

# ROLE OF PESTICIDE IN AGRICULTURE, ENVIRONMENT AND ALSO IN HUMAN BEING

Dr. Usha Yadav <sup>1</sup> and Dheeraj Kumar<sup>2</sup>

<sup>2</sup>Research Scholar, Deptt. Of Chemistry, Singhania University, Rajasthan.

## ABSTRACT

*Pesticides are substances meant for attracting, seducing, and then destroying, or mitigating any pest. They are a class of biocide. The most common use of pesticides is as plant protection products (also known as crop protection products), which in general protect plants from damaging influences such as weeds, plant diseases or insects. As pesticides are also used for non-agricultural purposes. The term pesticide includes all of the following: herbicide, insecticide, insect growth regulator, nematocide, termiticide, molluscicide, piscicide, avicide, rodenticide, predacide, bactericide, insect repellent, animal repellent, antimicrobial, fungicide, disinfectant (antimicrobial), and sanitizer.*

**Key Words:** Pest, Biocide, Weeds, Plant diseases, Insects.

## INTRODUCTION

Any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted 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 be administered to animals for the control of insects, arachnids, or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. In general, a pesticide is a chemical or biological agent (such as a virus, bacterium, antimicrobial, or disinfectant) that deters, incapacitates, kills, or otherwise discourages pests. Target pests can include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms), and microbes that destroy property, cause nuisance, or spread disease, or are disease vectors.



**A crop-duster spraying pesticide on a field.**



**A Lite-Trac four-wheeled self-propelled crop sprayer spraying pesticide on a field**

| Type of pesticide       | Target pest group   |
|-------------------------|---------------------|
| Herbicides              | Plant               |
| Algicides or Algaecides | Algae               |
| Avicides                | Birds               |
| Bactericides            | Bacteria            |
| Fungicides              | Fungi and Oomycetes |
| Insecticides            | Insects             |
| Miticides or Acaricides | Mites               |

|               |           |
|---------------|-----------|
| Molluscicides | Snails    |
| Nematicides   | Nematodes |
| Rodenticides  | Rodents   |
| Virucides     | Viruses   |

## REVIEW OF LITERATURE

Since before 2000 BC, humans have utilized pesticides to protect their crops. The first known pesticide was elemental sulfur dusting used in ancient Sumer about 4,500 years ago in ancient Mesopotamia. The Rig Veda, which is about 4,000 years old, mentions the use of poisonous plants for pest control. By the 15th century, toxic chemicals such as arsenic, mercury, and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides, pyrethrum, which is derived from chrysanthemums, and rotenone, which is derived from the roots of tropical vegetables. Until the 1950s, arsenic-based pesticides were dominant. Paul Müller discovered that DDT was a very effective insecticide. Organochlorines such as DDT were dominant, but they were replaced in the U.S. by organophosphates and carbamates by 1975. Since then, pyrethrin compounds have become the dominant insecticide. Herbicides became common in the 1960s, led by "triazine and other nitrogen-based compounds, carboxylic acids such as 2,4-dichlorophenoxyacetic

The agricultural use of DDT is now banned, but it is still used in some developing nations to prevent malaria and other tropical diseases by spraying on interior walls to kill or repel mosquitoes. Although pesticides have benefits, some also have drawbacks, such as potential toxicity to humans and other desired species.

## MATERIAL AND METHOD

Pesticides are often referred to according to the type of pest they control. Pesticides can also be considered as either biodegradable pesticides, which will be broken down by microbes and other living beings into harmless compounds, or persistent pesticides, which may take months or years before they are broken down: it was the persistence of DDT, for example, which led to its accumulation in the food chain and its killing of birds of prey at the top of the food chain. Another way to think about pesticides is to consider those that are chemical pesticides or are derived from a common source or production method.

Some examples of chemically-related pesticides are:

### **ORGANOPHOSPHATE PESTICIDES**

Organophosphates affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. Most organophosphates are insecticides. They were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. Some are very poisonous. However, they usually are not persistent in the environment.

### **CARBAMATE PESTICIDES**

Carbamate pesticides affect the nervous system by disrupting an enzyme that regulates acetylcholine, a neurotransmitter. The enzyme effects are usually reversible. There are several subgroups within the carbamates.

### **ORGANOCHLORINE INSECTICIDES**

They were commonly used in the past, but many have been removed from the market due to their health and environmental effects and their persistence (e.g., DDT and chlordane).

### **PYRETHROID PESTICIDES**

They were developed as a synthetic version of the naturally occurring pesticide pyrethrin, which is found in chrysanthemums. They have been modified to increase their stability in the environment. Some synthetic pyrethroids are toxic to the nervous system.

### **BIOPESTICIDES**

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. At the end of 2001, there were approximately 195 registered biopesticide active ingredients and 780 products. Biopesticides fall into three major classes:

- Microbial pesticides consist of a microorganism e.g., a bacterium, fungus, virus, or protozoan as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest. For example, there are fungi that control certain weeds, and other fungi that kill specific insects.

The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt. Each strain of this bacterium produces a different mix of proteins, and specifically kills one or a few related species of insect larvae. While some Bt's control moth larvae found on plants, other Bt's are specific for larvae of flies and mosquitoes. The target insect species are determined by whether the particular Bt produces a protein that can bind to a larval gut receptor, thereby causing the insect larvae to starve.

- Plant-Incorporated-Protectants (PIPs) are pesticidal substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the Bt pesticidal protein, and introduce the gene into the plant's own genetic material. Then the plant, instead of the Bt bacterium, manufactures the substance that destroys the pest. The protein and its genetic material, but not the plant itself, are regulated by EPA.
- Biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, are, in general, synthetic materials that directly kill or inactivate the pest. Biochemical pesticides include substances, such as insect sex pheromones, that interfere with mating, as well as various scented plant extracts that attract insect pests to traps.
- **CLASSIFIED BY TYPE OF PEST**

Pesticides that are related to the type of pests are:

| Type   | Action  |
|--|---|
| <a href="#">Algicides</a>                    | Control algae in lakes, canals, swimming pools, water tanks, and other sites  |
| <a href="#">Antifouling</a> agents           | Kill or repel organisms that attach to underwater surfaces, such as boat bottoms  |
| <a href="#">Antimicrobials</a>               | Kill microorganisms (such as bacteria and viruses)  |
| <a href="#">Attractants</a>                  | Attract pests (for example, to lure an insect or rodent to a trap). (However, food is not considered a pesticide when used as an attractant.) |
| <a href="#">Biopesticides</a>                | Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals          |
| <a href="#">Biocides</a>                     | Kill microorganisms   |
| <a href="#">Disinfectants</a> and sanitizers | Kill or inactivate disease-producing microorganisms on inanimate objects  |
| <a href="#">Fungicides</a>                   | Kill fungi (including blights, mildews, molds, and rusts)   |
| <a href="#">Fumigants</a>                    | Produce gas or vapor intended to destroy pests in buildings or soil   |

|                                      |  |
|--------------------------------------|--|
| <a href="#">Herbicides</a>           | Kill weeds and other plants that grow where they are not wanted                                    |
| <a href="#">Insecticides</a>         | Kill insects and other arthropods  |
| <a href="#">Miticides</a>            | Kill mites that feed on plants and animals   |
| <a href="#">Microbial pesticides</a> | Microorganisms that kill, inhibit, or out compete pests, including insects or other microorganisms |
| <a href="#">Molluscicides</a>        | Kill snails and slugs  |
| <a href="#">Nematicides</a>          | Kill nematodes (microscopic, worm-like organisms that feed on plant roots)                         |
| Ovicides                             | Kill eggs of insects and mites   |
| <a href="#">Pheromones</a>           | Biochemicals used to disrupt the mating behavior of insects  |
| <a href="#">Repellents</a>           | Repel pests, including insects (such as mosquitoes) and birds                                      |
| <a href="#">Rodenticides</a>         | Control mice and other rodents   |

## CONCLUSION AND RESULT

### USES

Pesticides are used to control organisms that are considered to be harmful. For example, they are used to kill mosquitoes that can transmit potentially deadly diseases like West Nile virus, yellow fever, and malaria. They can also kill bees, wasps or ants that can cause allergic reactions. Insecticides can protect animals from illnesses that can be caused by parasites such as fleas. Pesticides can prevent sickness in humans that could be caused by moldy food or diseased produce. Herbicides can be used to clear roadside weeds, trees and brush. They can also kill invasive weeds that may cause environmental damage. Herbicides are commonly applied in ponds and lakes to control algae and plants such as water grasses that can interfere with activities like swimming and fishing and cause the water to look or smell unpleasant. Uncontrolled pests such as termites and mould can damage structures such as houses. Pesticides are used in grocery stores and food storage facilities to manage rodents and insects that infest food such as grain. Each use of a pesticide carries some associated risk. Proper pesticide use decreases these associated risks up to a level.

Pesticides can save farmers' money by preventing crop losses to insects and other pests; in the U.S., farmers get an estimated fourfold return on money they spend on pesticides. One study

found that not using pesticides reduced crop yields by about 10%. Another study, conducted in 1999, found that a ban on pesticides in the United States may result in a rise of food prices, loss of jobs, and an increase in world hunger.

DDT, sprayed on the walls of houses, is an organochloride that has been used to fight malaria since the 1950s. WHO's malaria chief, said, "One of the best tools we have against malaria is indoor residual house spraying. Of the dozen insecticides WHO has approved as safe for house spraying, the most effective is DDT. A later October 2007 study linked breast cancer from exposure to DDT prior to puberty. Other studies have found no link. Symptoms include nervous excitement, tremors, convulsions, or death. Scientists estimate that DDT and other chemicals in the organophosphate class of pesticides have saved 7 million human lives since 1945 by preventing the transmission of diseases such as malaria, bubonic plague, sleeping sickness, and typhus. However, DDT use is not always effective, as resistance to DDT was identified in Africa as early as 1955, and by 1972 nineteen species of mosquito worldwide were resistant to DDT.

### AMOUNTS USED

In 2006 and 2007, the world used approximately 5.2 billion pounds of pesticides, with herbicides constituting the biggest part of the world pesticide use at 40%, followed by insecticides (17%) and fungicides (10%). In 2006 and 2007 the U.S. used approximately 1.1 billion pounds of pesticides, accounting for 22% of the world total, including 857 million pounds of conventional pesticides, which are used in the agricultural sector (80% of conventional pesticide use) as well as the industrial, commercial, governmental and home & garden sectors. Pesticides are also found in majority of U.S. households with 78 million out of the 105.5 million households indicating that they use some form of pesticide. As of 2007, there were more than 1,055 active ingredients registered as pesticides, which yield over 20,000 pesticide products that are marketed in the United States.

The US used some 2.2 pounds per hectare of arable land compared with 10.3 in China, 3.0 in the UK, .2 in Cameroun, 13.1 in Japan and 5.6 in Italy. Insecticide use in the US has declined by more than half since 1980, (.6%/yr) mostly due to the near phase-out of organophosphates. In corn fields, the decline was even steeper, due to the switchover to transgenic Bt corn.

For the global market of crop protection products, market analysts forecast revenues of over 52 billion US\$ in 2019.

### COSTS

On the cost side of pesticide use there can be costs to the environment, costs to human health, as well as costs of the development and research of new pesticides.

**HEALTH EFFECTS:-**

A sign warning about potential pesticide exposure.

Pesticides may cause acute and delayed health effects in people. Pesticide exposure can cause a variety of adverse health effects, ranging from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, mimicking hormones causing reproductive problems, and also causing cancer.

The American Academy of Pediatrics recommends limiting exposure of children to pesticides and using safer alternatives:

The World Health Organization and the UN Environment Programme estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die. Owing to inadequate regulation and safety precautions, 99% of pesticide related deaths occur in developing countries that account for only 25% of pesticide usage. According to one study, as many as 25 million workers in developing countries may suffer mild pesticide poisoning yearly.

One study found pesticide self-poisoning the method of choice in one third of suicides worldwide, and recommended, among other things, more restrictions on the types of pesticides that are most harmful to humans.

**ENVIRONMENTAL EFFECT**

Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them. Pesticides are one of the causes of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination.

In addition, pesticide use reduces biodiversity, contributes to pollinator decline, destroys habitat (especially for birds), and threatens endangered species. Pests can develop a resistance to the pesticide (pesticide resistance), necessitating a new

pesticide. Among marine animals, pesticide concentrations are higher in carnivorous fishes, and even more so in the fish-eating birds and mammals at the top of the ecological pyramid. Global distillation is the process whereby pesticides are transported from warmer to colder regions of the Earth, in particular the Poles and mountain tops. Pesticides that evaporate into the atmosphere at relatively high temperature can be carried considerable distances (thousands of kilometers) by the wind to an area of lower temperature, where they condense and are carried back to the ground in rain or snow.

In order to reduce negative impacts, it is desirable that pesticides be degradable or at least quickly deactivated in the environment. Such loss of activity or toxicity of pesticides is due to both innate chemical properties of the compounds and environmental processes or conditions. For example, the presence of halogens within a chemical structure often slows down degradation in an aerobic environment. Adsorption to soil may retard pesticide movement, but also may reduce bioavailability to microbial degraders.

| Harm                             | Annual US Cost       |
|----------------------------------|----------------------|
| Public Health                    | \$1.1 billion        |
| Pesticide Resistance in Pest     | \$1.5 billion        |
| Crop Losses Caused by Pesticides | \$1.4 billion        |
| Bird Losses due to Pesticides    | \$2.2 billion        |
| Groundwater Contamination        | \$2.0 billion        |
| Other Costs                      | \$1.4 billion        |
| <b>Total Costs</b>               | <b>\$9.6 billion</b> |

## **BENEFITS**

There are two levels of benefits for pesticide use, primary and secondary. Primary benefits are direct gains from the use of pesticides and secondary benefits are effects that are more long-term.

### **PRIMARY BENEFITS**

#### *1. Controlling pests and plant disease vectors*

- Improved crop/livestock yields

- Improved crop/livestock quality
- Invasive species controlled

### 2. *Controlling human/livestock disease vectors and nuisance organisms*

- Human lives saved and suffering reduced
- Animal lives saved and suffering reduced
- Diseases contained geographically

### 3. *Controlling organisms that harm other human activities and structures*

- Drivers view unobstructed
- Tree/brush/leaf hazards prevented
- Wooden structures protected

## ALTERNATIVES

Alternatives to pesticides are available and include methods of cultivation, use of biological pest controls (such as pheromones and microbial pesticides), genetic engineering, and methods of interfering with insect breeding. Application of composted yard waste has also been used as a way of controlling pests. These methods are becoming increasingly popular and often are safer than traditional chemical pesticides. In addition, EPA is registering reduced-risk conventional pesticides in increasing numbers.

Cultivation practices include polyculture (growing multiple types of plants), crop rotation, planting crops in areas where the pests that damage them do not live, timing planting according to when pests will be least problematic, and use of trap crops that attract pests away from the real crop. In the U.S., farmers have had success controlling insects by spraying with hot water at a cost that is about the same as pesticide spraying.

Release of other organisms that fight the pest is another example of an alternative to pesticide use. These organisms can include natural predators or parasites of the pests. Biological pesticides based on entomopathogenic fungi, bacteria and viruses cause disease in the pest species can also be used.

## REFERENCES

1. Council on Scientific Affairs, American Medical Association. (1997). Educational and Informational Strategies to Reduce Pesticide Risks. Preventive Medicine, Volume 26, Number 2
2. Types of Pesticides. Last updated on Thursday, January 29th, 2009.

3. Kamrin MA. (1997). Pesticide Profiles: toxicity, environmental impact, and fate. CRC Press.
4. Cornell University. Toxicity of pesticides. Pesticide fact sheets and tutorial, module 4. Pesticide Safety Education Program. Retrieved on 2007-10-10.
5. EurekaAlert. (2009). New 'green' pesticides are first to exploit plant defenses in battle of the fungi.
6. The benefits of pesticides: A story worth telling. Purdue.edu. Retrieved on September 15, 2007.
7. Helfrich, LA, Weigmann, DL, Hipkins, P, and Stinson, ER (June 1996), Pesticides and aquatic animals: A guide to reducing impacts on aquatic systems. Virginia Cooperative Extension. Retrieved on 2007-10-14.
8. Kellogg RL, Nehring R, Grube A, Goss DW, and Plotkin S (February 2000), Environmental indicators of pesticide leaching and runoff from farm fields. United States Department of Agriculture Natural Resources Conservation Service. Retrieved on 2007-10-03.
9. Kuniuki S (2001). Effects of organic fertilization and pesticide application on growth and yield of field-grown rice for 10 years. Japanese Journal of Crop Science 70 (4): 530–540.