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Environmental Pollution by Pesticides: Sources and Solution

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Abstract:

The deterioration of the environment caused by various factors is a known fact. The pesticides are poisoning our land and water resources to such a large extent that even the existence of human life are in grievances situation. The toxicology of pesticides has been of great concern from social and scientific viewpoints. An attempt has been made to study toxic behavior on soil and human health. Soil gets an enormous amount of pesticides as an inevitable result of their application to crops. Pesticide of air by pesticide is a manmade problem. Pesticides reach the air from aerial spraying, aimed at certain crops. The study emphasized that pesticides can be degraded by biodegradation, chemical or photochemical means. Latest studies show neem as a nature's bitter boon as pesticide. The study concluded that researchers should be encouraged to devise newer methods of biological control. The use of microbial pesticides and biodegradation of pesticides is an economical method and has fewer hazards to environmental pollution. Truly biodegradable materials should be developed in future to avert soil pollution. The agriculturists should be encouraged to grow such varieties of crops and reduce substantially the cost of pesticide production and minimize pesticide pollution. This will save the life of living biota from hazardous effect of pesticides and will protect natural system.

Key words: Pesticides; health effects; Poisoning; Reduction; Biodegradation

1. Introduction

With the advancement of human civilization, there is tremendous increase in demand of foodstuff. In fact, industrialized technology has now penetrated major areas of human activities and influenced the life style of human. In the beginning, in the field of agriculture, man has put a lot of his efforts into the protection of crops-discovering, innovating, experimenting with means and methods. Pesticides occupy a special chance of effectiveness. Environmental pollution is not a creation of just a few years, but it has been there from very early times, but the environment pollution by pesticides emerged as a great monster in the sixties of twentieth century. Due to excessive use of pesticides, there is danger of contamination in air we breathe, the water we drink, and food we eat [1]. Consequently, production technology was developed to save the crops during growth period and storage. It is well known that soil is the ultimate reservoir of pesticides. These chemical, when applied as aerial spray or when applied on plants, weeds or herbs, reach the soil. When it is aimed to kill insects and other organisms, it ultimately reaches the soil. Even when it reaches the soil, it is acted upon by a variety of physical and chemical factors and microbial organisms. DDT is persistent insecticide. Successive application of DDT in soil leads to accumulation to a great extent [2]. So, most of these pesticides are so persistent in soils, water and air that they attain the toxic levels and are as potential danger to the existence of most of fauna and even human beings. The production and protection need led to contaminate environment and endanger man, animal and plant life. No doubt, pesticides elevate the yield of cultivated field by controlling crop pests, for example "IR-8" and "TN-1" varieties, but at the same time, these pesticides enter into water system affecting living biota and aquatic environment.

2. What Are Pesticides

Pesticides are organic chemical used to control unwanted and dangerous species of plants and animals [3]. These are poison which affects the impact of pests. These can be classified as-Fungicides, Herbicides, Insecticides, Rodenticides, Nematicides, Molluscicides, and Piscicides [4].

Types	Function	Examples
Fungicides	Toxic to fungi and mould	Copper sulfate pentahydrate and hexachlorobenzene
Herbicides	Kill weeds or undesirable vegetation	Aim EW, Finale, Buctril
Insecticides	Kill insects in agricultural field	Organ chloride (DDT), Organophosphate, carbamate
Rodenticides	Used against rats and mice	Pyrethroid, Alderinand dielderin
Nematicides	Inhibit nematodes	Warfarin, Pindone, Phosphides, Coumatetraly, Bromadiolone
Molluscicides	Kill mollusks namely snails	Aldicarb, DBCP, Natural-Neem cake and marigold
Piscicides	Control undesirable fish species	Mollucid, CuSO ₄ , Sodium Pentachlorophenate, Bayluscide, Frescon
Synthetic Pesticides	Used as weed Killer	Rotenone, Saponins, Niclosamide, Bayluscide 2, 4-D and 2, 4, 5-T

Table 1

Let us study Toxic behavior of commonly used Pesticides.

2.1 DDT

Its trade name is Dinocide, Neocidal. Its chemical name is dichlorodiphenyl trichloroethane. It is white odourless crystalline solid. It was first discovered in 1873. Earlier, it was widely popular as miracle pesticides, quite effective against insects and pests [5]. It helps in controlling the insects that spread fever, yellow fever, typhus. In India, around 120 pesticides are registered for use in which DDT is most common and dangerous since it accumulates in animal tissue [6]. In India, around 4000 tons of DDT are produced annually but demand is almost double for use.

Exposure:

- Residue of DDT sample found in human tissue sample.
- DDT is easily absorbed by lungs and gastrointestinal system, readily taken up by skin.
- DDT residue is detected in different food crops, food fish, crabs, wild ducks.
- DDT residue is found in migratory birds, insects and fish.

Health effects:

- It is toxic to nervous system of mammals and insects.
- In mammals, common symptoms are headache, numbness of face, vomiting, unrest, confusion, excessive irritability and respiratory failure.
- DDT may cause mutation and affects liver system.
- Intensive use DDT affects ecology of birds, and fish species.
- DDT is probable human carcinogen by EPA (Environmental protection agency)

To prevent and protect its harmful effects, prefer to use safer alternatives such as Malathion and carbamate propoxure in place of DDT. Wash thoroughly fruits, vegetables with water to remove residue of DDT [7].

2.2 Aldicarb

Its trade name is Temik. It is a carbamate insecticide which is effective against a variety of insects, mites and roundworms. It is generally applied to food crops, sweet potatoes, potatoes, soya bean and sugarcane [8].

Exposure:

- Aldicarb leaches from soil and becomes source of groundwater contamination.
- Aldicarb gets easily absorbed in particularly in acidic, sandy soils under moist, warm conditions.
- Its half-life period is one or two weeks, but its residue persists up to ten weeks.

Health effects:

- Low dose of aldicarb has adverse effects and inhibits the action of enzyme cholinesterase and its metabolites products.
- Common signs of poisoning in humans are dizziness, stomach cramping, diarrhea, sweating, nausea and convulsion.
- Aldicarb may cause mutation and affect the nervous system.
- It also affects reproductive effects (Spontaneous abortion)
- It is toxic to wild life including some species of freshwater fishes, birds, invertebrates.

To protect and prevent its harmful effects, avoid contamination of nontarget crops. Wear protective clothing, glasses using synthesis of pesticides. Heating and proper cooking reduce the levels of residue of Aldicarb.

2.3. Alderin and Dielderin

Its trade name is Aldrex or alderine. It is dark brown solid with chemical odour and insoluble in water. These are commercial organochlorine insecticides. Actually, dielderin is conversion products of alderin after oxidation. So, Dielderin is considered to primary toxic nature. It does not get easily degradable and even persist in soils for years. In living organisms, it get accumulated in fatty tissues [9].

Exposure:

- Major sources of alderin and dielderin are agricultural crops.
- Excessive use of alderin act as air pollutants
- Maximum exposure to those people who apply these pesticides and get inhalation.

Health effects:

- High dose of this chemical affect central nervous system
- Severe poisoning cause fatalities to human.
- Common symptoms in human are headache, excessive irritability, nausea, tremors, convulsion, coma and even death.
- Chronic exposure cause weight loss, skin irritation, muscular twitching.

To protect and prevent its harmful effects, care must be taken to avoid direct contact with alderin. Activated charcoal is given to absorb dielderin from digestive tract. Peel off outer layers of agricultural crops.

3. Poisoning by Pesticides

- There are about 3, 75,000 cases of human poisoning by pesticides in developing countries every year, with some 10,000 death.
- The contamination of wheat and flour with highly toxic pesticides caused epidemic outbreaks of poisoning in Brazil, Jamaica and Mexico.
- According to WHO report, volatile herbicides sprayed on sugarcane plantation easily be carried by wind and reach neighboring crops such as cotton, beans, tomatoes and destroy them. Over- intensive aerial application of pesticides causing headache, dizziness and nausea.[10]
- In India, about 67000 metric tons of pesticides are used. Many of pesticides are banned or restricted to limited use, but still it is used freely such as DDT, BHC, Methyl parathion, heptachlor etc.
- DDT is banned in several countries since it leaves residue in soil, water, food and declared as carcinogens, but in India, it is widely used.
- BHC is declared as “Highly Hazardous “but in India, it is still used.
- Methyl parathion is 20 times more toxic than DDT and difficult to handle since it has high dermal toxicity and declared as “Extremely hazardous”.
- In India, in year 2010-2011, out of 15,321 samples; pesticide residue were detected in 1044 samples by 21 participating laboratories which is above maximum residue limit. Residue of chloropyriphos, cypermethrin, and triazophos were most frequently detected.

There are many more other substances such as Heptachlor, Lindane, DBCP (Dibromochloropropane), 2, 4-D herbicide, Paraquat, Toxaphene which are strictly banned or under review for suspecting carcinogenic, mutagenic and tetragenic effects. These are freely available and used in India.

4. Reduction of Pesticide Pollution

- To grow such varieties of crops that needs minimum pesticides.
- Use plant or animal extracts having pesticidal properties.
- Use improved techniques tissue culture and genetic engineering for pest resistant varieties.
- Require careful control over quantities, formulation and timing of application.
- Require knowledge of pest’s life cycle, its predator, parasites and environmental requirement.
- Need of establishment of “Continuing monitoring system” is necessary.
- Need to generate toxicological data on different pesticides synthesized, cytogenic effects.
- Develop new techniques for monitoring and predicting harmful effects of pesticides, diagnosis toxic hazard symptoms and finally developing methods of prevention and control.
- Another way to minimize pesticide pollution is to use less persistent pesticides and harmful pesticides, proper utilization of persistent pesticides. If pesticides are used, then chemical treatment methods like coagulation, volatilizing, irradiation, sedimentation and filtrate must be adopted.
- Still vigil on import of food grains from other countries.
- Regular chemical testing of pesticides under local condition, which are transported from western countries.
- Direct mixing of insecticidal dust with food grains to be avoided.
- Consumers should be advised to wash vegetables throughouly with water and peel all the vegetables and fruits before use.
- Need to stress on Biopesticide, for example-NPV i.e. Nuclear Polyhedrosis Virus which is ecofriendly, less toxic and compatible with many chemical pesticides.[11]

- There is need to educate farmers, field workers and public regarding use of pesticides because farmers are good researchers.
- At last, general public awareness is an uphill task for improving our environment.

The excessive use of pesticides cause major hazard to environment and soil. These pesticides in the soil can be degraded by the following ways:

- Biodegradation
- Chemical degradation
- Photochemical degradation

4.1. Biodegradation Method

Soil act as good medium for degradation of pesticides by microbial and chemical activities. In fact, soil mico-organisms, earthworm, insects and protozoa play an important role in the degradation of pesticides. An interesting example- DDT and methoxychlor get metabolized by soil microorganism to phenol and further degraded to acetate. After their conversion, they become less persistent. Similarly, 2, 4-D and 2, 4, 5-T undergo rapid degrade by micro-organism to their phenols and further to oxalic acid.

4.2. Chemical Degradation

In the laboratories, chemical degradation of pesticides has been carried out on soils and clays sterilized to remove all microbial activity. Generally, clay act as good catalyst for the hydrolysis of 2, 4, 5- trichlorophenyltriphosphate. Actually, this effect is attributed to hydroxyl groups (-OH) on the mineral surface.

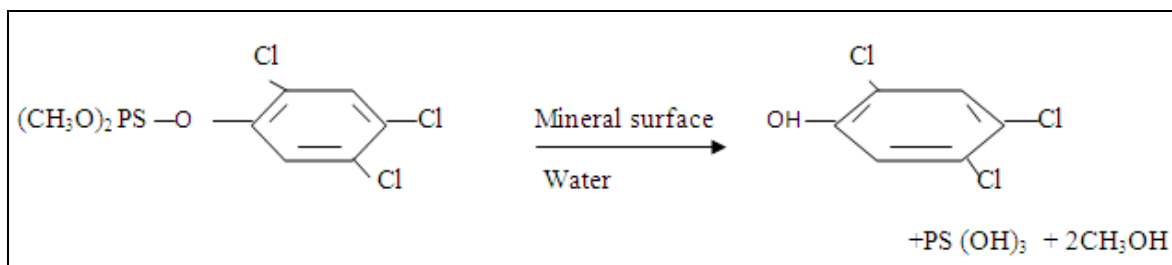


Figure 1

4.3. Photochemical Degradation

In the soil, pesticides get exposed to light and undergo photochemical reaction. Actually, soil molecule get excited by the absorption of light and subsequently react with pesticide molecule to produce further degraded products. 2, 4-D and 2, 4, 5-T herbicides that inhibit the plant growth hormone indoleacetic acid, but their excess about abnormal growth of plant. They also undergo photochemical cleavage of acetic acid side chain and photochemical hydrolysis of aryl chloro group.

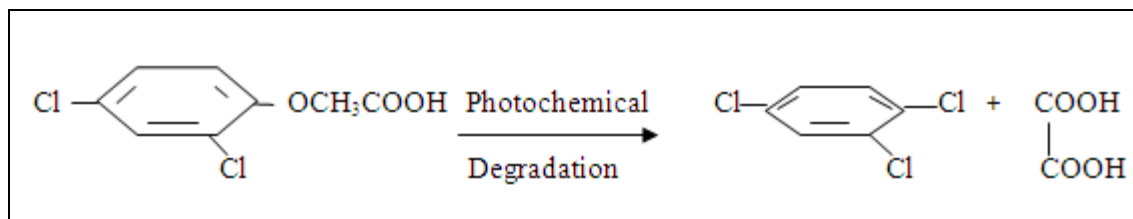


Figure 2

5. Conclusion

Recent studies have indicated that our environment is chronically polluted by pesticides and levels of biocidal contamination have increased tremendously. According to famous statement [12] by President of (IIED) International Institute of Environment and development”-----It is act of man, not acts of god, which pose fundamental threat to the human species. Our survival now is bases on growth and balance. Balance between human population and their natural environment----.Our survival depend on series of fragile and delicately balanced system.” Latest saying in IIED that our organization is potentially working at local and global level about the sustainability of development. There is a need to expertise and frame out policies at international level to tackle the crisis of environmental degradation. Fair ideas at IIED” Bringing knowledge, creating spaces bringing people together” [13]. Enormous use of pesticides leads to biological, ecological, geological cycle of the earth and created several newer problems. The environmental deterioration due to pesticides is endangering the situation of future. There is a dire need to control and prevent pesticide pollution in aquatic system [14]. Biodegradation of pesticides is essential to maintain environmental quality. This can be achieved by chemical methods viz. hydrolysis, oxidation, and dehalogenation and epoxide formation. For example, alderin can be oxidized to dielderin by epoxide formation. Pesticides can be degraded by enzyme present in soil. Besides this, we have to plan for future by selective use of pesticides. Repeated application of insecticides should be avoided. The scientific community to take an active interest in the matter and offer necessary leadership in educating the government and public regarding the actual situation of environment. Scientist must be

well aware of consequences of extension and continuous use of chlorinated hydrocarbon that were being retained in soil and concentrating in food chains. It is important that lay public must be informed about consequences of scientific developments that are adopted for commercial purposes.

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