IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Pesticides Use In Indian Agriculture- A Review

Kavita Yadav

Department of Chemistry
Narain (P.G) College, Shikohabad, 283135, India

Abstract: The globally more than half of the pesticides are utilized in Asia. India stands 12th in pesticide use globally and 3rd in Asia after China and Turkey. In present study, the data of different types of pesticides use pattern and detailed pesticide consumption of the India and world were collected, organized and summarized. Around 70% of the total population is employed under agriculture sector which is the most important sector of Indian economy. The commonly used pesticide includes insecticides, fungicides and herbicides for management of uncontrolled weeds and pests on agricultural sites. However in the total pesticide consumption, insecticides occupies highest share in India. India share only1% of the global pesticide use. As per the data of FAO, India has utilized around 58160 tonnes of pesticide in 2018. Per hectare application rate of pesticide was only 0.31 kg in 2017. While the consumption in China, Japan and America was around 13.07, 11.76 and 3.57 kg ha-1 of pesticides respectively.

Keywords- Pesticides, Chemical Pesticides, Bio-Pesticides, Indian Agriculture.

I. INTRODUCTION

Pesticides are substances (natural or manmade) used to control pests, weeds, and diseases in plants in various agronomic practices. Herbicides, insecticides, fungicides, rodenticides, nematicides, and other pesticides are examples of pesticides. The losses of crops caused by insect pests are quite high in both developing and developed countries (G. S. Dhaliwal et al, 2015). Reduced crop loss will be a key component and enhanced pest management, including diseases and weeds, will require significant effort. Pesticides have become a key tool for the plant protection and improvement of crops in process of the agricultural development (S. Savary et al, 2019). Pathogens and pests are causing global wheat losses ranging from 10% to 28%, rice losses ranging from 25% to 41%, maize losses ranging from 20% to 41%, potato losses ranging from 8% to 21%, and soybean losses ranging from 11% to 32%, according to the study published in the journal Nature, Ecology & Evolution (E. C. OERKE et al, 2006). The intensity of protection for crops as shown by a 15-20-fold increase in pesticides used around the world has increased significantly in order to make the agriculture more productive and profitable. Despite a clear increase in the pesticide use, crop losses have not decreased significantly over the last 40 years (Popp. J. Pető. K et al, 2013). Food, feed, fiber, biofuel, and other bio-based goods are in the high demand, and agriculture must meet it. An increase in population size in developing countries is forecast to raise food production demand by 70% in view of shifts in dietary trends towards high-quality food, e.g. increased meat and dairy intake, and increased use of kernels for livestock feed (J. F. Carriger et al, 2006). The world population also increased from the 1.65 billion to 7.7 billion throughout the twentieth century alone Green (2018), Nations (2019). Moreover, the world population is predicted to expand to about 8.5 billion by 2030, 9.7 billion in 2050 and 10.9 billion in 2100 Nations (2019). Pesticides are used to increase the agricultural productivity, but they are used indiscriminately and pollute the biota. Non-target species are harmed as a result of pesticide transfer in the environment. Some insecticides have potential to harm the human health and the environment. Only around 0.1 percent of pesticides are believed to reach the intended organisms, with the rest polluting the environment and causing the environmental harm (H. K. Gill et al, 2014, WHO et al, 2019). The closer look at pesticide use finds that we are using the more pesticides and treating crops more frequently than ever before. The Global pesticide use (in tonnes of active ingredient) increased by 46% between 1996 and 2016, according to the FAOSTAT database WHO (S. Gilbert et al, 2012). Pesticides work by the causing harm to creatures they

target. However, the pesticides do not function in the same way for every species. They also have an impact on the non-target species. Organophosphate, carbamate, and pyrethroid insecticides are most often used the pesticides (FAO et al, 2018). Currently, around four million tonnes are used per year on a global basis most of which are herbicides (56%), followed by the insecticides (19%), fungicides (25%) and other types such as rodenticides and nematicides (S. Prabha et al, 2017). This literature review firstly provides the basic scientific information about the classification of pesticide in use and pesticides usage pattern in India and world. The review shows the current scenario of pesticide usage pattern in the Indian agriculture.

1. CLASSIFICATION OF PESTICIDES

Diverse criteria are used to describe the pesticides for example, their toxicity, pest organisms that are killed and their functioning as pesticides, chemical composition and the route of entrance, mode of action, how or when it works, formulations and sources of origin (M. M. Akashe et al, 2018).

1. Classification of pesticides according to its toxicity: Pesticide toxicity is primarily determined by two factors: dose and time. Thus, the amount of this chemical (dose) is involved and how often (time) the material is exposed to lead to two different kinds of the toxicity acute and chronic.

2. Classification of Pesticides according to Chemical Composition: This is the most popular and useful way of the pesticide classification based on chemical makeup. Pesticides such as the insecticides, fungicides, herbicides, and rodenticides are also classed based on their chemical compositions, as shown below:

a. Insecticides: Insecticides are classed chemically as the Carbamates (Carbaryl), Organochlorine (Endosulfan), Organophosphorus (Monocrotophos), Pyrethroids (permethrin), Neonicotinoids (Imidacloprid), various pesticides such as the Spinosyns (Spinosad), Benzolureas (diflubenzuron) and Antibiotics (abamectin).

b. Fungicides: Fungicides are categorised as the aliphatic nitrogen fungicides (dodine), amide fungicides (carpropamid), aromatic fungicides (chlorothalonil), dicarboximide fungicides (famoxadone), dinitrophenol fungicides (dinocap) and others.

c. Herbicides: Herbicides include anilide herbicides (flufenacet), phenoxyacetic herbicides (2, 4-D), quaternary ammonium herbicides (Paraquat), chlorotriazine herbicides (atrazine), sulfonylurea herbicides (chlorimuron), and others.

d. Rodenticides: Rodenticides are classed as the inorganic rodenticides (Zinc phosphide, Aluminium Phosphide) or organic coumarin rodenticides (bromadiolone, coumatetralyl) (M. A. Hassaan et al, 2020).

3. Classification of pesticides based on the pest organism they kill and pesticide's functionality (Use): Pesticides are characterized in this way based on the pest organisms they kill and their functions. Different types of pesticides are mentioned below: Insecticides are chemicals that are used to kill insects and other the arthropods. Fungicides are chemicals that kill fungi. Acaricides are pesticides that kill mites and ticks. Algicides are chemicals that kill or suppress algae. Herbicides are chemicals that are used to kill the undesired plants. Antifeedants are chemicals that stop insects and other pests from eating. Avicides are poisonous chemicals used to kill birds. Bactericides are substances that kill or inhibit bacteria. Larvicides stop larvae from growing. Repellents are substances that repel bugs based on their taste or odour. Dessicants work by drying the tissues of plants. Virucides are antiviral agents Ovicides inhibits the growth of insect and mite eggs. Nematicides are chemicals that kill nematodes, which are plant parasites. Termiticides are chemicals that kill the termites. Chemicals that make an insect sterile and hence prevent it from the reproducing are known as chemosterillants. Plant growth regulators are substances that affect the expected rate of plant growth, flowering, or reproduction (S. Nayak et al, 2020).

4. Classification of pesticides based on Mode of Entry: Pesticide modes of entry refer to the various ways pesticides come into touch with or enter the target.

a. Systemic pesticides: pesticides absorbed into and transported to untreated tissue by the plants and animals. 2, 4-Dichlorophenoxyacetic acid (2, 4-D) and glyphosate are both examples of the systemic insecticides.

b. Contact (non-systemic) pesticides: When the target pests come into contact with them, the pesticide acts on them. Paraquat and diquat dibromide both contact insecticides are examples.

c. Stomach poisons: These toxins enter the body of the pest through the mouth and digestive system.

d. Fumigants: Pesticides that kill or may kill target the pests by creating vapour and entering the pest's body through the trachea.

e. Repellents: Repellents do not kill but they are disgusting enough to keep them away. The capacity of the pesticide to locate a crop also interferes.

5. Classification of pesticides by mode of action: The various pesticides have various mode of action and pesticides are categorised as following according to the mode of action.

a. Physical poison: Pesticides kill an insect with the physical effect. Protoplasmic poisons: The protein precipitation is caused by the pesticides.

b. Respiratory poison: The chemical substances which are respiratory enzymes that are in-active.

6. Classification based on sources of origin: Pesticides are divided into two categories: Bio-pesticides and Chemical pesticides, depending on their source of the origin. Organochlorine, organophosphate, carbamate, and pyrethroid pesticides are further classified into the organochlorine, organophosphate, carbamate, and pyrethroids, as explained in the previous section. Pesticides originating from natural sources such as animal, plant and microorganisms are known as bio-pesticides (bacteria, viruses, fungi and nematodes). They are divided into the three categories (M. Tudi et al, 2021).

a. Microbial pesticides: They are type of pesticide that is produced by the microorganisms such as bacteria, fungi and protozoa are the active ingredient in microbial pesticides. These pesticides kill insects by releasing poisons produced by the microbiological organisms or infecting them.

b. Plant-incorporated pesticides: These pesticides are naturally produced by the plants. In addition, genetic engineering is used to insert the gene required for pesticide production into the plant. As a result the pesticide produced by such a plant, as well as the genetic material injected are referred to as plant integrated the protectants (PIPs).

c. Biochemical pesticides: These are natural compounds with nontoxic pest control processes. Insect sex pheromones (which interfere with mating) and a variety of fragrant plant extracts are examples of the biochemical insecticides (Gio et al, 2021).

1.2. PESTICIDE USAGE PATTERN

There are 293 pesticides registered in India and it is reported that 104 pesticides are still being produced by used in the country despite being prohibited in two or more nations around the world. Out of total insecticides used for pest management in India, 50% are diverted to cotton pest management (P. S. Birthal et al, 2004). Due to over dependence and indiscriminate use of insecticides, many ill-effects including residue in plant parts, resistance to insecticides, secondary pest out-break, pollution to natural resources, health complications for human and wildlife etc., war rant to switch over to eco-friendly pest management methods (S. Yadav et al, 2020). In 2017 the Indian use is low, compared to 19.6 kg per ha in Saint Lucia, 16.59 in Hong Kong, 13.9 in Ecuador, 13.3 in Taiwan and 13.07 in China, at about 0.31 kg per ha of pesticide. America has reduced its use by 2.54 kg per hectare (GIO et al, 2020). Chlorpyriphos is the most widely used insecticide pesticide. Its consumption has risen from 471 MT in 2014-15 to 1431 MT in 2019-20. Sulphur is the most often used fungicide, with a consumption of 1548 MT in 2014-15, which has climbed to 3878 Mt in 2019-20. In India, a high concentration of 2, 4-D amine salts is used as a weedicide (herbicide). Its usage was 1MT in 2014-15, but it increased to 1067 MT in 2019-20. Zinc phosphide has been the most often used rodenticide, with consumption ranging from 65 to 200 MT from 2014 to 2020 (P. K. Maurya et al, 2016). The most often used insecticides are organophosphates, followed by neonicotinoids and pyrethroids. According to one study, cotton is the most pesticide consuming agri-product (93.27%), followed by vegetables (87.2%), wheat (66.4%), millet (52.6%), and mustard (12.6%) (S. Mathur et al, 2022, S. Kumar et al, 2013, R. Chand et al,1997).

1.3. PESTICIDES CONSUMPTION SCENARIO

Pesticide production in India began in 1952 with the development of a facility for the manufacturing of BHC in Calcutta, and India is today Asia's second largest maker of pesticides after China, ranking twelfth internationally (N. Agnihotri et al, 2022). In India, there has been consistent rise from 5,000 metric tonnes in 1958 to 102,240 meter tonnes in 1998 in the manufacturing of technical grade pesticides. Pesticide demand was anticipated to be at Rs. 22 billion (USD 0.5 billion) in 1996-97, accounting for around 2% of the overall global (R. J. Chelliah et al, 2007). According to the graph, pesticide usage in India has surged hundreds of times over the previous seven decades, from 154 MT in 1953-54 to 57,000 MT in 2016- 17. In 1994-1995, India used the most pesticides (80,000 MT) in a single year (FAO et al, 2018, A. Mansouri et al, 2017, R. Upadhyay et al, 2016, A. S. Grewal et al. 2017). Due to a prohibition or limit on using organochlorine pesticides, including HCH (BHC), DDT, aldrin, etc and the decrease was recorded between 2000 and 2010. One of the reasons for reducing pesticide usage is the adoption of the Stockholm Convention with high levels of application and the development of integrated pesticides management programmes (S. Kumar et al, 2015). Pesticide application in India is hampered by the use of low-grade pesticides and a lack of information about pesticide use. Pesticide usage without sufficient restrictions has resulted in a rise in pesticide residue identified in food items in India, according to the Economic Survey 2015-16 (O. K. Koul et al, 2011, J. J. Villaverde et al, 2016) during 2016-17, Maharashtra had the highest total pesticide consumption, followed by Uttar Pradesh, Punjab, and Haryana. While Punjab had the greatest per acre pesticide consumption (0.74 kg), followed by Haryana (0.62 kg), and Maharashtra (0.57 kg). According to the data Maharashtra and Uttar

Pradesh account for 41% of India's pesticide consumption. More than 70% of crop protection chemicals are used in India by the top six states combined. In these days, many individuals prefer natural alternatives to synthetic chemicals with a greater concern for the environment and for their own health. Because of the benefits related with environmental safety, target-specificity, efficacy, biodegradability, and applicability in integrated pest management (IPM) programmes, biopesticide is gaining popularity. The potential environmental safe application of biopesticides is well known. In view of increased requests for organic food, attention has been gaining (L. H. Samada et al, 2022). Pesticides derived from natural resources such as plants, animals, microbes, and certain minerals are known as biopesticides. Included in biopesticides are natural pests (Biochemical Pesticides), pesticide control (Microbial Pesticides) microorganisms and regulators of biochemical plant growth. Biopesticides have come a long way from the time of the emergence and general usage of more harmful synthetic pesticides to control agriculture as early as the 17th century (Wickramaarachchi. W. A. R. T. et al, 2017, J. Mishra et al. 2020, Y. N. Tripathi et al, 2020). There are currently 970 biopesticide products registered with the Central Insecticides Board and Registration Committee (CIBRC), which is the key governing organisation in India for all sorts of biopesticide usage (V. Kandpal et al, 2014, K. Sharma et al, 2018). Bacterial, fungal, viral, and other (plant-based, pheromones) biopesticides account for 29, 66, 4, and 1 percent of total biopesticide production, respectively. In comparison to other products such as bioherbicides, biofungicides, and bionematicides, bioinsecticides continue to be in high demand. Bioinsecticides account for about 70 percent of the market, with special focus on that category for manufacturers, providing greater control and food safety. In India, only 12 different kinds of biopesticides under the Insecticide Act of 1968 have been recorded (K. R. Kranthi et al, 2022). The main biopesticides manufactured and used in India are Neem-based insecticides, Bacillus thuringensis, NPV, and Tricho derma. While the register for use as chemical pesticides is greater than 230 synthetics. Tricoderma, Psedomonas, and NPV-H (nuclear polyhedrosis virus of Helicoverpa armigera) are the most often used insecticides in 2019-20. Most biopesticides, except some used in agriculture, are employed in public health. Besides transgenic plants and beneficial organisms known as bio-agents are also used for pest management in India. When chemical pesticides failed to eradicate Helicoverpa armigera, Spodoptera litura, and other cotton pests in India, a significant technological breakthrough in the field of biocontrol occurred. It was found that biocontrol is the only technology that can be used to control the widespread resistance of chemical pesticides to pest insects in a safe, cost-effective, and environmentally beneficial manner. Biopesticides were later included in IPM, which had previously relied only on the application of chemical pesticides (V. Kandpal et al, 2014).

II. CONCLUSION

For a more than 60 years, pesticides have been regarded the rapid convenient and lowcost alternative for managing weeds and insect pests in agriculture, public health and other sectors in India. It is the established that pesticides have contributed the significantly in increasing agricultural production and the farmers' income globally. India has become self-sufficient in production of pesticides and also an important exporter of pesticides. More than 50% of pesticides used in the India are of insecticides. The chlorpyriphos insecticide has been utilized in the highest amount compared to other insecticides. The average chemical pesticide consumption noted around 55000 tonnes per year during 2014-2018 while average bio-pesticides consumption observed around 3500 tonnes per year during 2014-2019. Maharashtra and Uttar Pradesh both states of India occupies total 40% of segment in the pesticide use. The trichoderma viride is the most frequently utilised species in Indian biopesticide industry having been utilised on 87 different crops 70 soil-borne diseases, and 18 foliar diseases, respectively. Biopesticides can help farmers transition away from the chemical pesticides and toward more dependable, sustainable and environmentally friendly options. It is proposed that the commercial and public sectors work together to help farmers at the grassroots level by the developing an integrated policy and supporting guidelines for use of the bio-pesticides and chemical pesticides.

REFERENCES

[1] Dhaliwal. G. S, Jindal. V and Mohindru. B. 2015. Indian Journal of Entomology, 77(2), 165-165.

[2] Savary. S, Willocquet. L, Pethybridge. S. J, Esker. P, McRoberts. N and Nelson. 2019. Nature Ecology & Evolution, 3(3),

430- 439.

[3] OERKE. E. C. 2006. The Journal of Agricultural Science, 144(1), 31- 43.

[4] Popp. J. Pető. K and Nagy. J. 2013. Agronomy for Sustainable Development, 33(1), 243-255.

[5] Carriger. J. F, Rand. G. M, Gardinali. P. R, Perry. W. B, Tompkins. M. S and Fernandez. A. M. 2006. An International

Journal, 15(1), 21- 45.

[6] Gill. H. K and Garg. H. 2014. Pesticides: Environmental Impacts and Management Strategies, Intech Open.

[7] WHO. Global situation of pesticide management in agriculture and public health. 2019.

[8] Gilbert. S, A Small Dose of Toxicology. 2012. The Health Effects of Common Chemicals. Boca Raton, FL, USA: Healthy

World Press.

[9] FAO, Pesticide Use Data-FAOSTAT. 2018.

[10] Prabha. S, Yadav. A, Kumar. A, Yadav. A, Yadav. H, Kumar. S, Yadav. R and Kumar. R. 2017.

[11] Akashe. M. M, Pawade. U. V and Nikam. A. V. 2018. International Journal of Research in Ayurveda and Pharmacy, 9(4),

144-150.

[12] Hassaan. M. A and Nemr. A. E. 2020. The Egyptian Journal of Aquatic Research, 46(3), 207-220.

[13] Nayak. S, Sahoo. A, Kolanthasamy. E and Rao. K. 2020.

[14] Tudi. M, Ruan. H. D, Wang. L, Lyu. J, Sadler. R, Connell. D, Chu. C and Phung. D. T. 2021. International Journal of

Environmental Research and Public Health, 18(3), 1112-1112.

[15] Goi, Insecticides and Pesticides Registered under section 9**(**3**)**, 2021.

[16] Birthal, P. S, & Sharma, O. P. 2004. Integrated Pest Management in Indian Agriculture. Proceeding, 11.

[17] Yadav. S and Dutta. S. 2019. International Journal of Current Microbiology and Applied Sciences, 8(4), 96-104.

[18] GOI, Statistical Database, Directorate of Plant Protection, 2020.

[19] Maurya. P. K and Malik. D. S. 2016. A Critical Review. J. Ind. Pollut. Control, 32.

[20] Mathur. S and Tannan. S. 2022. Future of Indian pesticides industry in next millennium, Pestic. Inf, 24, 9-23.

[21] Kumar. S. 2013. Asian Journal of Environmental Science, 8(1), 51-57.

[22] Chand, R and Birthal. P. S. 1997. Indian J. Agric. Econ, 52.

[23] Agnihotri. N, Pesticide Consumption in Agriculture in India - an Update, 2022. Pestic. Res. Journa, 150-155.

[24] Chelliah. R. J, Appasamy. P. P, Sankar. U and Pandey. R. 2007. Ecotaxes on Polluting Inputs and Outputs.

[25] FAO, Pesticide Use Data-FAOSTAT, 2018.

[26] Mansouri. A, Cregut. M, Abbes. C, Durand. M.J, Landoulsi. A, and Thouand. G. 2017. Applied Biochemistry and

Biotechnology, 181(1), 309-339.

[27] Upadhyay. R and Nishant. N. 2016. Presence of pesticide residue in vegetable crops: A review. Agricultural Reviews, 37(3),

173-185.

[28] Grewal. A. S, Singla. A, Kamboj. P and Dua. J. S. 2017. Journal of Medicinal Chemistry and Toxicology., 2(1), 40-46.

[29] Kumar. S and Singh. A. 2015. Present Status and the Future Prospects. J. Fertil. Pestic, 6.

[30] Koul. O. K. O. 2011. Nutrition and Natural Resources, 6(56).

[31] Villaverde. J. J, Sandín-España. P, Sevilla-Morán. B, López-Goti. C and Alonso-Prados, J. L. 2016. BioResources, 11(2),

5618-5640.

[32] Samada. L. H and Tambunan, U. S. F. 2020. OnLine Journal of Biological Sciences. 20(2), 66-76.

[33] Wickramaarachchi. W. A. R. T, Chaudhary. M and Patil. J. 2017. Facilitating microbial pesticide use in agriculture in South

Asia.

[34] Mishra. J, Dutta. V and Arora. N. 2020. Biopesticides in India: technology and sustainability linkages.

[35] Tripathi. Y. N, Divyanshu. K, Kumar.S, Jaiswal. L. K, Khan. A, Birla. H, Gupta. A, Singh. S. P and Upadhyay. R. S. 2020.

Biopesticides, Current Status and Future Prospects in India.

[36] Kandpal. V. 2014. Biopesticides. Res. India Publ, 4, 190-196.

[37] Sharma K, Raju. S, Kumar. D and Thakur. S. 2018. Biopesticides an effective tool for insect pest management and current

scenario in India.

[38] Kranthi. K. R, Jadhav. D. R, Kranthi. S, Wanjari. R. R, Ali. S. S, and Russell. D. A. 2022. Crop Protection, 21(6), 449-460.