How Insecticides Work

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Insecticides kill insects. They are poisons 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 poisons 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,
protoplastic posion, respiratory poison and nerve poison.

Chemical nature of the toxicant. Insecticides are
divided into two major groups: inorganic compounds and organic
compounds. The inorganic compounds include the arsenicals,
fluorine 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 protoplastic poison; that is,
it poisons the contents of all types of cells. Most tissues
and organs, therefore, are affected in arsenic poisoning.
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 metabolism 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 unsteadiness which causes spurious nerve impulses inducing uncontrolled activities.

Organophosphate compounds are chemically reactive materials and are less persistent 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 reversed than phosphorylation.

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.