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Harmful Effects of Chemical Pesticides

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Abstract

After the rise of Green Revolution in Indian agriculture, pesticides have played an important role in increasing crop production and protecting crops from pests, diseases and weeds. India is the third largest consumer (BWD) of pesticides in the world and the largest consumer among countries in South Asia. India is the second largest producer of common insecticides (thempb chmejpbpakme) in Asia after China and ranks 12th in the world. India is the 13th largest exporter of pesticides in the world after Brazil, US. A. Exports pesticides to countries like France and Netherlands. Over the decades, the consumption of pesticides in India has increased manifold from 154 MT in 1953-54 to 85000 MT in 2009-2010. Pesticide consumption per hectare in India is among the lowest in the world, at 0.6 kg per hectare recently. Other countries of the world like- U.K. Of. (5.7 kg. per hectare), France (5-6 kg. per hectare), Korea (7 kg. per hectare), U.S.A. (7 kg. per hectare), Japan (12 kg. per hectare), China (13 kg. per hectare) and Taiwan (17 kg. per hectare) are consumed. The highest consumption of pesticides in our country is Andhra Pradesh, Maharashtra and Punjab, in which 45 percent of the total consumption is used. Most of the pesticides are used in crops like cotton, paddy, fruits and vegetables. According to the Insecticides Act 1968, there are about 155 insecticides registered in India, including 57 insecticides, 44 fungicides, 33 weedicides, 7 rodenticides, 4 plant growth regulators, 4 fumigants, 3 octapadicides, 1 molluscicide, 1 nematode, 1 soil sterilizer. Of the total pesticides in our country, 60 percent insecticides, 18 percent fungicides, 16 percent weedicides, 3 percent biocides and 3 percent other chemicals are used in agriculture.

Keywords

Pesticide Pollution, Modern Agriculture, Plant Diseases, Crop Growth

1. Introduction

The Pesticide has an indirect role in the agricultural production because it protects the plant from insect, pest and diseases. In modern agriculture, farmers are intensively using pesticides to ascertain high yield, but in the due course the pests becoming resistant to pesticides. The crops valued more than seven crores are damaged only due to pests in India in which weeds cause 33%, diseases 26%, insects and rodents 26%, and birds, nematodes etc. cause 15% damage. The seventy per-

cent (70%) of the used pesticides are insecticides, 12-15% fungicides and 4-5% weedicides.

In India, ninety thousand tons pesticides are used every year, out of which 63% are used in agricultural purposes. Insecticides valued of nearly Rs. 6 hundred crores are used in Andhra Pradesh, Karnataka, Gujarat and Punjab, out of which 76% are used on cotton, paddy, jowar and wheat crops; 10% insecticides are used on the cultivation of vegetables and fruits. A comparative consumption of insecticides in developed countries in as table 1.

Table 1. Per hactare concumption of insecticide

S. No.	Country	Per ha consumption of insecticide (in grams)
1	Japan	10,000
2	Europe	2,000
3	America	1500
4	India	400

From the above table it is evident that the consumption of insecticides in India is very less as compared to of developed countries, though there are some states vise, Punjab, Haryana, U.P., A.P., Tamil Nadu Gujarat where consumption is very high. The residue of the pesticide contaminates the food-chain and pollutes the environment. Therefore, to control insect-pests and diseases, it is advisable to go for Bio-intensive integrated pest Management by adopting Judicious use of chemicals. In this study, the different types of pesticides are explained, the pesticides which are banned in India as well as the impact and harmful effects are discussed.

The remainder of the survey is organized as follows. Section 2 presents a preliminary background of pesticides. Section 3 surveys the categories of insecticides. Section 4 discusses the ban on manufacture, import and use of the twenty-seven pesticides in India. Section 5 gives the details of pesticides restricted for use in India. In section 6, harmful effects of the pesticides are discussed. Section 7 explains the impact of pesticides. The persistence of pesticides in soil and effect on soil organisms are provided in section 8. Finally, section 9 gives the concluding remarks.

2. Pesticides

Pesticides are chemicals used to kills pests. So, pesticides are called biocides. The undesirable changes in the environment brought about by pesticides is called pesticide pollution. Chemical compounds that are used to control plant pests and diseases, eradicate weeds, kill insects and micro-organisms that destroy agricultural products, and control parasites and dangerous microbes for humans and animals are called pesticides.

Pesticides are classified on the basis of their use for control as follows-

a. Insecticide: To kill insects
b. Fungicide: To destroy fungus
c. Weedicide: To destroy weeds
d. Nematode: For nematodes

e. Ashtapada Nashi: To kill mites etc.
f. Raticide: To kill rats.
g. Algaecides: To destroy algae
h. Molluscicides: For the mollusc community
i. Bactericides: To destroy bacteria.

3. Categories of Insecticides

In the beginning, inorganic insecticides like lead rcnet, paris green, calcium rcnet were used for pest control. But these insecticides started leaving a fatal effect on the plants as well. Then botanical insecticides like nicotine, rotinone, pyrethrum etc. were invented at the end of the nineteenth century, but these insecticides were not easily available, and their effect remained only for a day or two. Therefore, there was a need for such insecticides which would destroy the insects permanently and would be easily available.

The real era of insecticides started in 1939 with the discovery of DDT insecticide by Dr. Paul Müller. From this time chemical pest control started. Dr. Paul Müller also received the Nobel Prize in 1948 for this discovery. Pesticides are divided into the number of classes.

3.1. Chlorinated hydrocarbons

These are highly toxic, their effects last for a long time. They act like both touch and internal or abdominal poison. They are insoluble in water and soluble in petroleum etc. These are toxic to mammals. D.D.T., B.H.C., Aldrin, Dieldrin, Heptachlor, Chlordane etc. These insecticides were earlier used for underground insects such as lamp, cutworm, white braid. They were very effective. Some of them like B. HC, Heptachlor etc. were sprayed on the plants. But the residues of these pesticides started being found in food grains. When the land started getting polluted by them, the Government of India banned them. Some of these, such as endosulfan, have been used for many years on borer insects. Lindane is still used for pest control on crops.

3.2. Organo phosphate insecticides

Parathion, methyl parathion, ethion, dimethate, domaton, phosphamidon, phorate etc. are very effective in controlling the pest. But most of these are extremely toxic. That's why the Government of India has banned some. Malathipon, acephate etc. are insecticides of this community which are still used on crops, especially vegetables and fruit crops. Their insect killing capacity is fine. Their residues decompose quickly and are comparatively less toxic to humans and animals.

3.3. Carvamate insecticides

Carvaril, Aldicarv, Carvo furan are the insecticides of this category. Of these, Karil is used on various crops. Carbofuran is also used for underground insect termites etc. and in seed treatment. Aldicarv is very deadly, so it should not be used.

3.4. Synthetic pyrethroids

Cypermethrin, permethrin, deltamethrin and fenvalerate etc. These insecticides are extremely lethal to insects even in very small amounts but are less lethal to humans and their residues decompose quickly. Therefore, they are specially used for piercing insects. But their repeated use leads to the increase of other small insects like white fly, green oil etc. Mahu, therefore, spray only once or twice on the crops.

4. Ban on manufacture, import and use of the following twenty seven pesticides in India

Aldrin, Benzene hexachloride, Calcium cyanide, Chlordhan, Copper acetoacetin, Bromochloropropane, Indrin, Ethyl mercury chloride, Ethyl parathion, Heptachlor, Manazone, Nitrophen, Paraquat di methyl sulphate, Pentachloro Nitro Benzene, Pentachloro Phenol, Phenyl Mercury Acetate, Sodium Methane Arsonate, Tretadiphone, Ofloxacin, Aldecarv, Chlorobenzylate, Dieldrin, Maleic Hydrazide, Ethyl Dibromide, T.C.A, Metooxuron, Chlorfenvinphos.

5. Pesticides Restricted for Use in India

Aluminum Phosphide, D.D.T., Lindane, Methyl Bromide, Methyl Parathion, Sodium Cyanide, Methoxyethyl Mercuric Chloride, Monocrotophos, Endosulfan, Phenytotrione, Dizinone, Phenthrione, Diazomate, etc.
Sources: Directorate of Plant Protection and Storage, Faridabad

6. Harmful Effects of Pesticides

Repeatedly use of the pesticides contaminates soil, air and ground water in addition to crop plants and its produce. Carelessly use of such pesticides creates intensive toxicity. It's long term use affects the biological system of the animals. Such pesticides are generally known for its carcinogenic Cancer producing) effect, tertogenic (deformity producing), tumouragenic (tumour and cyst producing) effects. The heavy and uncontrolled use of chemicals brings down the biodiversity of natural enemies due to which epidemic of secondary pests may spread and above all these pests become resistant to pesticides. The persistent use of pesticides causes hazards to non-targeted and useful organisms and thus several minor pests may appear in epidemic form. For example, in rice-ecosystem, there is 3.5 times decline and in cotton-ecosystem, there is 12 times decline in natural enemies. Previous several minor-pests have become harmful and major pests viz. Rice leaf folder (Canphalocrocis medinalis), Green leaf hopper (Nephotettix spp.) and white backed planthopper (Sogatella furcifera) in rice-ecosystem and old-world boll worm (Helicoverpa armigera) in cotton ecosystem. Several other pests have developed resistance to pesticides at the normal doze viz. Old world bollworm (H. armigera) Brown plant hopper (Nilaparvatha lugens) of rice; diamond back moth (Plutella xylostella) of crucifers, black aphid (Aphis craccivora) of groundnut tobacco caterpillar (Spodoptera litura) of groundnut and other crops, Mustard aphid (Lipaphis erysimi) of castor, Serpentine leaf miner (Liriomyza trifolii) of tomato and other crops.

Some pesticides are easily degraded and decomposed in soil after doing their work, but some don't. Some are cyclic-hydrocarbon viz. BHC, DDT, Aldrin etc. in which chlorine is the main constituent. Such elements are inhibitors of biological degradation and stop the oxidation-ring. These elements are remained in the environment for the long time.

The concentration of such materials is increased year by year. These materials are accumulated in the soil and water. From there they enter into the food chain through producers. When vegetarians consume them as food, these harmful pesticides are deposited in their body tissues where their concentration becomes more than that of the producer. And if these vegetarians are consumed by the non-vegetarian consumers, these pesticides reach in their body where they become more and more concentrated. Moving through different levels of food-chain, these injurious pesticides are deposited in human body where their concentrations reach to the highest because man is the top consumer. Such an increment in the concentration of pesticides is known as Biological Magnification/Biomagnification. Many surveys showed that majority of the people living in the Indian cities have more amount of DDT above the tolerance level in their bodies. The more concentration of pesticides like DDT in birds decreases the thickness of eggshell as a result these eggs hatch prematurely before the complete embryo-development. For this reason, a number of aquatic birds like pelicans has been decreasing day by day.

The use of different agricultural chemicals causes the effect of phytotoxicity, Pollen-sterility, pollution and developmental obstruction. Due to these hazardous effects of pesticides an awakening has been seen in agricultural scientists and now they

have been emphasized on the need-based use of chemicals and Bio-intensive integrated pest management. Now the farmers are instructed to use chemicals in the special conditions only after the recommendation when other methods of pest-control become failure.

7. Impacts of Pesticides

a. Pesticides such as DDT, Endrin, Dieldrin, etc. contaminate ground water and decrease the quality of the water.
b. Aquatic organisms take in pesticides directly and accumulate them in their body tissues.
c. The increase in the concentration of pesticides in body tissues of organisms of successive trophic levels is called bio-magnification. It is injurious to health.
d. Pesticides kill predatory insects.
e. Pesticides deposit in body tissues of human beings and cause cancer.
f. They also cause mass death of human beings and domestic animals. e. g. Bhopal Episode.
g. Due to continuous application of pesticides, the insects develop resistance against them and survive well even in the presence of the pesticides.

8. Persistence of pesticides in soil and effect on soil organisms

Most of the pesticides that are used to control insects and weeds end up in the soil. The effectiveness of pesticides and the adverse effects of their harmful residues depend on the time they remain in the soil. For example- D.D.T. remains stable for 3 years in arable soil while organo phosphate and carbamate insecticides remain stable for a few days or a few months only (Chamtepage). The permanence of some insecticides in the soil are as follows: Heptachlor 9 years, Aldrin and Dieldrin 9 years, D.D.T. 10 Years, B.H.C. 11 years, chlorodane 12 years, diuron 19 months, atrazine 18 months, 2-4D persists in the soil for 14 to 30 days. Pesticide levels gradually decrease in the soil by growing crops, by leaching, and by decomposition of organic matter. Long-term effects of toxic pesticides are fatal to living organisms.

Specific types of pesticides are used to kill specific types of harmful organisms because not all types of harmful organisms are killed by the same type of pesticide. Fumigators are more effective for nematodes. Organo-phosphates and chlorinated hydrocarbons are more effective for mites. Most insecticides are ineffective on earthworms except carbamates and nematocides.

Pesticides have a detrimental effect on bacteria participating in nitrification, nitrogen fixation. Insecticide fungicides have been found to be more harmful than weed killers on these actions. Pesticide effect is effective only for some time on soil organisms. Harmful effect on organisms can be saved by using limited and balanced quantity of these pesticides.

9. Conclusion

The Human health impacts of pesticides can happen through one of three routes: ingestion, inhalation and skin contact that occur through the handling of pesticide products. It is worth nothing that pesticides enter the water by run off or by leaching. There are two major biological mechanism that leads to pesticides degradation. The first is microbiological interactions in water and soils, while the second is the pesticide's metabolism when living organisms consume it as part of their food uptake. The non-selective persistent pesticides such as DDT must be phased out of use. Only selective pesticides must be used. Pesticides must be used in small industry. Repeated pesticide application should be stopped. Enough ideas should be given to the farmers about the problems of pesticide application. Scientific research should be carried out to know the effects of pesticides and to know how to control the ill effects.

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