How Insecticides Work

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Insecticides kill insects. They are posions that affect the normal functions of specific cells and tissues in insects. A complete knowledge of chemical poisons used against insects has great value in the formulation of insecticides. The posions must be capable of reaching the proper target and destroying the insect's natural defenses against the poison in question. Thus, if scientists know how a certain chemical poisons an insect they can select or synthesize other chemicals of similar action.

Insecticides have been classified on the basis of their mode of entry, mode of action and chemical nature of the toxicant.

Mode of entry. Insecticides are classified into three groups based on their mode of entry: stomach poison, contact poison and fumigant.

Mode of action. Insecticides are classified into four groups based on the way in which the chemicals act upon the system of the insect to cause death: physical poison, protoplasmic posion, respiratory poison and nerve posion.

Chemical nature of the toxicant. Insecticides are divided into two major groups: inorganic compounds and organic compounds. The inorganic compounds include the arsenicals, flourine compounds, sulphur, lime-sulphur and zinc phosphate. The organic compounds may be of an animal origin (Nereis-foxin), a plant origin (nicotine alkaloids, pyrethrum and rotenonoids) or synthetically manufactured (dinitrophenol, thiocyanate, organochlorines, organophosphates, carbamates, sulphur-containing compounds and fumigants).

The poisonous properties of the inorganic arsenic compounds are due to the formation of the water soluble compounds, arsenious or arsenic acid, in the digestive tract. Arsenic is considered a general protoplasmic poison; that is, it poisons the contents of all types of cells. Most tissues and organs, therefore, are affected in arsenic posioning. Arsenic affects insects by abrading and destroying the lining of the intestine.

Nicotine first stimulates and then depresses the nervous system. Paralysis follows rapidly and results in the failure of organs to function; the poisoning action of nicotine occurs in the nerve ganglia of insects.

Pyrethrum powder, the ground flowers of certain species of chrysanthemums, contains the chemical pyrethrin. The rapid paralyzing action of pyrethrum is evident to anybody who has sprayed a room with a household fly spray and watched the flies drop to the floor. Pyrethrin acts directly on the central nervous system of insects.

Rotenone kills insects by slowing the rate of heart action and breathing.

Non-volatile oils penetrate the insects' breathing tubes, thus causing suffocation. Volatile oils penetrate the tissues and organs as gases and poison them. In either event death is due to respiratory failure.

Dinitrophenol increases the metabolic rate. The poison acts directly on cells causing them to increase the rate at which they use oxygen. Fat metablosim is involved because the excess oxygen is used only for burning this body food. DDT poisoning affects the nervous system. The sensory nerves which carry impulses to the central nervous system are the most sensitive to DDT poisoning; the nerve ganglia are the least sensitive. Other effects of DDT on the physiology of insects include increased consumption of oxygen and decreased food storage within the body.

Thiocyanates are contact poisons that act on the nervous system of insects.

Organochlorine compounds affect the functions of the nervous system. The pesticide molecules interfere with the ionic permeability of the nerve cell membrane and produce an unstability which causes spurious nerve impulses inducing uncontrolled activities.

Organophosphate compounds are chemically reactive materials and are less persist in the environment. Their solubility properties often enable them to act as systemics. The action of these compounds depend upon inhibition of the enzyme acetylcholinesterase. This enzyme functions in various parts of the nervous system and inhibition of this enzyme results in disruption of nervous control. Symptoms of poisoning by these compounds include hypersensitivity, tremors, convulsions, paralysis and death.

Carbamates act in a similar fashion to the organophosphates, that is they inhibit the action of acetylcholinesterase through a carbamylation of the enzyme. The carbamylation of the enzyme is more easily reveresed than phosporylation.

Sulphur containing compounds are acaricides which are effective against mites and ticks.

A fumigant is a gaseous poison which enter the insect's body through the spiracles to bring about death.