# The Adverse Effects of Pesticides on Human Health

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**ABSTRACT**

Serious concerns have been raised about the health risks associated with occupational exposure to pesticides as well as from residues in food and drinking water, despite the fact that pesticides are developed through very strict regulatory processes to function with reasonable certainty and minimal impact on human health and the environment. Workers in the pesticide industry, exterminators of household pests, and agricultural workers in open fields and greenhouses are frequently exposed to pesticides on the job. The majority of the population is exposed to pesticides through consuming pesticide-tainted food and drinking water, but there is also a risk of significant exposure in or near the home. Regarding adverse environmental effects (exudations, spills, spray drift water, soil, air pollution, and adverse effects on wildlife, fish, plants and other non-target organisms), many of these effects were taken after application. Toxicity of pesticides generated during the procedure, dosages used, adsorption to soil colloids, general weather conditions after application, and duration of pesticides in the environment. Therefore, the risk assessment of the effects of pesticides on human health or the environment depends on the duration and level of exposure, the type of pesticide used (in terms of toxicity and persistence), and environmental characteristics. In areas where pesticides are commonly used. In addition, the number of criteria and methods of implementation used to assess the harmful effects of pesticides on human health influence risk assessments, and in the near future already approved pesticide characterization and new compounds. It may affect the authorization. Therefore, new tools or techniques that are more reliable than existing ones are needed to anticipate the potential dangers of pesticides and reduce their adverse effects on human health and the environment. Meanwhile, the implementation of alternative pesticide systems that are less dependent on pesticides, the development of new pesticides with new mechanisms of action and improved safety profiles, and the pesticide formulations already in use for safer formulations. Improvement (eg microcapsule suspension)). It can reduce the harmful effects of agriculture, especially the toxic effects of pesticides. In addition, by using proper and well-maintained spray equipment and taking all necessary precautions at all stages of pesticide handling, human exposure to pesticides and potential environmental impacts are minimized. It can be suppressed. So the need for food security and vector control, pesticides are used to manage pests and will likely continue to be utilised in the future. Most pesticides have the potential to be hazardous to people, with serious health effects. There is proof that parental exposure as well as exposure during childhood or adolescence may raise the risk over the long run. Many human diseases, including Alzheimer's, Parkinson's, amyotrophic lateral sclerosis, asthma, bronchitis, infertility, birth defects, attention deficit hyperactivity disorder, autism, diabetes, and obesity, as well as respiratory illnesses, organ diseases, and system failures have all been linked to pesticide exposure. Pesticide exposure increases the risk of developing a number of malignancies, such as non-Hodgkin lymphoma (NHL), leukaemia, brain tumours, and cancers of the breast, prostate, lung, stomach, colon, liver, and urinary systems.

Key words – pesticide toxicity; pesticide safety; risk assessment, pesticides,human diseases, cancer.

## I.INTRODUCTION

Any substance that is being used to prevent, eradicate, or repel pests from causing damage is considered a pesticide. Any living thing that poses a serious threat to mankind through transmission of disease, property damage, or competition for food is referred to as a pest. According to the target pest organism, a pesticide can be an insecticide, an insect and plant growth regulator, a fungicide, a herbicide, a molluscicide, and an algaecide, among other things. Pests include insects, rodents, bacteria, fungi, and weeds (unwanted plants), among other things.

In order to chemically control numerous pests, agriculture is the greatest consumer of pesticides, accounting for over 85% of global production. Additionally, pesticides are employed in public health initiatives to manage undesirable plants (such as grass and weeds) and vector-borne diseases (such as malaria and dengue) in ornamental landscaping, parks, and gardens. They are also helpful in preventing or reducing the growth of germs, fungi, and algae in paint, carpets, electrical equipment, paper, cardboard, and food packaging materials.

Chemicals are used in modern agriculture to boost crop productivity. Due to an increase in the concentration of these chemicals, fertiliser used to promote growth and pesticide used to prevent pest.There have been millions of incidents of pesticide poisoning in the environment every year.

Use of pesticides has benefits, including increased economic potential for food production and a reduction in vector-borne diseases. However, the subpar agricultural methods used by the Farmers, along with the widespread use of pesticides,"If a little is good, more will be better," is a fallacy. And application of inadequate harvesting wait times have caused extensive environmental pollution. India currently produces the most insecticides in Asia.is the 12th-largest pesticide consumer in the world. The pattern of pesticide usage in India is different from that for the world in general. As can be seen in Figure 1, in India 76% of the pesticide used is insecticide, as against 44% globally.

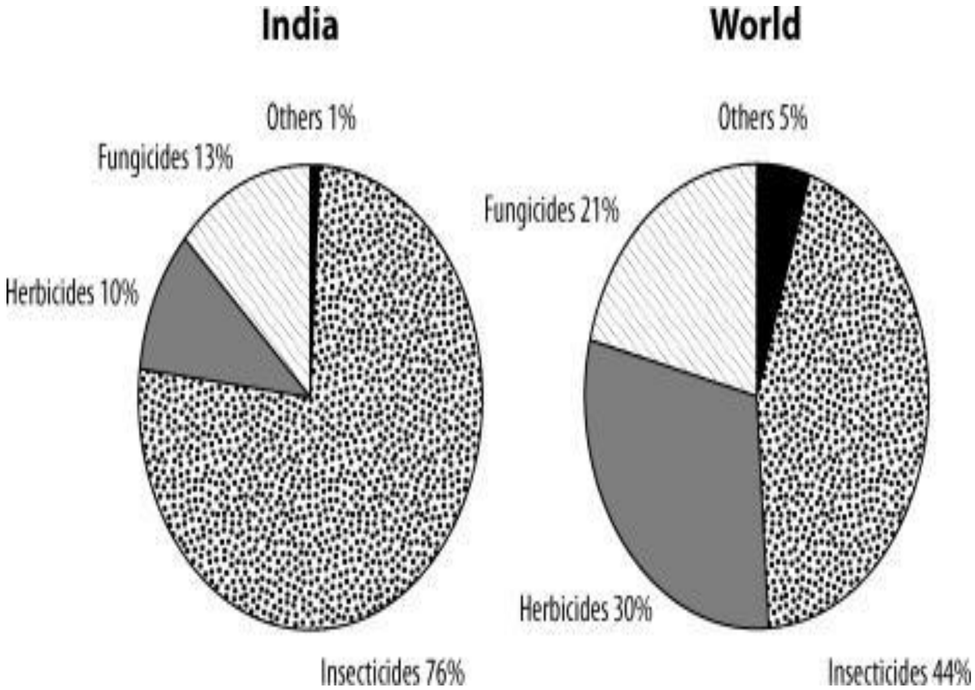


**Figure :1 In India 76% of the pesticide used is insecticide, as against 44% globally**

The use of pesticides is debatable due to their negative consequences. Rachel Carson's publication "silent spring" elaborated the negative effects of DDT in 1962 and resulted in its restriction on agricultural use. In similarly how other dangerous chemicals were outlawed in subsequent years by Environmental Defense Fund (EDB), EPA (ethylene dibromide). Due to its effects as a carcinogen and mutant, it was banned in 1983. Pesticide Remaining remnants are hazardous and last for a very long time by eradicating harmless insects, mammals, and other organisms from the environment, fishes and changed their genetic makeup by introducing resistance into them against these insecticides (pest). Despite their widespread usage and popularity, pesticides have been linked to major health problems, including exposure of farmers working in treated fields or mixing and applying pesticides, as well as residues on food and in drinking water for the general public. These Several accidental poisonings have been brought on by activities, and even the regular application of pesticides can pose significant short- and long-term health concerns to farmers and can harm the environment. Farmers in poor nations suffer significant exposure hazards as a result of the use of hazardous pesticides that are wrong application methods, poorly maintained, prohibited or restricted in other countries, entirely improper spraying apparatus, poor storage procedures, and frequently reusing old insecticide. It is clear that exposure to pesticides continuously creates a health risk, particularly in the agricultural working environment. The majority of pesticides exhibit significant levels of toxicity by design because they are made to kill specific species and so produce there is considerable danger. In this context, the usage of pesticides has sparked grave concerns regarding not just potential affects on fragile ecosystems and species in addition to implications on human health.

The WHO estimates that about a million people worldwide suffer from acute poisoning brought on by pesticide exposure. The annual death rate ranges from 0.4 to 1.9 percent. Several pesticides induce neurological disorders and degenerative diseases, some affect prenatal growth and result in congenital malformations, and some are human carcinogenic, according to evidence from the last two decades about pesticide exposure and health. In many developing nations over the past three decades, the careless use and handling of pesticides in agriculture has resulted in major issues with human health.

Humans are exposed to pesticides in many ways, and the intensity of these exposures varies, which contributes to the differences in their effects. Farmers, fruit and vegetable vendors, pesticide industry employees, those transporting these dangerous chemicals, and Consumers are exposed to various pesticide concentrations. Pesticide exposure is thought to might be connected to a variety of illnesses, including Hodgkin's disease (HD), non-Hodgkin Parkinson's disease, NHL and respiratory illness, endocrine disruption and as well as reproductive issues. Additionally, it is considered that pesticides human diseases, such as the link between glyphosate and breast cancer.

The pesticides which contain alkyl ureas and amines are found to be associated with brain tumors .The prostate cancer risk was found to increase in people exposed to Agent Orange [a mixture of 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), picloram, and cacodylic acid], which was heavily used by the USA. Dieldrin causes tumors of lung, liver, lymphoid tissue, uterus, thyroid, mammary gland in test animals at doses as low as 0.1 ppm. Several pesticides are recognized as endocrine disruptor compounds (EDCs) which were first recognized by the WHO in 2002. These are exogenous substances, natural or synthetic, that interfere with endocrine systems and therefore may cause adverse effects on physiological processes including development, growth, and reproduction in organisms and/or in their progeny. Transcriptional activity of nuclear receptors is one of the prime targets of EDCs, and several pesticides including organochlorines, diphenyl ethers, organophosphorus pesticides, pyrethroids, carbamates, acid amides, ureas were found to act as agonists of these nuclear receptors. Oxidative stress is one of the major mechanisms which is associated with several diseases and aging. Naturally, this phenomenon increases with age and affects several vital processes in the body. Many pesticides (paraquat, rotenone and maneb) cause Reactive Oxygen Species (ROS)- mediated stress and neurodegenerative diseases. For instance, at cellular level, Parkinson’s disease (PD) is closely associated with excessive production of

ROS from mitochondrial respiratory complexes, which in turn causes serious injuries to mitochondrial DNA and other macromolecules. Similarly, Alzheimer's disease (AD), one of the most common disability in aged people, is characterized by abnormal deposition of amyloid β (Aβ) protein is also closely coupled with oxidative stress.Long-term exposures atlow doses of paraquat, dieldrin, organochlorine, and organophosphates have found to generate ROS-mediated neurotoxicity which is positively related to Alzheimer's disease .

Though there are several associated threats, still the necessity of these pesticides forces us to use these substances regularly. These chemicals also support us to fight against deadly diseases and ensure the availability of food supply to the exponentially growing human population at affordable prices. In a hypothetical condition of banning pesticides in the USA alone, it was estimated that supplies of food grains such as wheat, corn and soybeans would drop by 27%.

To ban pesticides completely, must acquire more agricultural lands to fulfill the food demands, which in turn will largely reduce forest's canopy and eventually will destruct the flora and fauna. The best notion to decrease the damages caused by these chemicals is to investigate narrow-spectrum pesticides and natural agents such as bacteria, viruses which have ultimate specificity. The alternative approach is to use insect hormones such as juvenile hormone and molting hormone and their derivatives as insecticides, which could be an alternative strategy to avoid resistance in insects and minimize effects on non-targeted species including humans.

## II.HISTORY

Since the dawn of civilization, human societies have worked to cultivate and preserve their food resources using the most efficient and quick methods possible. A practical example of this is how they grew nutritious and poisonous plants in the same area since the poisonous plants served as a barrier for the control of insects. The use of elemental sulphur has also occurred during this time. For several millennia, these would be the first techniques used to get rid of pests. The Ebers papyrus, one of the earliest still-extant manuscripts, arrived later and contains some of the preparation methods for removing insects from foods. Parallel to this, ancient sulphides are also used in traditional Chinese medicine. It's also fascinating to note that Homer's epic poem "Odysseus," which was composed at about the same time, mentions using chemicals to get rid of insects. Early uses of "para-pesticides," such as mercury and arsenic, appeared about the year 1500. These compounds were employed up until the advent of synthetic pesticides (1940 and later), initially for the destruction of food stocks during World War II and then as priceless instruments for the cultivation of daily food items. It is important to note that throughout this time, numerous scientists have emphasised the harmful effects that pesticides can have on human health when used over an extended period of time. For instance, the sharp increase in lymphoma patients is a subject that is still being discussed today.Figure: 2 represents the historical development of pesticides.

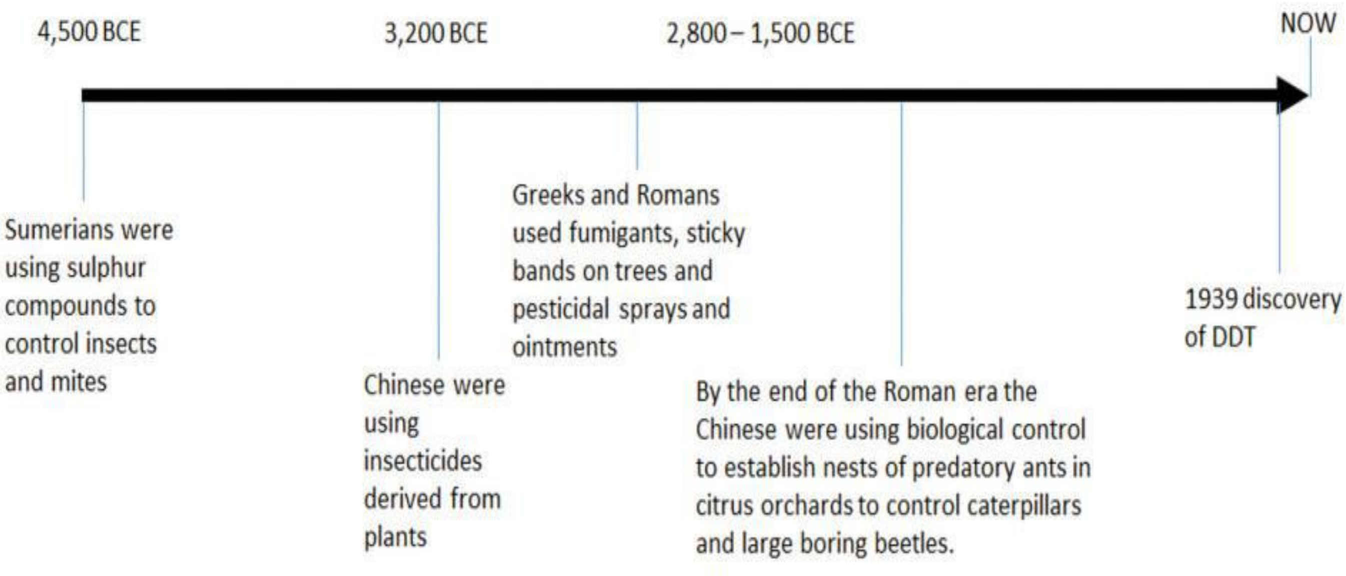


**Figure 2: History of pesticides**

## III.CLASSIFICATION OF PESTICIDES

The term "pesticide" refers to a broad category of insecticides, fungicides, herbicides, garden chemicals, household disinfectants, and rodenticides used to both eliminate and protect against pests. The chemical and physical characteristics of these insecticides vary from one class to another. It is therefore admirable to classify them according to their characteristics and research their specific groups. Synthetic pesticides are manufactured from chemicals that don't naturally exist. Depending on their intended usage, they are divided into various groups. Currently, Drum recommends three commonly used classification systems for pesticides (1980). The chemical makeup of the pesticide, the entrance method, and the effect of the pesticide and the organisms it kills are the three main categories of pesticides. Depending on their sources, chemical pesticides are divided into four categories: carbamate, organophosphate, organochlorine, and pyrethroid pesticides. A different category of pesticides known as biopesticides, on the other hand, is made up of naturally occurring or derived substances, particularly from living creatures like plants, fungi, bacteria, etc. The three main categories of biopesticides are plant-incorporated protectants, microbial pesticides, and biochemical pesticides. Modes of entry are the approaches that pesticides can take to engage with or get to the intended pest. These three widely used methods of classifying pesticides include: I classification according to the mechanism of entry; (ii) classification according to the pesticide's function and the pest organism it kills; and (iii) classification according to the pesticide's chemical makeup.

## IV.Classification according to the mechanism of entry

Modes of entry refer to the methods by which pesticides enter or come into contact with the target. These include repellents, fumigants, stomach poisons, systemic poisons, and contact poisons.

### A.Systemic pesticides

Pesticides that are absorbed by plants or animals and go to untreated tissues are known as systemic pesticides. Throughout the body, systemic herbicide plant and can access untreated leaf, stem, or root parts. Those are capable of destroying weeds with only a partial spraying. They are competent pass via the plant vascular system and into the plant tissues to kill particular pests. Additionally, several systemic pesticides are used through animals to manage pests like fleas, lice, or warble grubs. The Pesticide transport in plant tissues can either be unidirectional or multidirectional. While other pesticides may only migrate vertically in plants, some pesticides may only go in one direction, either up or down. It will spread throughout the plant if applied to the root zone, but if applied to the leaves, it will not. Furthermore, few pesticides are thought to be locally systemic and only spread to a limited distance, separation of the point of contact within a plant. Systemic pesticide examples include glyphosate and 2, 4-Dichlorophenoxyacetic acid (2, 4-D). With the introduction of soluble organophosphorus (OP) chemicals including dimethoate, demeton-S-methyl, mevinphos, and phorate, systemic insecticides were first created in the 1950s. They were helpful in several cases for reducing burrowing larvae and sucking pests. Crops, with their primary benefit being their transfer to all plant tissues. Sys-Aldicarb and carbofuran were the subsequent temic carbamates in the 1960s. After that, both insects a substantial majority of broad-spectrum insecticides used in agriculture belong to the ticidal groups around the globe. Today, OPs are the most widely used pesticides in tropical, developing nations like the Philippines and Vietnam, where 22 and 17 percent, respectively, of the agrochemicals are deemed to be "very dangerous", or WHO class I. parasitic insect growth regulators are a small class of drugs that were created in the 1980s and 1990s.Chemicals that are superior to their predecessors in terms of selectivity. Beginning in 1990, cartap, In most wealthy countries, fipronil and neonicotinoids are replacing the previous dangerous pesticides both developed and emerging nations.

Through seed coatings and granular applications, systemic insecticides pose minimal risk of pesticide drift or worker exposure in agricultural, nurseries and urban settings. Neonicotinoids and fipronil are also preferred because they appear to be less toxic to fish and terrestrial vertebrates. Initially proposed as environmentally friendly agrochemicals, their use in Integrated Pest Management (IPM) programs has been questioned by recent research that shows their negative impact on predatory and parasitic agents. New for- mulations have been developed to optimize the bioavailability of neonicotinoids, as well as combined formulations with pyrethroids and other insecticides with the aim of broadening the insecticidal spectrum and avoid resistance by pests. Indeed, as with any other chemical used in pest control, resistance to imidacloprid by whitefly (Bemisia tabaci), cotton aphids (Aphis gossypii) and other pests is rendering ineffective this and other neonicotinoids such as acetamiprid, thiacloprid and nitenpyram.

Systemic insecticides are applied directly to the crop soil and seedlings in glasshouses using flowable solutions or granules, and often as seed-dressings, with foliar applications and drenching being less common. Being quite water soluble Table 1, these insecticides are readily taken up by the plant roots or incorporated into the tissues of the growing plants as they develop, so the pests that come to eat them ingest a lethal dose and die. Sucking insects in particular are fatally exposed to systemic insecticides, as sap carries the most concentrated fraction of the poisonous chemical for a few weeks, whereas leaf-eating species such as citrus thrips and red mites may not be affected. Systemic insecticides contaminate all plant tissues, from the roots to leaves and flowers, where active residues can be found up to 45-90 days, lasting as long as in soil. Thus, pollen and nectar of the flowers get contaminated, and residues of imidacloprid and aldicarb have been found at levels above 1 mg/kg in the United States. Guttation drops, in particular, can be contaminated with residues as high as 100-345 mg/L of neonicotinoids during 10-15 days following application. Because these insecticides are incorporated in the flesh of fruits, the highly poisonous aldicarb is prohibited in edible crops such as watermelons, as it has caused human poisoning.

### B. Contactonly (Non-Systemic) Pesticides

Because they act on target pests when they come into contact, contact pesticides are another name for non-systemic pesticides. Pesticides need to be applied physically. To be effective, contact with the pest is required. Pests absorb the pesticide into their bodies upon touch, via their skin, and results in poisoned death. These the plant tissues are not always penetrated by insecticides, so not carried by the vascular system of the plant. examples includes Paraquat and diquat dibromide. A non-systemic pesticide is any formulation applied to a plant directly onto its foliage, flowers, buds, stems, branches, roots, or seeds. Unlike systemic products, non-systemic pesticides can easily be flushed or drained from the plant's root zone prior to harvest, leaving little to no residues behind. This type of pesticide is very often used in hydroponics because they render the plants safe for consumption. Non-systemic pesticides can either be broad-spectrum (killing any and all insects they come in contact with) or selective (targeting just one specific species of pest).

Non-systemic pesticides are commonly used in home gardens because they are safer than their systemic counterparts. They often fall into the organic pesticide category. According to botanists, it is still important to wear gloves and other protective wear when working with non-systemic pesticides, as they are still strong substances in most cases that can irritate the skin. Unlike non-systemic pesticides, systemic pesticide affect the plant from the inside, which may render the plants unsuitable for consumption. As a result, systemic products are commonly applied to flowers, shrubs, and trees, while non-systemic products are used on consumable plants like cannabis, string beans, tomatoes, and the like. Systemic pesticides have also been known to affect the plant’s pollen, which can have a highly detrimental effect on pollinators. Non-systemic pesticides are easily obtained from the garden center, or made at home. Systemic products, however, are usually only available for use in commercial horticulture and agriculture.

Both systemic and non-systemic insecticides can be lethal to pollinators, or cause sub-lethal deleterious effects. The differences are more about where and when the insecticide is present in or on plant tissue and how that affects exposure, as outlined in the Table 1.

**Table 1: Difference between systemic and non systemic insecticides**

| Systemic | Non-Systemic |
|---|---|
| • May contaminate pollen, nectar, and leaf tissue from the inside (or from the outside when foliar applications are used) | • May contaminate pollen, nectar, and leaf tissue from the outside only |
| • Often present in plant tissue at lower, steadier concentrations than surface residues, thus there is a potential for prolonged chronic exposure | • Surface residues present at highest levels immediately after spray but concentrations can decline quickly |
| • Application during any season may present a toxic concern for pollinators due to prolonged uptake | • Bloom-time applications or applications when pollinators are present are of particular concern |

**C. Stomach toxicants and stomach poisoning**

The insecticide that causes stomach poisoning enters the body of the pest by its mouth and digestive tract and kills it by poisoning. the stomach poisons acquired when bugs consume the insecticide that was sprayed in, the plant's leaves and other components. Additionally, stomach toxins may enter the mouth and digestive system of insects, where they are located, the body of the insect absorbs it. This is more suitable, particularly in vector When bacteria or their toxins are added to water, a control measure, filter-feeding mosquito or black fly larvae will ingest the poison. These Insecticides work by killing the vector's midgut (or stomach) larvae.

Stomach toxicants are a type of pesticide that works by entering through the target pests body via feeding and then passing through the digestive system. The pest will consume the poison or have it otherwise absorbed into the body and the poison will eventually kill the pest after some time passes. There are various different active ingredients that are classified as stomach toxicants such as malathion, Bacillus thurigiensis (Bt), boric acid, borates and others. Stomach poisons also often come in different formulations such as liquids, dusts, gel baits and granules. Stomach toxicants work upon being ingested by the target pest. If the stomach toxicant comes in liquid or dust form, they are usually applied in areas pests come across during their normal travels and will curiously feed upon it. When stomach toxicants comes in bait or granule form, they often are mixed with a food ingredient that the pest is attracted by (such as sweets, proteins and oils) to entice the pest to readily consume it. Once eaten, the poison travels through the digestive system and begins to effect the pest, harming it's insides until it ceases to function and drops dead.

**D. Fumigants**

Pesticides known as "fumigants" act or may kill the pests they are intended to control by vaporising them. When used, these herbicides produce toxic fumes. These Pests' trachea allows vaporised insecticides to enter their bodies. (respiratory) through spiracles and poisoning results in death. Certain of their when packaged under high pressure, active substances are liquids but transform. when gases are discharged, to gases. Volatile liquids are additional active substances. when kept in a regular container and weren't pressure-formulated.Fruits and vegetables are fumigated to eliminate pests from stored products.both grains They are also very helpful in reducing soil pests. Soil fumigants are pesticides that, when applied to soil, form a gas to control pests that live in the soil and can disrupt plant growth and crop production. Common fumigants used to treat stored products or nursery stock include hydrogen cyanide, naphthalene, nicotine, and methyl bromide. Soil fumigants commonly used as nematocides are methyl bromide, dichloropropane, propylene oxide, dibromochloropropane, organophosphate insecticides, and chloropicrin.

**E. Repellents**

Repellents do not kill but are distasteful enough to keep pests away from treated areas/commodities. They also interfere with pest's ability to locate crop. There are multiple active ingredients in insect repellents registered with the Environmental Protection Agency (EPA). DEET, picaridin, IR3535, and oil of lemon eucalyptus are referred to in this fact sheet as common insect repellents. The Centers for Disease Control and Prevention (CDC) recommends using products with one of these EPA registered ingredients. They can be applied to human skin and some can be used on clothing. They come as sprays, wipes, or lotions. Oil of lemon eucalyptus and IR3535 are based off of chemicals that occur in nature but are man-made ingredients. Because they are related to substances found in nature, they are both considered to be biopesticides. Oil of lemon eucalyptus (OLE) may also be listed on products by its chemical name, p-menthane-3,8-diol (PMD).The ways pesticides come in contact with or enter the target are called modes of entry which is shown in Table 2.

**Table 2: Classification of pesticides on the basis of mode of entry**

| SI.No | Type of pesticide | Description | Examples |
|---|---|---|---|
| 1 | Systemic Pesticides | These are pesticides which are absorbed by plants or animals and transfer to untreated tissue | 2,4-D, glyphosate |
| 2 | Contact pesticides | It acts on target pests when they come in contact | Paraquat,diquat |
| 3 | Stomach poisons | It enters the pests body through their mouth and digestive system | Malathion |
| 4 | Fumigants | Pesticides which acts or may kill the target pests by producing vapour and enter pests body through tracheal system | Phosphine |
| 5 | Repellents | Repellents do not kill but distasteful enough to keep pests away from treated area.They also interfere with pests ability to locate crop. | Methiocarb |

**V.Classification according to the pesticide's function and the pest organism it kills**

Pesticides are categorised according to the organism of the target pest and are given unique names that represent their activity. These pesticides' group names are derived from the Latin word cide, which means "to kill or killer) that are added as a suffix to the associated pest name .Not, all pesticides have the word "cide" at the end. some pesticides are additionally categorised based on their functions. Examples include growth. pest growth regulators that either promote or inhibit the growth of pests; defoliants that plant leaves to fall off; desiccants, which accelerate the drying of plants that may be harvested mechanically or that kill and dry out insects; insect repellents pests away; attractants that draw pests, typically to a trap; and Chemosterilants are chemicals that kill bugs. Table 3: Pesticide classification by target pests

Additionally, certain pesticides are effective against more than one type of insect and can be categorised under more than one pesticide class. Acaricide, insecticide, and herbicide are all possible classifications for the extensively used aldicarb in Florida citrus industry.due to the fact that it regulates mites, insects, and nematodes separately. Another such illustration is 2, 4-D, a broadleaf weedkiller.even at low rates it acts as a plant growth regulator. Attractants because due to their employment in pest control, repellents are regarded as pesticides.

**Table 4: Pesticide classification by target pests**

| Sl. No. | Type of pesticide | Target pests/Functions | Examples |
|---|---|---|---|
| 1. | Acaricides | Substances that are used to kill mites and ticks or to disrupt their growth or development | DDT, dicofol, chlorpyrifos, permethrin, etc |
| 2. | Algicide | Substances that used to kill or inhibit algae | Copper Sulphate, diuron, oxyfluorfen, etc |
| 3. | Antifeedants | Chemicals which prevent an insect or other pest from feeding | Chlordimeform, azadirachtin, etc |
| 4. | Avicides | Chemicals that are used to kill birds | Strychnine, fenthion, etc |
| 5. | Bactericides | Compounds that isolated from or produced by a microorganism or a related chemical that is produced artificially, which are used to kill or inhibit bacteria in plants or soil | Streptomycin, tetracycline, etc |
| 6. | Bird repellents | Chemicals which repel the birds | Diazinon, methiocarb, etc |
| 7. | Chemosterillant | Chemicals that renders an insect infertile and thus prevent it from reproducing. | Diflubenzuron |
| 8. | Desiccants | Act on plants by drying their tissues | Boric acid |
| 9. | Fungicides | Chemicals which are used to prevent, cure eradicate the fungi. | Cymoxanil, thiabendazole, Bordeaux mixture |
| 10. | Herbicide softener | A chemical that protect crops from injury by herbicides, but does not prevent the herbicides from killing weeds. | Benoxacor, cyometrinil |
| 11. | Herbicides | Substances that are used to kill the plants, or to inhibit their growth or development. | Alachlor, paraquat, 2,4-D |
| 12. | Insect attractant | A chemical that lures pests to trap, thereby removing them from crops animals and stored products | Gossyplure, Gyplure |
| 13. | Insect growth regulator | A substance that works by disrupting the growth or development of an insect | Diflubenzuron |
| 14. | Insecticides | A pesticide that is used to kill insects or to disrupt their growth or development | Azadirachtin, DDT, chlorpyrifos, malathion, etc. |
| 15. | Larvicides | Inhibit the growth of larvae. | Methoprene |

**Table 5:Table 3: Pesticide classification by target pests**

| | | | |
|---|---|---|---|
| 16. | Lampricides | Target larvae of lampreys which are jawless fish like vertebrates | Nitrophenol |
| 17. | Mammal repellent | A chemical that deters mammals from approaching or feeding on crops or stored products | Copper napthanate, trimrethacarb, etc. |
| 18. | Mating disrupters | Chemicals that are interfere with the way that male & female insects locate each other using airborne chemicals, thereby preventing them from reproducing | Disparlure, gossyplure, etc. |
| 19. | Molluscicides | Substances used to kill slugs and snails. | Metaldehyde, thiadicarb, etc. |
| 20. | Moth balls | Stops any damage to cloths by moth larvae | Dichlorobenzene |
| 21. | Nematicides | Chemicals which are used to control nematodes | Carbofuron, chlorpyrifos, methyl bromide, etc. |
| 22. | Ovicides | Inhibit the growth of eggs of insects and mites | Benzoxazin |
| 23. | Piscicides | Acts against fishes | Rotenone |
| 24. | Plant growth regulators | Substances alters the expected growth, flowering or reproduction rate of plants | 2,4-D, gibberellic acid, etc. |
| 25. | Rodenticides | Substances used to kill rats and related animals | Strychnine,Warfarin, zinc phosphide, etc. |
| 26. | Silvicides | Acts against woody vegetation | Tebuthiuron |
| 27. | Synergists | A chemical enhances the toxicity of a pesticide to a pest but that is not by itself toxic to pest | Piperonyl butoxide |
| 28. | Termiticides | Kill termites | Fipronil |
| 29. | Virucide | An agent having capacity to destroy an inactivate viruses | Ribavirin |
| 30. | Miscellaneous | - | Aluminium phosphide, sodium cyanide |

### VI.Classification according to the pesticide's chemical makeup

Based on their chemical makeup and the type of their active chemicals, pesticides are categorised most frequently and most effectively. Such classification provides information about the effectiveness, both physical and chemical characteristics of the corresponding insecticides. The details on chemicals and when determining the mode of action of pesticides, physical properties are highly helpful of application, measures that need to be taken during application and the rates of application. Pesticides are divided into four main classes according to their chemical composition: organochlorines, organophosphorus, carbamates, pyrethrin, and pyrethroids. Based on chemicals pesticide categorization is a complicated process. The majority of contemporary insecticides are organic substances. They consist of both natural and synthetic insecticides origin. But certain inorganic substances are also employed as insecticides. Important pesticides, such as insecticides, can be further divided into a number of subclasses. Figure 3 provides the sub-classification of pesticides.

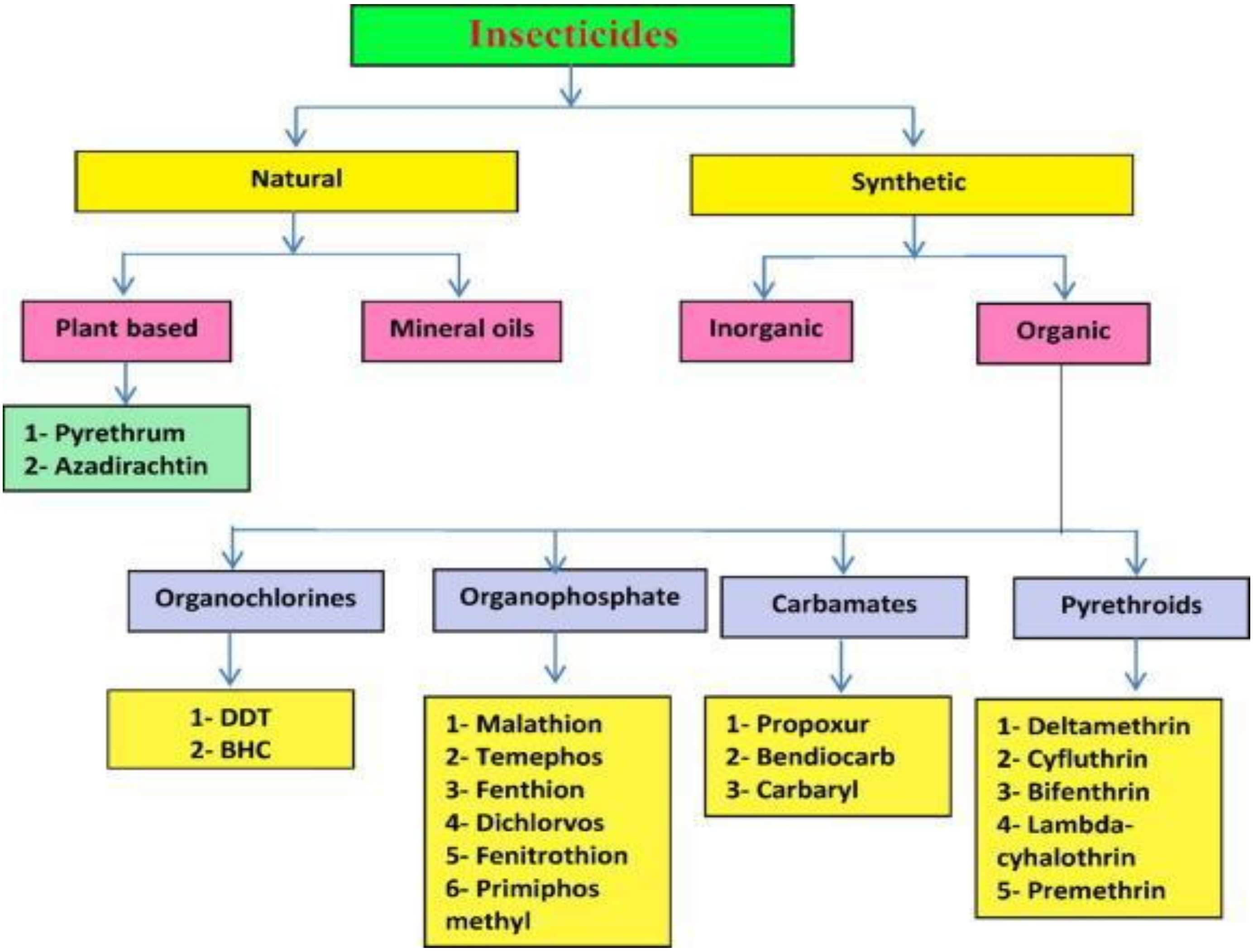


**Figure 3: Insecticides Classification**

**A. Organochlorines**

Organochlorines pesticides (also known as chlorinated hydrocarbons) areorganic compounds attached with five or more chlorine atoms. They represent the one of the first group of pesticides ever synthesized and used in agriculture and in public health. Most of them were widely used as insecticides for the control of a wide range of insects, and they have a longterm residual effect in the environment. These insecticides may disrupt the nervous system of the insects leading to convulsions and paralysis followed by eventual death. Most common examples of these pesticides includes: DDT, lindane, endosulfan, aldrin, dieldrin and chlordane. Though, the production and application of DDT was banned in most developed countries including United States many years ago, it is still being used in most tropical developing countries for vector control (particularly where malaria occurs). People can be exposed to organochlorine pesticides through accidental inhalation exposure if you are in an area where they were recently applied. The chemicals can also be ingested in fish, dairy products, and other fatty foods that are contaminated. Organochlorine pesticides accumulate in the environment. They are very persistent and move long distances in surface runoff or groundwater. Prior to the mid-1970s, organochlorines resulted in widespread reproductive failure among birds because birds laid eggs with thin shells that cracked before hatching.

Exposure to organochlorine pesticides over a short period may produce convulsions, headache, dizziness, nausea, vomiting, tremors, confusion, muscle weakness, slurred speech, salivation and sweating. Long-term exposure to organochlorine pesticides may damage the liver, kidney, central nervous system, thyroid and bladder. Many of these pesticides have been linked to elevated rates of liver or kidney cancer in animals. There is some evidence indicating that organochlorine pesticides may also cause cancer in humans. Organochlorines can be measured in fat, blood, urine, semen, and breast milk. Samples of blood and urine are easy to obtain, and levels in these samples may help show low, moderate or excessive exposure. However, the tests cannot show the exact amount of chemical to which a person was exposed, or predict the chance of health effects in this person.

**B. Organophosphates**

Organophosphorus insecticides are chemicals used to kill many types of insects. These chemicals account for a large share of all insecticides used in the United States, including those used on food crops. Most home uses of organophosphorus insecticides have been phased out in the United States. Certain organophosphorus insecticides (e.g., malathion, naled) are also used for mosquito control in the United States. Organophosphate pesticides are considered to be one of the broad spectrum pesticides which control wide range of pests due to their multiple functions. They are characterized with stomach poison, contact poison and fumigant poison leading to nerve poisons. These pesticides are also biodegradable, cause minimum environmental pollution and are slow pest resistance. Organophosphorus insecticides are more toxic to vertebrates and invertebrates as cholinesterase inhibitors leading to a permanent overlay of acetylcholine neurotransmitter across a synapse. As a result, nervous impulses fail to move across the synapse causing a rapid twitching of voluntary muscles, hence, leading to paralysis and death. Some of the widely used organophosphorus insecticides include parathion, malathion, diaznon and glyphosate Table 6.

People are exposed to organophosphorus insecticides by eating foods treated with these chemicals. Exposure can also occur from hand-to-mouth contact with surfaces contaminated with the insecticides. Less common exposures include breathing in the insecticides or absorbing them through the skin. Farm workers, gardeners, florists, pesticide applicators, and manufacturers of these insecticides may have greater exposure than the general population. Once they enter the body, about 75% of the organophosphorus insecticides in use in the U.S. are converted to breakdown products called dialkyl phosphate metabolites. These metabolites are not considered toxic, but indicate an exposure to organophosphate insecticides. A sudden exposure to large amounts of organophosphorus insecticides may lead to health problems such as nausea, vomiting, irregular or slow heartbeat, difficulty breathing or tightness in the chest, salivation, weakness, paralysis, and seizures. When people are exposed over a long period of time to smaller amounts of these pesticides, they may feel tired or weak, irritable, depressed, or forgetful.

Organophosphates poison insects and other animals, including birds, amphibians and mammals, primarily by phosphorylation of the acetylcholinesterase enzyme (AChE) at nerve endings. The result is a loss of available AChE so that the effector organ becomes overstimulated by the excess acetylcholine (ACh, the impulse-transmitting substance) in the nerve ending. The enzyme is critical to normal control of nerve impulse transmission from nerve fibers to smooth and skeletal muscle cells, secretory cells and autonomic ganglia, and within the central nervous system (CNS). Once a critical proportion of the tissue enzyme mass is inactivated by phosphorylation, symptoms and signs of cholinergic poisoning become manifest. At sufficient dosage, loss of enzyme function allows accumulation of ACh peripherally at cholinergic neuroeffector junctions (muscarinic effects), skeletal nervemuscle junctions and autonomic ganglia (nicotinic effects), as well as centrally. At cholinergic nerve junctions with smooth muscle and secretory cells, high ACh concentration causes muscle contraction and secretion, respectively. At skeletal muscle junctions, excess ACh may be excitatory (cause muscle twitching) but may also weaken or paralyze the cell by depolarizing the end plate. Impairment of the diaphragm and thoracic skeletal muscles can cause respiratory paralysis. In the CNS, high ACh concentrations cause sensory and behavioral disturbances, incoordination, depressed motor function and respiratory depression. Increased pulmonary secretions coupled with respiratory failure are the usual causes of death from organophosphate poisoning. Recovery depends ultimately on generation of new enzyme in critical tissues. Organophosphates are efficiently absorbed by inhalation and ingestion. Dermal penetration and subsequent systemic absorption varies with the specific agents.

**Table 6:Types of organophosphorous pesticides**

| S. No. | Type | Pesticides |
|---|---|---|
| 1 | Pyrophosphates and related compounds | TEPP, Schradan |
| 2 | Phosphates | Chlorfenvinphos, Mevinphos, Dichlorvos, Monocrotophos, Tetrachlorvinphos |
| 3 | Thiophosphates | Chlorpyriphos, Diazinon, EPN, Ethyl parathion, feniitrothion, Fenthion, Methyl parathion, Primiphosmethyl, Triazophos |
| 4 | Dithiophosphates | Dimethoate, Aazinphos-methyl, Malathion, Phorate |
| 5 | Phosphonates | Terbufos, Trichorfon |
| 6 | Phosphoramidates | Acephate, Tebophos, Methamidophos |

**C. Carbamates**

The carbamates are esters of carbamic acid. Unlike organophosphates, carbamates are not structurally complex. Presently, the volume of carbamates used exceeds that of organophosphates, because carbamates are considered to be safer than organophosphates. However, they differ in their origin. Organophosphates are derivatives of phosphoric acid, while carbamates derived from carbamic acid. The working principal of carbamate pesticides is similar to organophosphate pesticides by affecting the transmission of nerve signals resulting in the death of the pest by poisoning. Sometimes, they are also used as stomach and contact poisons as well as fumigant. They can be easily degraded under natural environment with minimum environmental pollution. Some of the widely used insecticides under this group include carbaryl, carbofuran, propoxur and aminocarb. Carbamates are used as sprays or baits to kill insects by affecting their brains and nervous systems. They are used on crops and in the home to kill cockroaches, ants, fleas, crickets, aphids, scale, whitefly, lace bugs and mealy bugs. Some carbamates control mosquitoes. Some carbamates have been found in groundwater at levels high enough to cause concern.

Acetylcholinesterase is an enzyme found in the nervous system, red blood cells and blood plasma. These pesticides damage nerve function by acting as acetylcholinesterase inhibitors in the nervous system. Breathing Short term exposure can produce muscle twitching, headache, nausea, dizziness, loss of memory, weakness, tremor, diarrhea, sweating, salivation, tearing, constriction of pupils, and slowed heartbeat. Long term exposure can produce delayed neurotoxicity, such as tingling and burning in the extremities. This delayed neurotoxicity can progress to paralysis and is seldom reversible. Damage to the liver, kidney, immune system and bone marrow may occur. Some carbamates are also suspected carcinogens. Carbamate poisoning is treated with a substance called atropine.

**D. Synthetic pyrethroids**

Synthetic pyrethroids are synthesized derivatives of naturally occurring pyrethrins, which are taken from pyrethrum, the oleo-resin extract of dried chrysanthemum flowers. The insecticidal properties of pyrethrins are derived from ketoalcoholic esters of chrysanthemic and pyrethroic acids. Pyrethroids are broad spectrum insecticides, effective against a wide range of insect pests of the orders *Coleoptera, Diptera, Hemiptera (Homoptera* and *Heteroptera*), *Hymenoptera, Lepidoptera, Orthoptera* and *Thysanoptera*. Prior to harvest, they are sprayed over edible products to control pests and are also used as household insecticides and grain protectants. They are employed in animal houses, fields, green houses and extensively used in veterinary medicine Table 7. The efficacy of the pyrethroids and their selectivity between insect species depends on factors like shape, key structural features like ester or non-ester, specific chirality and *cis* or *trans* stereochemistry across the cyclopropane ring, physical properties (e.g. volatile compounds are good against flying insect pests) and chemical properties (e.g. polar compounds better for knockdown and high lipophilicity which result in reduced fish toxicity while fluorinated compounds have high miticidal activity) .

**Table 7:Applications of Pyrethroids**

| Pyrethroid | Insects | Crops | Other locations and applications |
|---|---|---|---|
| Allethrin | Flies, mosquitoes, ants | N/A | Residential, public health, animal houses, topical application in pet sprays and shampoos |
| Bifenthrin | Beetles, weevil, houseflies, mosquitoes, lice, bedbugs, aphids, moths, cockroaches, locust | Alfalfa hay, beans, cantaloupes, cereals, corn, cotton, field and grass seed, hops, melons, oilseed rape, potatoes, peas, raspberries, watermelons, squash | N/A |
| Bioresmethrin | Houseflies, mosquitoes, cockroaches | N/A | Household, public health, animal houses |
| Cyfluthrin | Aphids, cabbage stem flea beetle, cockroaches, houseflies, mosquitoes, rape winter stem weevil | Alfalfa, cereals, cotton, citrus, deciduous fruit, ground nuts, maize, oilseed rape, pears, potatoes, rice, sugar beet, sugarcane, tobacco, vegetables. | Green houses |
| Cyhalothrin | Bedbugs, beetles, houseflies, ked, lice, mosquitoes, moths, weevils | N/A | Public health, animal houses, inert surfaces |
| Cypermethrin | Cockroaches, flies, mosquitoes, moths | Cotton, lettuce, onions, pears, peaches, pecans, sugar beets | Residential and commercial buildings, animals houses |
| Deltamethrin | Aphids, beetles, bollworm, bud-worm, caterpillars cicadas, coding moths, totrix moths, weevils, whitefly, winter moths | Alfalfa, beet, cereals, coffee, cotton, figs, fruits, hops, maize, oilseed rape, olives, oil palms, potatoes, rice, soybeans, sunflowers, tea, tobacco, vegetables. | Forests, households, animal houses, stored products |
| Esfenvalerate | Beetles, moths | Cabbage, corn, cotton, fruit trees, grains, groundnuts, maize, pecan, potatoes, sorghum, soybeans, sugar cane, sunflowers, sweet corn, tomatoes, vegetables, wheat | Ornamentals, non crop land. |
| Fenvalerate | Beetles, cockroaches, flies, locusts, mosquitoes, moths | Alfalfa hay, apples, beet, cereals, cotton, corn, cucurbita, fruit, green beans, groundnuts, hops, maize, nuts, oilseed rape, olives, potatoes, sorghum, soybeans, squash, sugarcane, sunflower, vegetables, vines, tobacco. | Ornamentals, forestry, non-crop land. |
| Fluvalinate | Aphids, leafhoppers, moths, spider mites, thrips, white-flies. | Apples, cereals, cotton, pears, peaches, tobacco, vegetables, vines | Outdoor and indoor ornamentals, turf. |
| Permethrin | Ants, beetle, bollworm, bud-worm, fleas, flies, lice, moths, mosquitoes, termites, weevils. | Alfalfa hay, corn, cotton, grains, lettuce, onion, peaches, potatoes, sweet corn, tomatoes, wheat. | Home gardens, green houses, pet sprays and shampoos. |

**E. Other Classes of Pesticides**

Classification based on mode of action:

**Table 8:Classification of pesticide based on mode of action**

| Type | Mode of action | Examples |
|---|---|---|
| Physical poison | Bring about killing of one insect by exerting a physical effect | Activated clay |
| Protoplasmic poison | Responsible for precipitation of protein | Arsenicals |
| Respiratory poison | Chemicals which inactivate respiratory enzymes | Hydrogen cyanide |
| Nerve poison | Chemicals inhibit impulse conduction. | Malathion |
| Chitin inhibition | Chemicals inhibit the chitin synthesis in pests. | Diflubenzuron |

## VII.Classification based on sources of origin

Classification based on sources of origin Pesticide is a chemical or biological substance that aims to destroy the pests or prevent the damage caused by pests. Based on sources of origin, pesticide may be classified into chemical pesticide and bio-pesticides. The main benefits of using biological pesticides are host specificity. They act on the target pest only and strongly linked organisms, whereas chemical pesticides are usually of wide range which affects large group of non-target organisms. Bio-pesticides are usually environmentally friendly as they are less toxic, decomposed easily and required in small quantities. Chemical pesticides cause major environmental pollution as they are quite toxic and not always biodegradable. Another important advantage of using bio-pesticide is the fact that they are less susceptible to genetic modification in plant populations. This confirms the little chance of pesticide resistance in pests, which is hardly seen in case of chemical pesticides. Chemical pesticides are further divided into organochlorine, organophosphate, carbamate and pyrethroids and are discussed already in previous section. Bio-pesticides group of pesticides derived from natural materials such as animal, plant and microorganism (bacteria, viruses, fungi, and nematodes). They are classified into three groups.

**A.Microbial pesticides**

The active ingredient in microbial pesticides is microorganism such as bacterium, fungus or protozoan. These pesticides kill insects either by toxins released by microbial organisms, or by infection by the organisms. Two most common pesticides that fit within this group include the bacterial toxin produced by Bacillus thuringiensis (Bti), and the live bacteria, Bacillus sphaericus (Bs). The mode of action generally is producing a protein that binds to the larval gut receptor which starves the larvae. These two bacterial toxins are used against mosquito larvae and black fly larvae. Most microbial pesticides are more selective than biochemical pesticides.

**B. Plant incorporated protectants**

These groups of pesticides are produced by plants naturally. Also, the gene necessary for production of pesticide is introduced into the plant through genetic engineering. Hence, the pesticide then produced by such plant and the genetic material introduced are together defined as plant incorporated protectants (PIPs).

**C. Biochemical pesticides**

The third class is Biochemical pesticides which include natural materials that have nontoxic mechanisms to control pests. Examples of Biochemical pesticides are insect sex pheromones (act by interfering in mating), a range of aromatic plant extracts (work by attracting insect pests into traps).

## VIII.Classification based on range of target it kills

Under this method of classification, pesticides are classified into two groups as broad spectrum pesticides and selective pesticides. Broad spectrum pesticides are those pesticides that are meant to kill a wide range of pests and other non-target organisms. They are nonselective and are often lethal to reptiles, fish, pets and birds. Some examples of broad spectrum pesticides are chlorpyrifos and chlordane. Selective pesticides on the other hand are those pesticides which kill only a specific or group of pests leaving other organisms unaffected or with a little effect. A good example of selective pesticides is 2, 4-D which affects broad-leaved plants leaving the grassy crops unaffected.

## IX.Classification based on types of pesticide formulation

Pesticide formulations are a mixture of the active ingredient (AI) and inert ingredients. Active ingredients are chemicals that aimed to control target pests, while inert ingredient (such as water, petroleum solvent, wetting agents, spreaders, stickers, extenders) are the materials added to the AI to make pesticide safer, more effective and easier to measure, mix and apply. They are also more convenient in handling. One group of pesticide may be mixed with another group of non-pesticides or used in combination to produce such pesticides. One group of pesticides is combined with another group of pesticides in such a way that the effectiveness of one pesticide increased and will provide better protection against one pesticide compound. Also, they are capable of controlling multiple pesticides in single dose of application. Pesticide formulations can be divided into three main types: solids, liquids or gases. Some formulations are ready for use while others need further dilution with water or, a petroleum-based solvent, or air (as in air blast or ULV applications) before they are applied. The most commonly used formulations are listed under Table 9.

**Table 9:The most commonly used formulations of pesticides**

| Sl. No. | Type of Pesticide Formulations | Description | Typical Uses | Examples |
|---|---|---|---|---|
| | | **Solids** | | |
| 1. | Bait | Mixture of active ingredient and food that attracts pests in the form of meal, pellets. | For insects, rodents, birds, or slugs | Maxforce FC, Niban, Amdro etc |
| 2. | Dry flowable (DF)or Water Dispersible Granules (WDG) | Mixture of active ingredient and inert material made into small pellets, granules. Forms a suspension in water. | Sprays for insect's disease and weed control. | |
| 3. | Dust (D) | Finely ground inert particles i.e., talc, clay, and volcanic ash. | Spot treatment, Animal powder, Seed treatment | Deltadust, Ficam D, Drione, Sevin D, Malathion D |
| 4. | Ear tag/ Vapour Strips | Solid material with volatile or solid active ingredient slowly release vapour | Animal ear tag, Fly control | |
| 5. | Granules (G or GR) | Dry inert materials (i.e., clay, walnut shell, corn cob) combined with active ingredient | Sol treatment for insect or weed control. | Dursban G, Talstar G |
| 6. | Pellets | Inert material containing active ingredient like granules, but has more uniform shape and weight. | For control rodents, slugs | |
| 7. | Soluble powder (SP) | Dry powder or granules which dissolves in water to spray solution. | Mostly sprays for insects & weed control. | |
| 8. | Wettable powder (WP or W) | Finely ground inert ingredients with active ingredient Forms a suspension in water. | Sprays for insect, disease and weed control. | Demon WP, Tempo WP |
| | | **Liquids** | | |
| 9. | Aerosols (A) | Usually contain small amount of active ingredient and a petroleum solvent. Two main Types: 1. Ready-to-use small pressurized containers. Fog generators are not under pressure; equipment breaks the liquid into fine mist or fog. | Spray cans used for home/ garden insecticides. Used in greenhouses or mosquito control. | Wasp Freeze, ULD-BP-50, Ultracide, Ultraguardian |
| 10. | Emulsifiable concentrate (EC) | Contains active ingredient, petroleum solvent and emulsifiers. Pesticide is suspended in spray which is milky coloured. | Sprays for insect, disease and weed control | Chlorpyrifos EC Cypermethrin EC. |
| 11. | Flowable (F) | Finely ground particles suspended in an inert liquid carrier. Forms suspension in spray mix like WP | Sprays for insect, disease and weed control | Carbaryl AF |
| 12. | Gel | Semi liquid emulsifiable concentrate | Herbicides and insecticides | |
| 13. | Micro- encapsulated materials | Consists of pesticide surrounded by aplastic coating. Mixed with water and sprayed. Break down slowly. | Insecticide and pheromone sprays | Demand ES |
| 14. | Solution(SN) | Active ingredient dissolved in liquid. Forms a solution in spray mix. | Sprays for weed control. | Premise SC, Termidor SC, Bora-care |
| 15. | Ultra-low volume concentrate (ULV) | Liquid with very high concentration of active ingredient designed to be used as is *or slightly diluted in ULV equipment.* | Insecticide sprays inside greenhouses or for forestry. | |
| | | **Gases** | | |
| 16. | Fumigants | Volatile liquids or solids packaged to release a toxic gas | Greenhouses, mushroom houses, graineries. Pre-plant soil treatment for soil borne pests. | Phosphine, Phostoxin, |
| | | **Packaging** | | |
| 17. | Water-Soluble Packets | Pre-weighed amount of WP or SP formulation in a special plastic bag which dissolves in spray tank and releases contents. | | Demon WP |

### X.Classification according to the toxicity of pesticides

Pesticide's toxicity is the capability to cause injury to an organism. It is determined by exposing target organisms to a varying dosage of a particular formulation, according to hazardous health effects associated with toxic pesticide behavior. The World Health Organization (WHO) divided them into four types. A lab experiment on rats was conducted by WHO to administrate the pesticide doses (orally and dermally). The four categories ranked from the lowest to highest toxicity and expressed a certain toxicity level are shown in Table 10.

**Table 10:the lowest to highest toxicity and expressed a certain toxicity level**

| WHO Type | Toxicity Level | $LD_{50}$ for the Rat(mg/kg Body Weight) | | Examples |
|---|---|---|---|---|
| | | Oral | Dermal | |
| Type Ia | Extremely hazardous | <5 | <50 | Parathion, Dieldrin |
| Type Ib | Highly hazardous | 5–50 | 50–200 | Eldrin, Dichlorvos |
| Type II | Moderately hazardous | 50–2000 | 200–2000 | DDT, Chlordane |
| Type III | Slightly hazardous | >2000 | >2000 | Malathion |

## XI.Routes of pesticide exposure to human

Exposure to pesticides can occur directly from occupational, agricultural, and household use, while they can also be transferred indirectly through diet. Moreover, the general population may be exposed to pesticides due to their application on golf courses, around major roads, etc. The main routes of human exposure to pesticides are through the food chain, air, water, soil, flora, and fauna. Pesticides are distributed throughout the human body through the bloodstream but can be excreted through urine, skin, and exhaled air. There are four common ways pesticides can enter the human body: dermal, oral, eye, and respiratory pathways. The toxicity of pesticides can vary depending on the type of exposure such as dermal, oral, or respiratory (inhalation). As would be generally expected, the danger of pesticide contamination usually increases on the dosage (concentration) and critical periods in addition to toxicity of the chemical of interest.

### A. Dermal exposure

Dermal exposure is one of the most common and effective routes through which pesticide applicators are exposed to pesticides. Dermal absorption may occur as a result of a splash, spill, or spray drift, when mixing, loading, disposing, and/or cleaning of pesticides .Absorption may also result from exposure to large amounts of residue. Pesticide formulations vary broadly in physicochemical properties and in their capacity to be absorbed through the skin ,which can be influenced by the amount and duration of exposure, the presence of other materials on the skin, temperature and humidity, and the use of personal protective equipment .In general, solid forms of pesticides (e.g., powders, dusts, and granules) are not as readily absorbed through the skin and other body tissues as liquid formulations. However, the hazard from skin absorption increases when workers are handling (e.g., mixing) concentrated pesticides (e.g., one containing a high percentage of active ingredients). Certain areas of the body (such as the genital areas and ear canal) are more susceptible to pesticide absorption than other areas of the body. As such, the rate at which dermal absorption proceeds differs for each part of the body figure 4..

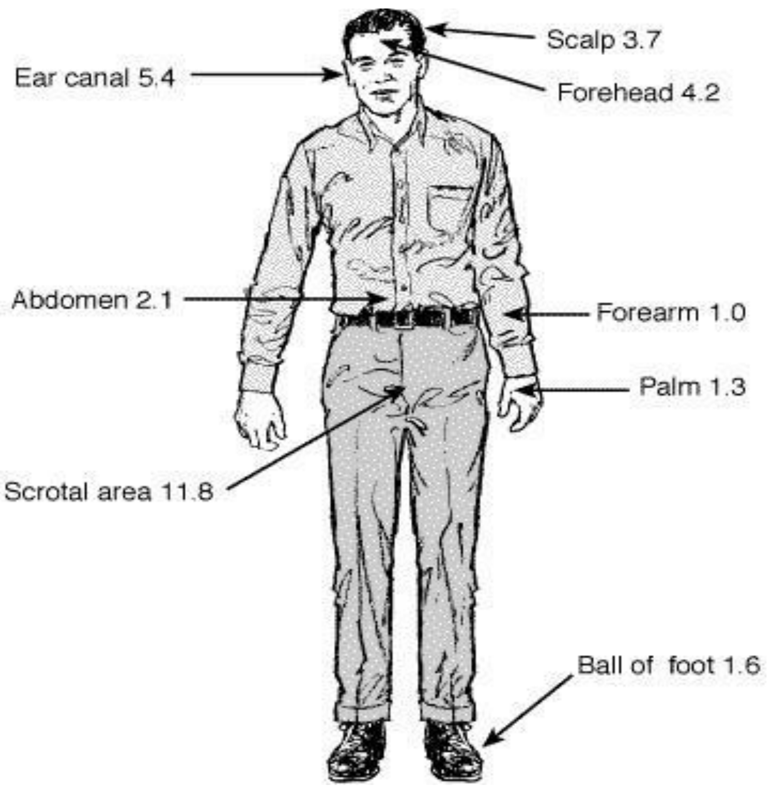


**Figure 4:dermal exposure to pesticides in different parts of the body**

### B. Oral exposure

The most severe poisoning may result when a pesticide is introduced through oral exposure. Oral exposure of a pesticide usually arises by accident due to carelessness or for intentional reasons. The most frequent cases of accidental oral exposure were reported to occur when pesticides were transferred from their original labeled container to an unlabeled bottle or food. There are many cases in which people have been poisoned by drinking pesticides kept in soft drink bottles or after drinking water stored in pesticide-contaminated bottles (U.S. Environmental Protection Agency, USEPA, 2007). Workers handling pesticides or equipment for their application can also consume pesticides if they do not wash their hands prior to eating or smoking (U.S. Environmental Protection Agency, USEPA, 2007). Consequently, applicators should be carefully instructed on the handling of pesticides such as not to clear a spray line or nozzle by blowing through their mouth.

### C. Respiratory exposure

Due to the presence of volatile components of pesticides, their potential for respiratory exposure is great. Inhalation of sufficient amounts of pesticides may cause serious damage to nose, throat, and lung tissues. However, the risk of pesticide exposure is in general relatively low when pesticides are sprayed in large droplets with conventional application equipment. However, if low-volume equipment is used to apply a concentrated material, the potential for respiratory exposure is increased due to the production of smaller droplets. It is recognized that respiratory exposure to pesticides can be significant if applied in confined spaces (e.g., an unventilated storage area or greenhouse). In addition, with increased temperature, vapor levels of many pesticides increase to worsen such exposures. Thus, it is recommended that pesticides should not be applied at air temperatures above 30 °C (U.S. Environmental Protection Agency, USEPA, 2007). Moreover, pesticides with high vapor hazards should be applied with sufficient equipment for respiratory protection.

### D. Eye exposure

The potential for chemical injury is high for tissues of the eye. Some pesticides were reported to be absorbed by the eyes in sufficient quantities to cause serious or even fatal illness. Granular pesticides pose a particular hazard to the eyes depending on the size and weight of individual particles. If pesticides are applied with power equipment, the pellets may bounce off vegetation or other surfaces at high velocity to cause significant eye damage. Eye protection is also needed when measuring or mixing concentrated or highly toxic pesticides. Protective face shields or goggles should be worn whenever spraying pesticides or to prevent eye contact with dusts.

## XII.Pesticides and human health

Risk assessment of pesticide impact on human health is not an easy and particularly accurate process because of differences in the periods and the levels of exposure, type of pesticides (regarding toxicity), mixtures or cocktails used in the field, and the geographic and meteorological characteristics of the agricultural areas where pesticides are applied. Such differences refer mainly to the people who prepare the mixtures in the field, the pesticide sprayers, and also the population that lives near the sprayed areas, pesticide storage facilities, greenhouses, or open fields. Therefore, considering that human health risk is a function of pesticide toxicity and exposure, a greater risk is expected to arise from high exposure to a moderately toxic pesticide than from little exposure to a highly toxic pesticide. However, whether or not dietary exposure of the general population to pesticide residues found on food and drinking water consists of a potential threat to human health, is still the subject of great scientific controversy.

Pesticides can cause short-term adverse health effects, called acute effects, as well as chronic adverse effects that can occur months or years after exposure. Examples of acute health effects include stinging eyes, rashes, blisters, blindness, nausea, dizziness, diarrhea and death. Examples of known chronic effects are cancers, birth defects, reproductive harm, immunotoxicity, neurological and developmental toxicity, and disruption of the endocrine system. Some people are more vulnerable than others to pesticide impacts. For example, infants and young children are known to be more susceptible than adults to the toxic effects of pesticides. Farm workers and pesticide applicators are also more vulnerable because they receive greater exposures.

### A. Acute (immediate)health effects

Immediate health effects from pesticide exposure includes irritation of the nose, throat, and skin causing burning, stinging and itching as well as rashes and blisters. Nausea, dizziness and diarrhea are also common. People with asthma may have very severe reactions to some pesticides, particularly pyrethrin/pyrethroid, organophosphate and carbamate pesticides. In many cases, symptoms of pesticide poisoning mimic symptoms of colds or the flu. Since pesticide-related illnesses appear similar or identical to other illnesses, pesticide poisonings are often misdiagnosed and under-reported. Immediate symptoms may not be severe enough to prompt an individual to seek medical attention, or a doctor might not even think to ask about pesticide exposure. Still, seek medical attention immediately if you think you may have been poisoned by pesticides.

### B. Chronic (long term)health effects

Chronic health effects include cancer and other tumors; brain and nervous system damage; birth defects; infertility and other reproductive problems; and damage to the liver, kidneys, lungs and other body organs. Chronic effects may not appear for weeks, months or even years after exposure, making it difficult to link health impacts to pesticides. Pesticides have been implicated in human studies of leukemia, lymphoma and cancers of the brain, breasts, prostate, testes and ovaries. Reproductive harm from pesticides includes birth defects, still birth, spontaneous abortion, sterility and infertility.

Endocrine disruptors are chemicals that often at extremely low doses by mimicking or blocking hormones (the chemical messengers that circulate in blood and regulate many body processes including metabolism, brain development, the sleep cycle and stress response). Some pesticides act as endocrine disruptors and have been shown to cause serious harm to animals, including cancer, sterility and developmental problems. Similar impacts have been associated with human exposure to these chemicals. Acute and chronic health effects associated with the exposure of pesticides are presented in Figure 5.

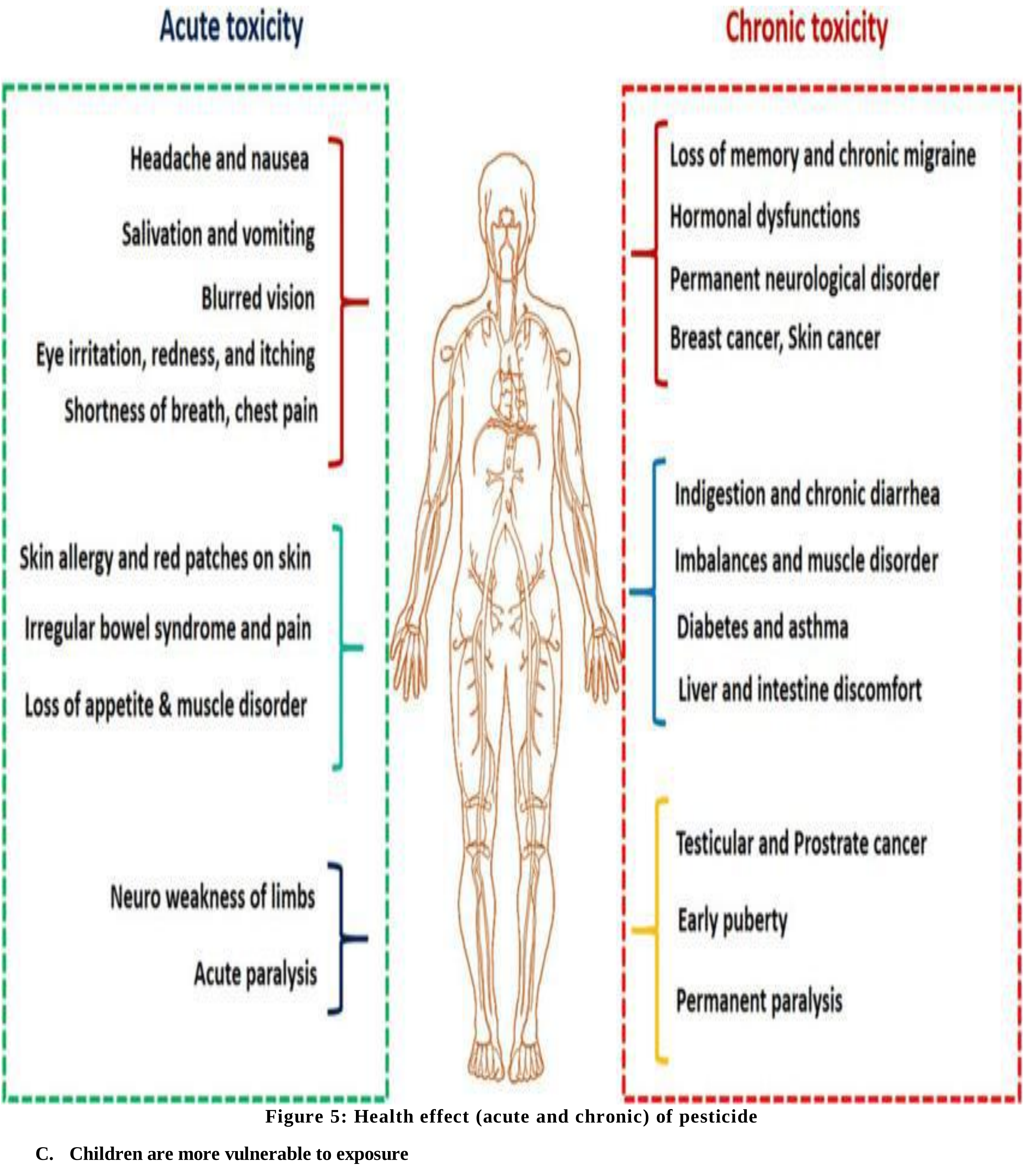


**Figure 5: Health effect (acute and chronic) of pesticide**

### C. Children are more vulnerable to exposure

Children are not simply “little adults.” Children are more vulnerable to pesticide exposure because their organs, nervous systems and immune systems are still developing. Children are also less able to detoxify and excrete pesticides. Exposure during certain early development periods can cause permanent damage.

In addition to being more vulnerable to pesticide toxicity, children’s behavior and physiology make them more likely to receive greater pesticide exposure than adults. Most pesticide exposure occurs through the skin and children have more skin surface for their size than adults. Children have a higher respiratory rate and so inhale airborne pesticides at a faster rate than adults. Children also consume proportionately more food and water and pesticide residues than adults. With their increased contact with floors, lawns and playgrounds, children’s behavior also increases their exposure to pesticides.

Human exposure whether directly or through diet may result in acute and delayed health effects. WHO estimates show that over 500,000 people died from self poisoning in south east Asia and western Pacific during 2000 alone . In developing countries, the estimated annual incidence rate in agricultural workers was found to be 18.2 per 100 000 full-time workers and 7.4 per million school children. In India, poisoning due to pesticides was first reported in 1958 in Kerala where over more than 100 people died after consuming parathion contaminated wheat flour and the proportion has been quite high in last 10 years as well . Acute pesticide poisoning symptoms include allergies, hypersensitivity, giddiness, double vision, headache, dermal abrasions etc. Mexican farmworkers who used pesticides mainly as organophosphates, triazines and organochlorine compounds showed acute poisoning (20 % of the cases) and diverse alterations of the digestive, neurological, respiratory, circulatory, dermatological, renal and reproductive system probably associated to pesticide exposure. Long term effects associated with pesticides include leukemia, lymphomas, soft tissue sarcomas, brain, bone and stomach cancers, damage to the central and peripheral nervous system, reproductive disorders, birth defects, disruption of the immune system and death. These effects along with their causative mechanisms have been explained in details hereafter and tabulated in Table 11.

**Table 11:Mechanism and Implications of Pesticide Toxicity**

| Organ system | Symptoms | General mode of action of pesticides |
|---|---|---|
| Respiratory system | Allergic rhinitis and bronchial asthma-like diseases<br>Fall in the diffusing capacity, lower pulmonary volumes<br>Chest pain or stiffness, cough, dyspnea or short breath and laryngeal itch and pain<br>Chronic bronchitis | I. Sensitization to allergens due to their possible modulatory effect on T-cells<br>II. Production of ROS due to pesticide induced oxidative stress<br>III. Peroxidation of lipid bilayer |
| Liver and kidney | Liver and kidney dysfunctions and RTI, heapatitis, dysponea and burning sensation<br>Heptomegaly | I. Oxidative stress leading to necrosis and apoptosis<br>II. Disruption of glycolysis and fatty acid cycles |
| GIT | Gastroenteritic irritation, intense nausea, vomiting, and diarrhoea | |
| Skin | Blister, dermatitis, urticaria, hyperhidrosis, pruritus and swelling<br>Chloracne in skin<br>Skin rashes while applying pesticides<br>Tickling sensation | Increased sensitization to allergens of various kinds due to their possible modulatory effect on T-cells |
| Cardiovascular system | Arrhythmia and tachycardia | Oxidative stress |
| Nervous system | Headache, dizziness<br>Emotional irritability, mental obtundation, cognitive impairment and convulsions, coma<br>Drowsiness, lack of attention confusion, lethargy, anxiety, emotional lability, depression, visuomotor integration, verbal abstraction, perception constructs fatigue and irritability. Occurrence of neonatal hypotonia or hyporeflexia<br>Alzhiemer's disease and Parkinson's disease<br>Suicidal tendency | I. Pesticide induced oxidative stress leads to neural degeneration and less ATP production which finally leads to apoptosis<br>II. Inhibition of enzyme acetylcholinesterase<br>III. Another possible mechanism is that pesticide induced oxidative stress leads to protein aggregation of plasma membrane $Ca^{2+}$-ATPase and its degradation<br>IV. Exposure to pesticides leads to misfolding and aggregation of α-synuclien |
| Reproductive System | Hypospadias, cryptorchidism, decreased penile length, low sperm counts disruption of male hormone signalling pathway<br>Foetal death | I. Endocrine disruption: Inhibition of natural ligands that bind to androgen receptors and androgen binding ligands, competitive inhibitor of androgen receptors<br>II. Pesticide can enhance reactive oxygen species (ROS) and oxidative stress which finally leads to apoptosis of sertoli cells and germinal cells, hence disturbing the spermatogenesis process |

### D. Neurotoxicity of pesticides

Many pesticides including organophosphates, organochlorine and carbamates affect central and peripheral nervous system by their toxic effects. Pesticides shown acute or chronic and long-term or short-term effects on nervous system by the high or low-level exposure during adult, childhood or in utero exposure, and it lead to very chronic nervous disorders like Parkinson disease. Neurotoxicity can be defined as any contrary influence on the central or peripheral nervous system induced by chemical, biological or physical agents. Nonetheless, cancer has been the foremost concern about chemicals, the neuro-behavioural effects of denunciation to chemicals remains a subject-matter of considerable present concern and importance. Formerly, it was contemplation that the antagonistic effects on brain development reflected the alike elemental mechanism that underlies integral noxiousness, particularly, cholinesterase inhibition and resultant cholinergic hyperstimulation.Though, exhibit compilation over the elapsed decade entangles a host of other mechanisms that rely alternately upon the direct targeting of incidents peculiar to the developing brain.Accretion of acetylcholine at cholinergic synapses caused by inhibition of AChE (acetylcholinesterase), bring about over-stimulation of muscarinic and nicotinic receptors. In addition, acetylcholine has crucial functions during brain development.

Hose with eminent denunciation to a mix of pesticides, including organophosphates, had diminished short-term memory, hand-eye coordination, and drawing ability, when in fact obscured children of the same tribe revealed ordinary development. Similarly, preschool children from agricultural fraternities in the USA revealed imperfect accomplishment on motor speed and latency than did those of urban fraternities.In addition to the acute cholinergic syndrome, OPs may also a reason of intermediate syndrome, which is witnessed in 20-50% of acute OP poisoning cases.The intermediate affliction is not a direct effect of AChE inhibition, and its explicit elemental mechanisms are anonymous, however it may terminate from nicotinic receptor desensitization by reason of elongated cholinergic stimulation.The CNS manifestations of OP intoxication consists convulsions, speech disorders, insomnia, drowsiness, coma, anxiety, irritability, depression, impaired memory, and personality disorders.The cholinergic symptoms on the CNS consist dizziness, mental confusion, headache, weakness, convulsions and coma. Some OPs have been connected with peripheral nerve diseases that emerges a few weeks after a intoxication incident.

The materialization of Organophosphate-induced delayed polyneuropathy (OPIDN) seems to accompany the phosphorylation and sequential maturing of an enzyme in axons called as neuropathy target esterase. Signs and symptoms consist shivering of the hands and feet, accompanied by sensory loss, advanced muscle impairment and flaccidity of the distal skeletal muscles of the lower and upper extremities, and then ataxia, which may happen 2-3 weeks after a single divulgence, when signs of both the acute cholinergic and the intermediate syndromes have depressed.The mechanism of poisonousness of carbamates is alike to that of OPs, as they also inhibit AChE. Oximes have been revealed to enhance the lethalness of carbaryl, but may have advantageous manifestations in case of other carbamates, such as aldicarb. The OP delayed neurotoxicity syndrome arises one to three weeks after divulgence. Earliest manifestations consists paresthesia, hypesthesia, abnormal reflexes, and muscle weakness.

Pesticides causes cancer, there is a substantial body of epidemiological exhibits linking to this fact, and in peculiar to child cancer following from both patriarchal and direct nonage exposures. For leukaemia and brain cancer exhibits are powerful, but there is exhibits also for confederation with non-Hodgkin’s lymphoma, neuroblastoma, Ewing’s sarcoma (a cancer of bone tissue), and Wilm’s tumour (kidney). Also a number of adult cancers are there linked with denunciation to pesticides along with breast, lung, multiple myeloma, non-Hodgkin’s lymphoma, leukaemia, ovary, pancreas, prostate, kidney bladder, stomach, colon, rectal, lip, connective tissue, brain, and testicular. Of these, at least breast, prostate, and testicular cancer are conceit to have genesis in betimes developmental denunciations to ecological hormone disruptors. Epidemiological researches have linked an apparel of cancers with all the chief operational categories of pesticides – herbicides, insecticides, fungicides, fumigants – and chemical categories consisting organochlorine (OC), organophosphate (OP), and carbamate insecticides, and phenoxy acid and triazine herbicides.

## XIII.Major health effects of pesticides

### A. Asthma

Several clinical and epidemiological studies have reported an association between pesticide exposure and symptoms of bronchial hyper-reactivity and asthma. Pesticide exposure may contribute to the exacerbation of asthma by irritation, inflammation, immunosuppression, or endocrine disruption.However, most pesticides are weakly immunogenic such that their potential to sensitize airways in exposed populations is limited, while only some pesticides are potent enough to damage the bronchial mucosa. Causes of asthma are complex and include factors related to early life environmental exposures such as pesticides. Pesticides are chemicals commonly used to kill or control pests (including weeds, insects and fungi). Compared to late-in-life exposures, exposures to pesticides early in life can lead to a greater risk of chronic effects that are expressed only after long latency periods have elapsed According to the Journal of the American Medical Association (JAMA), asthma can be triggered by pesticides. Several types of pesticides are known to cause allergic reactions or airway constriction.

Pesticides may be inhaled, ingested or absorbed and may be encountered as residues in food, air and water. People may also be exposed to pesticides used in agriculture, applications for pest control at home or at work, applications to roadside right-of-ways to control weeds and applications of pesticides for public health vector control programs. A specific pesticide exposure which might cause an allergic reaction in a susceptible individual can be 1,000 times less than a exposure which would cause a toxic reaction. For example, exposure to some pesticides can trigger an asthma attack at a trivial dose of exposure.

### B. Parkinson's disease

Parkinson disease is generated when dopamine is not produce by the substania nigra neuron (dopaminergic) in brain, which lead toward lack of coordination, trembling and loss of muscles control. Research show that some pesticides like rotenone and paraguata will disrupt these dopaminergic neuron and inhibit the production of dopamine and Parkinson disease result . It has found that pesticide exposure have some association with Parkinson disease, pesticide and it’s metabolites effects mitochondria and modulate xenobiotic metabolism which lead to Parkinson disease. In a separate research it is found that if rats are exposed to the rotenone then with the passage of time there is neurodegenration is found in the peripheral nervous system, there is decrease in motor nerve conduction velocity especially in sciatic nerves. It is due to absence of dopamine and disruption of chemical synapse in peripheral nervous system. Role of pesticide in parkinson disease is represented in Figure 6.

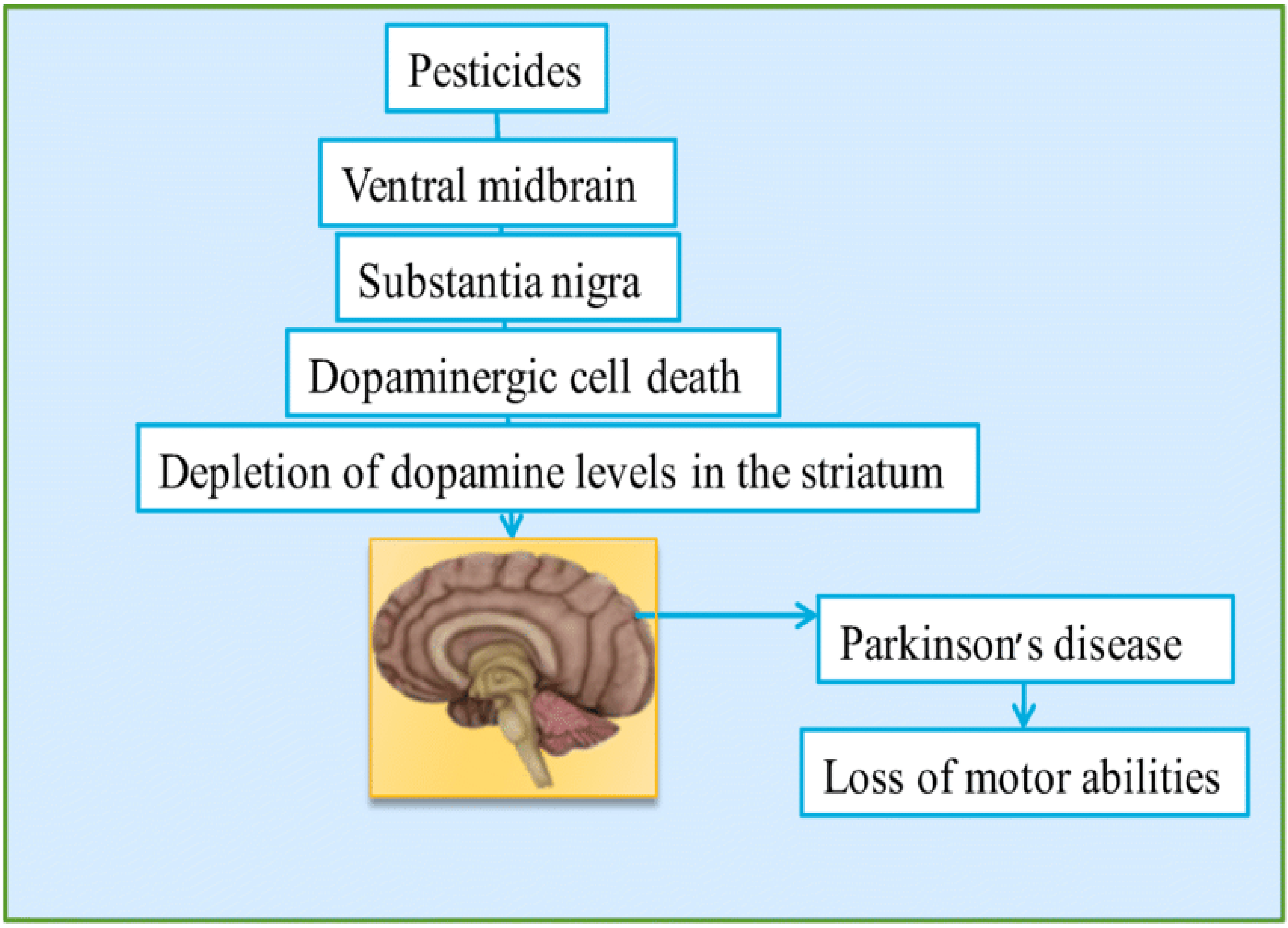


**Figure 6: Role of pesticides of pesticides in Parkinson's disease**

### C. Alzheimer disease

Dementia is decrease in brain capacity, in recent years dementia is increased. One concept about current increased is due to increase in pesticide exposure, may be pesticide increased the dementia pathogenesis. But other research elaborates that pesticide affect neuron function at molecular level by distrusting microtubules and hyperphophorylation which lead to Alzheimer diseases. Organophosphate and organochlorine pesticides are found to effect acetylcholineestrase regulation at synaptic junction in nervous system and may lead to the Alzheimer disease especially in exposed person during their late life. Another research shows some herbicides (rotenone and paraquat) will disrupt the bioenergetical activites of mitochondria, oxygen metabolism and redox function which lead to Alzheimer disease .

### D. Diabetes

Emerging scientific evidence suggests that diabetes should be affected by exposure to environmental pollutants. Exposure to pesticides, particularly organochlorines and metabolites, is suspected to impart a higher risk of developing type 2 diabetes and its comorbidities. Exposure to pesticides (Persistent Organic Pollutants, CPOs) in food, air and water and prevalence of type 2 diabetes in adults, regardless of age, gender and body mass index. These substances tend to concentrate in body fat, and they might be one of the reasons why obese people are more likely to develop diabetes, since the more fat the higher the COP concentrations in the body.

### E. Pesticides and cancer

Several well-designed epidemiological studies gave solid evidence between pesticide exposures and incidence of cancer. Application of pesticide on commercial level and in houses will highly increase the risk of leukemia, clone thyroid, brain and several other type of cancer. Collaborated efforts at molecular biology, pesticide toxicology and epidemiological studies help us to understand the pesticide carcinogenicity . Epidemiological studies show that many pesticides are carcinogenic like sulfallate, organochlorines and sulfates, while other pesticides lindane and chloradane are tumor causing agents.

### F. Childhood leukemia and pesticide exposure

Leukemia is a cancer which causes abnormal production of white blood cells, several researches show that childhood leukemia risk increased threefold by the parental exposure of pesticides. According to Children's Cancer Study Group the basic reason of acute nonlymphoblastic leukemia is parental exposure to pesticides and those children which are regularly exposed to household pesticide have 3.5 times great chance of leukemia. Pesticide also cause leukemia in children whose mothers are exposed to them during the period of their pregnancy, small children less than one year have seven time more chances of leukemia if they are exposed to permethrin pesticide. Leukemia also caused to those infants whose mothers are exposed during the period of pregnancy. Another insecticide permethrin used to protects pets from production of fleas and ticks and for killing of mosquitoes, this chemical may alter nervous system working in insects, in some researches it also conceder as a carcinogenic. Childhood leukemia is due to alteration in the DNA of infants. By research it is found that time from pregnancy to 11 month of nursing is very critical for children and if the exposed then they have two times more chances of leukemia .

### G. Bladder and colon cancer

Aromatic amines used as pesticides are conceder as carcinogenic, and produce the bladder cancer in exposed persons . Heterocyclic aromatic amines are found in adduct form in several cases of cancer . One of heterocyclic aromatic amine imazethapyr is extensively used in agricultural land as herbicides. Research finding show that person who are exposed to that pesticides have 137% increased risk of bladder cancer . In another research it is found that aromatic amines are used in crops for herbicide. By a research on aromatic amine one pesticide Imazethapyr is cause cancer. From total 20,646 applicator of that pesticide, 2,907 develop cancer. The cancer incidence depends upon the intensity and time of exposure. It is found that incidence of colon cancer is increased 78% in exposed persons. Through that research it is conclude that use of aromatic amine (imazethapyr and imidazolinone compound) is restricted to prevent bladder and colon cancer.

### H. Thyroid cancer

Different chemical used including several pesticides like dioxins, phthalates, polybrominated diphenyl ethers (PBDEs), and other halogenated organochlorines can disturbed the normal thyroid function by the mean of effect hormones production, transportation and their metabolism. Some other chemical which have structural similarities with thyroid hormones and bind with their receptor sites, and destroy the thyroid gland .

### I. Brain cancer

A research conducted for incidence of brain cancer on 767 patients, elaborate that 462 patients have glioma and 195 have meningioma both are different types of brain tumor. By further research on their disease through questionaries' show that glioma have no link with pesticide exposure. But meningioma have a clear link with past pesticide exposure in females rather than males. The extensive use of herbicide increases greatly the risk of meningioma . A study conducted on the pesticide exposure and childhood brain cancer show that, exposure before during or after pregnancy can greatly increase the brain cancer incidence. The risk of brain cancer is twofold increased in professional applicators by exposure to pesticide which is used to control the termites, then exposure to other pesticide. The risk of brain cancer is 30% by other pesticides, and 50% by termites controlling pesticides .

### J. Pesticides and reproductive health

Exposure to pesticides during vulnerable stages of life interferes with sexual development, reproduction and fertility of an organism. It may lead to several undesirable outcomes like decreased fertility, infertility, abortions, undiagnosed miscarriages, birth defects, teratogenecity, mutations, genetic defects and cancers .

### K. Male Reproductive System

Environmental toxicants with steroid receptors cause interference with developmental and functional aspects of testis, epididymis and accessory sex organs. Male reproductive system is susceptible to induction of ROS by environmental contaminants. Oxidative damage, in particular DNA damage caused by free radicals produced either by xenobiotics or endogenously, is a key molecular mechanism which results in poor semen quality, defective sperm function and male infertility . Organochlorine pesticides, so called xeno-hormones are responsible for various male sexual differentiation disorders such as reproductive abnormalities, hypospadias, cryptorchidism, decreased penile length, decreased testis and epididymis weight, low sperm count and quality and are capable of disrupting the male hormone signalling pathway.

### L. Female Reproductive System

Pesticides interfere with the female estrogen and/or androgen receptors which lead to disruption of the hormonal balance necessary for proper functioning. Potential effects of endocrine disrupting pesticides on the female reproductive system are modulation of hormone concentrations, ovarian cycle irregularities and impaired fertility. Exposure to pesticides has been associated with menstrual cycle disturbances, reduced fertility, prolonged time-to-pregnancy, spontaneous abortion, stillbirths and developmental defects which may or may not be due to disruption of the female hormonal function .

### M. Reproductive Abnormalities in Offsprings

Exposure of either parent to pesticide is directly related to abnormalities in the foetus and offspring. Pesticides penetrate both maternal and paternal reproductive tissues and organs, providing a pathway for initiating harm to the offspring before fertilization which continues throughout gestation and lactation . Exposure of men/women to pesticides at sufficient doses may increase the risk for male children deficit, spontaneous abortion, birth defects or foetal growth retardation. Consistent pattern with maternal exposure timing between late foetal deaths due to congenital anomalies have also been reported. Largest risks for foetal death due to congenital anomalies were from pesticide exposure during the 3rd–8th week of pregnancy. Exposure to endosulfan delayed sexual maturity and interfered with sex hormone synthesis in male children.

## XIV.Minimize the adverse effects of pesticides

Despite ongoing disagreements about the risks posed by pesticides, people appear to be increasingly concerned about the use of pesticides, especially their impact on human health and the quality of the environment. This heightened concern was primarily due to reduced confidence in agricultural and industrial production methods and government regulations to protect the environment and human health. Therefore, consider a certain existence. Uncertainty in assessing pesticide safety, scientific data, policy guidance, and expert judgment in assessing the beneficial use of pesticides within the acceptable risk limits of You have to think. The potential to reduce the environmental risk associated with the use of pesticides is very small. Because we believe that reducing risk means reducing production or increasing usage for alternatives to pesticide use. Therefore, strategies to mitigate the risks associated with the use of pesticides impose costs on the agricultural community, which in turn affects the prices of agricultural products. This was done by Paul et al. The cost function-based production model used was identified. This suggests that the requirements for reducing the environmental risks of the use of pesticides impose significant costs on agriculture. These costs are directly linked to the increased demand for effective pesticides at certain levels of agricultural production, which, coupled with the increased costs, are driving innovations to improve the quality of pesticides. Concerns about the impact of pesticide use on human health and the environment have led the EU to develop a "Thematic Strategy for Sustainable Use of Pesticides". In addition, farmers have begun developing alternative crop management systems to minimize the negative effects of agriculture on the environment and human health (mainly based on the use of pesticides to protect crops). In particular, Integrated Crop Management (ICM) provides guidelines used by farmers' organizations to implement measures to produce safe produce while respecting the environment. In addition, the ICM includes measures to implement Good Agricultural Practices (GAPs). , Worker safety and hygiene, product safety, comprehensive traceability of measurements, and specific measures to protect the environment. For pest control, ICM uses complementary pest control methods (eg, plant resistance to insects and fungi, biological control, and other cultural or physical measures) to pest in animals. Or pesticides against other components of the agricultural ecosystem, reducing weed populations to below economic damage levels.

## CONCLUSION

Pesticides are widely used in agriculture today.Industries to increase production by protecting crops potential threat, it is also used in apartments and other public places. Prevent insects and other unwanted creatures with increasing use. Pesticides are also exposed to humans due to their long lifespan. These chemicals do not break down easily and end up in the environment and on products on which they have used and their presence and exposure to humans cause a grave threat to people around the world. The increased Cases of Alzheimer's disease and Parkinson's disease and other neural abnormalities such as memory loss, disruption of neural coordination in the body and due to this disorder, paralysis of other body systems such as digestion respiratory, inhibition or overproduction of the production neurotransmitter, high response or no response from the receptor site these neurotransmitters are due or are due to exposure to pesticides increase this error rate.Exposure to pesticides is not only harmful for adults, but also for young children and fetuses during their development phase are more sensitiveto these pesticides because of their weak and inactive immune systems. Exposure of the fetus in utero in congenital genetic anomalies.The diseases begin due to a disruption in their DNA during development. Side effect of endocrine disruption observed during and after childbirth. The most harmful effects of pesticides on adults and children are due to their carcinogenic effect. This exposure causes in the child and Leukemia, bladder, cloned, thyroid and brain cancers in exposed adults People. After our studies, we found that pesticides are very harmful however, if exposed to humans, we cannot completely ban them or their use restricted due to their economic and medical importance kill vectors. But we reduce their exposure and impact by using specific Safety measures for agricultural workers and reduction of exposure of children and pregnant woman.

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