enter the food chain, and water bodies (Poudel et al;2020).

A review of literatures revealed that some pesticides are very selective in their mode of action, which is limited to test organisms. However, the contamination of water with pesticides can damage the water as well as the aquatic ecosystem (Hojj ati-Najefabadi et al., 2022). High level of pesticides residues is as a result of improper pesticides applications

which includes pesticides selection, excessive quantity and not adhering to the recommended mixing concentration (Kaye et al;2015).

CLASSIFICATION OF PESTICIDES AND MODE OF ACTION

Pesticides are classified based on intended organisms and degree of biodegradability. Common pesticides based on application on pest are insecticides, weedicides, and rodenticides (Ram et al., 2021). However, pesticides such as organophosphorous, organochlorin, nematocides, pyrethroids, herbicides, and biopesticides are based of chemical nature (Shah, 2021).

Insecticides are chemical substances to combat insects that damage crops leading to reduction of yield. It is classified with a specialized mode of action which affects the nervous system of the pest. Insecticides such as acetyl choline esterase, malathion, phorate, dichlorvovous on inhalation after application causes convulsions and hyperaxcitability of the pest. Endosulfan and fipronil on application on pests result to hyper excitation and nerve blockage of the pest. Other symptoms produced by the pest on application are lethargy and paralysis (Nicolopoulou et al., 2021).

Herbicides, target weeds that compete with crops for nutrients and sunlight affecting the growth of the crops and productivity. The pesticides disrupt the cell membrane, inhibit photosynthetic, amino synthesis, and growth of the weeds. Common herbicides are 2,4-Dichlorophenolic acetic acid (2,5-D), dicamba quinclorac, dichlorprop, MCPA (2, methyl-4-chloro phenoxy acetic acid), mecoprop etc, which affects the hormonal system of the weeds. Inhalation or swallow of the pesticides results into a significant respiratory dysfunction and other related respiratory diseases (Nicolopoulou-stamati et al., 2021).

Fungicides are chemical substances that control the effect of fungi on plants, affecting the quality and productivity. Fungicides prevent the growth of the pest by affecting the biological system of the causation organisms. The chemical substance targeted the respiratory system, amino, endocrine system and protein and lipid synthesis organ of the fungi.

Rodenticides are chemical substances apply to manage rodents which damage crops, contaminate food on storage and equally spread diseases. Common rodenticides are warfarin, brodifacoum,, and zinc phosphide. They are non-anticoagulant pesticides which disrupts cellular respiration of the rodents and causes death. Flocoumafen, difethialone, and chlorophacinone are rodenticides which inhibit respiration and caused death to the rodents. Chlorophacinone, strychnine, and flocoumafen causes accumulation of acetylcholine and causes death of rodents. Rodents can develop resistance to rodenticides reducing its effectiveness and can be poisonous to other non-targeted organisms.

IMPACT ON ECOSYSTEM

Pesticides harmful effects on the environment cannot be over emphasized. As it is dangerous to the pest, so as it affects non-target species like man, animals, and plants, soil and water. It has negative effects on farms, grazing areas, human settlements, and aquatic ecosystem. However, regular application of insecticides increases pest resistance (Asghar et al., 2016).

a. Impact of pesticides on human health

Application of pesticides on the environment have both short and long term effects on health. The short term effects includes eye stinging, blisters, rashes, skin irritation, blindness, nausea, and dizziness. Exposure of pesticides for a short period of time pose a risk to respiratory system, such as asthma attack, persistent cough, wheezing, and expectoration, This is brought by the symptoms of burning in the throat, lungs, congestion, cramps, skin peeling, diarrhea, headache, chest pain, weakness, and skin irritation (Nicolopoulou et al., 2021).

Long term effects of exposure pose a challenge and chronic effects. These includes cancer, disruption of endocrine system, birth abnormalities, damage to the reproductive system, neurological development, and toxicity. Pesticides persistence can also lead to leukemia, malignancies of the brains, breast, infertility, and other reproductive system. Furthermore, endocrine disruption includes obstruction of hormones (Asghar et al., 2016).

b. Impacts of pesticides on soil

Pesticides will pollute the soil after bioaccumulation. High concentration of pesticides in soil influences processes such as plant growth, diversity of biotic populations and damage to the soil. As well, pesticide residue damage the soil organism and disruption to the soil ecosystem. Soil contamination reduces microbial activity, soil nutrient as well as plant growth and productivity over a period of time.

c. Impact of pesticides on water

Pesticides residue in water are significant concerned to the world. Accumulation of the residue in surface and groundwater, posing risk to aquatic life and affecting the quality of water supply. Residues of organophosphates and carbamates harm the nervous system and being linked to cancer. However, some pesticides interfere with the hormone system in the body. Improper application of pesticides, poor irrigation lead to leaching into ground water.

PROSPECTIVE CHALLENGES

The government and other regulatory bodies should regulate the use of pesticides to ensure safety, efficacy and environmental protection. The regulatory frame work is based on enforcing, monitoring to manage pesticides risk effectively. Integrated Pesticides Management (IPM) has emphasize the management practice that minimize pesticides use by integrating biological, cultural, physical and chemical control methods. The IPM emphasize making pesticides utilization as the last resort to reduce environmental influences of pesticides and preserves the damage of environment by the pesticides.

2. SUSTAINABLE SOLUTIONS

The sustainable alternative control of pest to minimize the negative impact of pesticides on the environment is simply to adopt the biological control, organic farming practices, and precision agriculture.

- a. The biological controls involves using natural enemies such as predatory insects, microbial agents to regulate pest populations affectively. Biological control agent targets specific pests while minimizing non-target organism.
- b. Organic farming practices are methods which prohibit chemical substances and make natural input to enhance crop yields and productivity. It makes use of crop rotation, cover cropping and soil health management to combat pest and crop diseases. This pesticides management has benefited soil, water, and wildlife habitat.
- c. Precision agriculture utilizes technology involves a technology such as sensory based monitoring system to optimize pesticides applications and minimize negative effects on the environment. It involves monitoring the real time to apply pesticides, area where needed and this enhance resource efficiency and promote sustainable farming practices.

3. RECOMMENDATIONS

Farmers and agricultural professionals should be trained on integrated pest management (IPM) . Moreso, extension programs, workshop and outreach initiatives should be promoted or adopted to enhance environmental protection and sustainability.

4. CONCLUSIONS

Pesticides are beneficial to agriculture and enhance better output but the need for sustainable pest management practices and regulations should be encourage. Embracing integrated pest management (IPM), strategies, promoting biological control on pest and supporting organic farming practices would reduce the negative impact of pesticides on the environment. However, a public awareness by the integrated pest management (IPM) to minimize pesticides through natural methods (FAO,2020). The FAO/WHO joint meeting on pesticides residues (JMPR) should set a standard for maximum residue level (MRLs) on every pesticides.

5. REFERENCES

- [1] Acharya, B; Pouel, P; Poudel, S; Poudel B (2020). Pesticides Use and its Impact on Human Health and Environment, 'Environmet and Ecosystem Science 4: 47-51
- [2] Asghar, M.F; Malik M.; Javed (2016).. Pesticides exposure and Human Health. A Review. J, Ecosys Ecograph. 55: 005.
- [3] Hojjati-Najafabadi, A; Mansoorianfar, M; Liang, T (2022). A review on magnetic sensors for Monitoring of hazardous pollutants. Science of the journal water resources Env,824, 153844.
- [4] Hill, M.P; Macfadyen, S; Nash, M.A (2017). Broad spectrum pesticides application alters natural enemy communities and may facilitate secondary pest outbreaks. Peer J 5: e4179.
- [5] Kaye, E; Nyombi, A; Mutambuze, I.L; Muwesa (2015).Mancozeb residue on tomatoes In central Uganda. J Health Pollute 5(8); 1-6.
- [6] Kumar, N; Pathera, A; Saini, P; Kumar, M (2020). 'Harmful effects of pesticides on human Health. Agri. Bio Res, 17;165-8
- [7] Islam, M.A; Amin, S.N; Rahman, M.A; Juraimi, A.S (2022). Chronic effects of organic Pesticides on the aquatic environment and human health; A review. Environmental Nanotechnology. Monitoring Management.
- [8] Mohammed, A.O; Abdelgagi,A.O; Abdalla, A.M; Suleiman, A.E; (2021). Insecticides residues In cotton, sorghum, and fallow soil from the muba mountains cotton corporation of South Kordofan sate, sudan. Journal of Health Pollution, 1;11.
- [9] Nicopoulou,-Stamti, P; Maipas, S; Kotampasi, C; Hens, L (2021).Chemical pesticides and Human Health: The urgent need for a New Concept in Agriculture, Front. Public\ Health: 4.
- [10] Silva, J.S; Ocalzo, F.M; Serakides, R (2018). Thyroid hormones and female reproduction.
- [11] Biology of reproduction, 1 (99): 5.
- [12] Shah, R(2021). Pesticides and Human Health, Emerging Contaminants.