IJMPR 2023, 7(12), 01-05

International Journal of Modern Pharmaceutical Research

www.ijmpronline.com

ISSN: 2319-5878
IJMPR
Review Article

SJIF Impact Factor: 5.273

A ROLE OF PESTICIDE ON BIRDS' HEALTH AND SURVIVAL: A REVIEW OF LITERATURE

Muhammad Asad Ayub[1] and Hina Ayub*[2]

[1]University of Veterinary and Animal Sciences.
[2]Jeju National University, Korea.

Article Received on: 04/10/2023
Article Revised on: 24/10/2023
Article Accepted on: 14/11/2023

***Corresponding Author**
Hina Ayub
Jeju National University, Korea.

ABSTRACT

Agricultural practices commonly use pesticides to protect crops from pests and increase yields. However, in addition to the target species, they can also adversely affect non-target species, such as birds. Among the issues explored in this review are the mechanisms of pesticide toxicity, the types of pesticides commonly used, and the ecological consequences of pesticide exposure. As a result of our findings, pesticides can harm birds in various ways, including direct toxicity, indirect effects on food availability, and habitat degradation. Additionally, there is a possibility that the current regulatory system is insufficient to prevent the long-term impacts of pesticide exposure on bird populations.

KEYWORDS: Pyrethroids, pesticides, avians, toxicity, Insecticides.

INTRODUCTION

The world is a composition of four essential elements: air, water, soil, and food (Brady *et al.*, 2008). Although these sources directly impact the quality of organism life, the various contaminants may be unavoidable in this technologically advanced age (Yadav *et al.*, 2015). Meat is the primary nutritive source, containing many natural and chemical compounds that cause harmful effects (American Bird Conservancy *et al.*, 2013).

Pesticides are commonly used in agriculture worldwide (Carvalho, 2017). Pesticide use is becoming a more severe environmental issue in most developing countries due to water pollution, ecosystem destruction, and habitat contamination. (Marquis, 2013). Pesticides control pests by killing them, such as bacteria, fungi, plants, insects, and rodents. Many big fruit and vegetable crops have seen significant yields thanks to chemical pest control (Marquis, 2013). Pesticides are toxicants intended to destroy pests but can also harm wildlife that we do not consider problems (Capinera, 2012). In agriculture and public health, pesticides play a critical role. They are essential for enhancing future food production and ensuring health by reducing the prevalence of vector-borne infections. (Mossa *et al.*, 2018).

However, the word "pesticides" denoted numerous types of pesticides, i.e., bactericides, fungicides, nematicides, molluscicides, Insecticides, herbicides, acaricides, and rodenticides, and kill pests (e.g., bacteria, nematode, fungus, moth, weed, snail, and rat) (Mossa *et al.*, 2018).

Pesticides can have several negative environmental consequences (Watson, 2014). Their presence in the soil causes different effects, i.e., runoff to groundwater, bioaccumulation in living organisms, and the earth becoming unusable for farming, and this causes nutrient pollution (Biga, 2013). Furthermore, pesticides can cause various unintended adverse health effects in humans, including respiratory problems, nervous system dysfunction, baby and teenager development, and cancers, including lymphoma. Many of these unintended adverse effects remain unknown (Watson, 2014).

Many chemicals are stable, bioaccumulated, and toxic in the environment. (Muir *et al.*, 2006). Some pesticides remain in the atmosphere for years because they are permanent. Pesticide residues are found in water and food due to environmental pollution and cause biological and physical degradation of products (Bright *et al.*, 2008). Pesticides used for weeding and pest control only hit the target pests less than 1% of the time: spray drift, off-target accumulation, runoff, and photodegradation. (Bernardes *et al.*, 2015). It is impossible to calculate the exact number of birds killed by pesticides. Birds usually die far from the poisoning place, or their bodies may quickly decompose. As a result, only a small percentage of dead birds are reported (Ponce *et al.*, 2010). One of every three bird species in the United States is endangered, threatened, or in need of protection, with grassland and wetland birds experiencing the most significant decline (Arya *et al.*, 2019).

In an ecosystem, avians play a vital role. These species are the most diverse and active communities, with a significant population in the tropics. (BLI, 2008). The threats causing their extinction are numerous and varied, but agriculture alone is responsible for the end of 87 percent of the world's endangered bird species. (Mitra *et*

al., 2011). A wealth of knowledge on them is generally missing from other classes. (Arya *et al.*, 2019). Thanks to the efforts of ornithologists and birdwatchers all over the world. Birds serve as early warning systems for environmental issues. (Bright *et al.*, 2008).

Avian species that are in good health are indicators of ecological balance. Environmental changes are the leading cause of the decline of avian populations (Mitra *et al.*, 2011). Seed dispersal, pollination, recolonization and regeneration of degraded habitats, and pest control are all essential functions of avian species in the natural systems. (American Bird Conservancy *et al.*, 2013). Bird population decline is a significant problem in many parts of the world (Mitra *et al.*, 2011). In addition, the extensive use of pesticides leads to global bird population declines and mortality (Orduna *et al.*, 2011).

Pesticides are classified in various ways, including by the pests they regulate (Bernardes *et al.*, 2015). For example, insecticides prevent insects, herbicides kill weeds and grasses, rodents kill rats, avicides kill birds, fungi kill fungi, and nematodes kill nematodes (Arya *et al.*, 2019).

Compared to other pesticides, pyrethroids are highly selective and are easily degradable in the ecosystem, making them a common alternative to organophosphorus compounds (Bernardes *et al.*, 2015).

Pyrethroids created on the structure of natural insecticidal pyrethrin derived from Chrysanthemum and have improved photostability (Lidova *et al.*, 2019). They are widely used in agriculture and households to manage or eliminate rodents and in veterinary and human medicine to control or eliminate ectoparasites (Biga, 2013). Pyrethroids are a form of insecticide that is highly effective but low toxic to mammals and birds. In addition, they have a lower environmental persistence than organophosphates, carbamates, and organochlorine pesticides, but they harm marine crustaceans and fish (Lidova *et al.*, 2019).

Pyrethroid insecticides account for 30% of the insecticides used worldwide (Bayo et al., 2011). Even though extreme pyrethroid toxicity is rare in developed countries, it appears to be prevalent in developing countries due to its widespread and extensive use for agricultural and domestic purposes (Dar *et al.*, 2012).

Pyrethroids can travel with soil particles in runoff and hit sediments, contaminating water bodies and impacting marine species such as invertebrates and fish (Sumon, 2018). Pyrethrin and pyrethroid products are highly toxic to fish, so the pollution of water bodies is a concern (Gupta *et al.*, 2013). Furthermore, some formulations have different insecticides, repellents, and solvents, including alcohol and petroleum, which increase pesticide toxicity (Bernardes *et al.*, 2015).

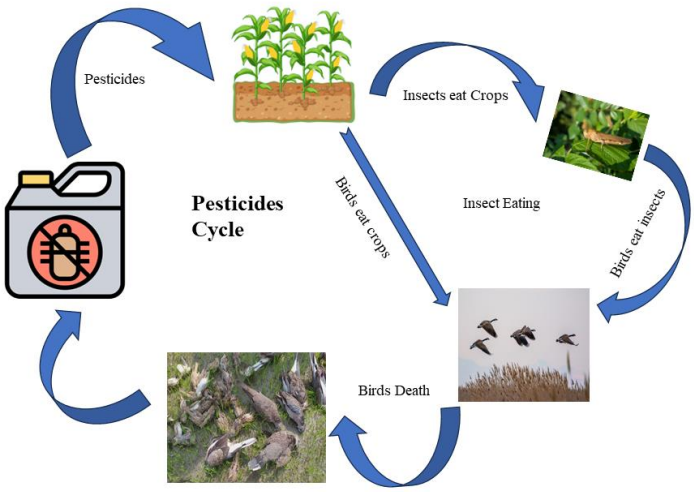

Figure 1: Pesticides cycle and birds' death. Representation of the Pesticide Cycle and its Impact on Avian Mortality. The diagram illustrates the continuous cycle of pesticide application in agriculture, depicting the sequence of events from pesticide use on crops to its subsequent effects on avian populations. The cycle commences with pesticide application on crops.

DIFFERENT TYPES OF PESTICIDES

According to Bahlai, insecticides with tiny ecological footprints must be chosen to establish sustainable agricultural systems because of the widespread public perception that natural products are universally safer and, hence, more ecologically friendly than synthetic chemicals; policies regulating pesticide selection frequently favor natural products and organic-certified pesticides to increase sustainability (Bahlai *et al.*, 2010). Ectoparasites can be controlled or treated using a variety of insecticides, including cypermethrin, lambda-

cyhalothrin (LCT), and ivermectin (Shah *et al*., 2007; Kakar and Kakarsulemankhel, 2009).

Natural pesticides

According to Ntalli, naturally occurring pesticides are plentiful and have many effects, while only a handful are commercially available. Mossa reported that chemical, mineral, and biological elements are found in natural pesticides, and some goods, such as neem, spinosad, rotenone, abamectin, garlic, cinnamon, pepper, and essential oil products, are commercially available. (Mossa *et al*., 2018).

Synthetic pesticides

Insecticides containing synthetic pyrethroids are severely deadly to pests and fish but only moderately dangerous to mammals and birds. They are regarded as one of the safest pesticides for use in food. The most used synthetic pyrethroid insecticides are cypermethrin, cyhalothrin, and Permethrin (Fothergill and Abdelghani, 2013). Ravula and Yenugu reported on actual human exposure circumstances. The effects of unintended pyrethroid pesticide consumption are rare. This type of exposure occurs mainly through the consumption of food products containing residual amounts of pyrethroids as part of a regular diet. (Ravula and Yenugu, 2021).

According to Chowanski, synthetic pesticides effectively control insects but can be detrimental to the environment and human health. They create ecosystem disruptions, are hazardous to a wide range of non-target creatures and have a high proclivity for accumulating in the environment (Chowanski *et al*., 2014). According to Zhang, the most regularly identified synthetic pesticides are organochlorine pesticides such as endosulfan, heptachlor, lindane, dieldrin, aldrin, endrin, and others (Wang *et al*., 2009).

Halder concluded that by direct spray and leaf dip methods, alphamethrin was shown to be the most lethal insecticide of the synthetic pyrethroids than cypermethrin. Organophosphate pesticides are termed broad-spectrum insecticides because of their many functions; they control a wide range of pests. (Hill *et al*., 2017). The most poisonous organophosphorus insecticide was profenophos, followed by chlorpyriphos, methyl demeton, triazophos, and quinalphos (Halder *et al*., 2007). Parathion, malathion, diazinon, and glyphosate are some of the most often-used organophosphorus pesticides (Kaur *et al*., 2019). Synthetic pesticide residues have built up in food, milk, water, and soil, posing a health risk for people and environment alike (Mossa *et al*., 2018).

Toxicity of pesticides

Organophosphorus, carbamate, organochlorine pyrethroid and neonicotinoid pesticides, and organomercury fungicides square measure all toxins and can potentially cause behavioral changes in birds. Several studies have identified the behavioral impacts of toxic pesticides on captive birds; however, it is difficult to observe such effects in the field, which may be a severe limitation given their potential to induce harmful effects at the population level. (Walker, 2003).

Behavioral consequences can potentially generate negative changes in the population, either directly or indirectly. Disturbances in reproduction, feeding, or predation turning away directly affect craniate populations. (Capinera, 2012). Objection to the prey population can indirectly affect predators, such as a reduction in the number of prey or selective predation by the predator on the most contaminated people within the prey population. (Bernardes *et al.*, 2015).

Attention is paid to the historical data for toxic and behavioral effects of persistent organochlorine pesticides, raising the subject of retroactively examining existing information and this once necessary and widely investigated category of substances. Less-lasting pesticides can also have toxic effects affecting birds throughout the field (Bernardes *et al.*, 2015).

Although the clinical manifestations of pyrethroid exposure are widely documented (e.g., paraesthesia, respiratory, ocular, and skin irritation), research on their long-term consequences at low concentrations is scarce and contentious (Ujvary, 2010). These compounds have been recognized as endocrine-disrupting chemicals (EDCs), and they are the cause of male reproductive problems (Sharma *et al*., 2020). Deltamethrin (Fetoui *et al*., 2015) and lambda-cyhalothrin (Zhang *et al*., 2019). Pyrethroid pesticides have a wide range of applications and high insecticidal action.

Deltamethrin is the most potent insecticide currently available. However, it is one of the most dangerous pyrethroids for vertebrates. Due to their low environmental persistence and toxicity, it is employed as an alternative for organochlorines and organophosphates in pest-control operations (Sayeed *et al*., 2003). Wang stated that deltamethrin is widely utilized around the world because of its effective insecticidal properties against pests and parasites (Lu *et al*., 2019). It causes varied degrees of toxicity, according to mounting data. Furthermore, oxidative stress and metabolism are strongly linked to toxicity (Wang *et al*., 2016).

CONCLUSION

The use of pesticides in modern agriculture has become essential, but their effects on non-target species, including birds, cannot be ignored. Pesticides negatively affect bird populations in several ways, including population declines, changes in behavior, and reproductive failures. Different pesticide types have different toxicity mechanisms, including neurological, reproductive, and immune effects. The current system of pesticide regulations may not be adequate to address the long-term impacts of pesticide use on bird populations despite regulations that minimize the impact of pesticides

on the environment. To ensure the long-term sustainability of agricultural practices, future research must focus on developing more effective, eco-friendly pesticides and improving regulatory frameworks.

REFERENCES

1. Bradberry SM, SA Cage, AT Proudfoot and JA Vale, 2005. Poisoning due to pyrethroids. *Toxicol Rev, 24:* 93-106.
2. Yadav, I. C., Devi, N. L., Syed, J. H., Cheng, Z., Li, J., Zhang, G., & Jones, K. C. (2015). Status of persistent organic pesticides residues in air, water, and soil, and their possible effect on neighboring countries: a comprehensive review of India. *Science of the Total Environment*, *511:* 123-137.
3. American Bird Conservancy, Mineau, P., & Palmer, C. (2013). *The Impact of the Nation's Most Widely Used Insecticides on Birds*. American Bird Conservancy.
4. Carvalho, F. P. (2017). Pesticides, environment, and food safety. *Food and Energy Security*, *6*(2): 48-60.
5. Marquis, S. (2013). *Agrochemical use in South Africa: The toxicological and sociological effects of agrochemicals on susceptible populations in South Africa's agricultural sector* (Doctoral dissertation).
6. Capinera, J. L. (2012). Insecticides and Wildlife. *EDIS*, *2012*(2).
7. Carpenter, K. J. (2012). The discovery of vitamin C. *Annals of Nutrition and Metabolism*, *61*(3): 259-264.
8. Mossa, A.-T. H., Mohafrash, S. M. M., & Chandrasekaran, N. (2018). Safety of Natural Insecticides: Toxic Effects on Experimental Animals. *BioMed Research International*, *2018;* 1–17. https://doi.org/10.1155/2018/4308054
9. Watson, S. L. (2014). Assessing the impacts of unrestricted pesticide use in small-scale Agriculture on water quality and associated human health and ecological implications in an indigenous village in rural Panam [aacute].
10. Biga, L. M. (2013). Effects of pesticides on amphibians with special reference to the pyrethroidinsecticide, cypermethrin.
11. Muir, D. C., & Howard, P. H. (2006). Are there other persistent organic pollutants? A challenge for environmental chemists. *Environmental Science & Technology*, *40*(23): 7157-7166.
12. Bright, J. A., Morris, T., & Winspear, R. J. (2008). *A review of Indirect Effects of Pesticides on Birds and mitigating land-management practices*. Sandy, Bedfordshire, *UK: RSPB.*
13. Bernardes, M. F. F., Pazin, M., Pereira, L. C., & Dorta, D. J. (2015). Impact of pesticides on environmental and human health. *Toxicology Studies-cells, Drugs and Environment*, 195-233.
14. Ponce, C., Alonso, J. C., Argandoña, G., García Fernández, A., & Carrasco, M. (2010). Carcass removal by scavengers and search accuracy affect bird mortality estimates at power lines. *Animal Conservation*, *13*(6): 603-612.
15. Arya, A. K., Singh, A., & Bhatt, D. (2019). Pesticide applications in agriculture and their effects on birds: an overview. *Contaminants in Agriculture and Environment: Health Risks and Remediation*, *5*(10).
16. BLI, 2008. State of the World's Birds: Indicators for Our Changing World. BirdLife International, Cambridge, UK.
17. Mitra, A., Chatterjee, C., & Mandal, F. B. (2011). Synthetic chemical pesticides and their effects on birds. *Res J Environ Toxicol*, *5*(2): 81-96.
18. Addy-Orduna, L. M., Zaccagnini, M. E., Canavelli, S. B., & Mineau, P. (2011). Formulated beta-cyfluthrin shows wide divergence in toxicity among bird species. *Journal of Toxicology*, *2011*.
19. Lidova, J., Buric, M., Kouba, A., & Velisek, J. (2019). Acute toxicity of two pyrethroid insecticides for five non-indigenous crayfish species in Europe. *Veterinární Medicína*, *64*(No. 03): 125–133. https://doi.org/10.17221/136/2018-VETMED
20. Sanchez-Bayo, F., & Hyne, R. V. (2011). Comparison of environmental risks of pesticides between tropical and nontropical regions. *Integrated Environmental Assessment and Management*, *7*(4): 577-586.
21. Sumon, K. A. (2018). Effects of insecticides on aquatic ecosystems in Bangladesh.
22. Takhshid, M. A., Tavasuli, A. R., Heidary, Y., Keshavarz, M., & Kargar, H. (2012). Protective effect of vitamins E and C on endosulfan-induced reproductive toxicity in male rats. *Iranian Journal of Medical Sciences*, *37*(3): 173.
23. DAR, M. A., RAINA, R., PANKAJ, N. K., SULTANA, M., & KUMAR, P. (2012). SUB ACUTE DERMAL TOXICITY OF BIFENTHRIN WITH SPECIAL REFERENCE TO HAEMATO-BIOCHEMICAL CHANGES IN RAT. *Journal of Veterinary Pharmacology and Toxicology/December*, *11*(1-2): 62-64.
24. Walker, C. H. (2003). Neurotoxic pesticides and behavioural effects upon birds. *Ecotoxicology*, *12:* 307-316.
25. Capinera, J. L. (2012). Insecticides and Wildlife. *EDIS*, *2012*(2).
26. Mossa, A. T. H., Mohafrash, S. M., & Chandrasekaran, N. (2018). Safety of natural insecticides: toxic effects on experimental animals. *BioMed research international*, *2018*.
27. Fothergill, A., & Abdelghani, A. (2013). A review of pesticide residue levels and their related health exposure risks. *WIT Transactions on Ecology and the Environment*, *170:* 195-205.
28. Ravula, A. R., & Yenugu, S. (2021). Effect of oral administration of a mixture of pyrethroids at doses relevant to human exposure on the general and male reproductive physiology in the rat. *Ecotoxicology and Environmental Safety*, *208:* 111714.
29. Chowański, S., Kudlewska, M., Marciniak, P., & Rosiński, G. (2014). Synthetic Insecticides--is There an Alternative?. *Polish Journal of Environmental Studies*, *23*(2).

30. Wang C, Chen F, and Zhang Q (2009): Chronic toxicity and cytotoxicity of synthetic pyrethroid insecticide cis-bifenthrin. *Journal of environmental Science*, 21: 1710-1715.
31. Hill, M. P., Macfadyen, S., & Nash, M. A. (2017). Broad spectrum pesticide application alters natural enemy communities and may facilitate secondary pest outbreaks. *PeerJ*, *5:* e4179.
32. Halder, J., Dhingra, S., Ganesh, K. S., & Bhandari, J. K. S. (2007). Relative Toxicity of Some Synthetic Insecticides with Special Reference to Change in Susceptibility Level of Myzus Persicae Sulz Over A Decade. *Pesticide Research Journal*, *19*(1): 76.
33. Kaur, R., Mavi, G. K., Raghav, S., & Khan, I. (2019). Pesticides classification and its impact on environment. *Int. J. Curr. Microbiol. Appl. Sci*, *8*(3): 1889-1897.