vading microorganisms in the wood behind the wound. These results indicate that various sublethal electrical treatments may have therapeutic value in limiting the invasion of pathogenic microorganisms after wounding.

Summary

We have entered into a new era of disease detection and diagnosis. The plant pathologist has begun to utilize electronic technology to obtain objective information about the health of shade trees just as the medical doctor has used similar technology to detect and diagnose human diseases. Electrical measurements from shade trees, just as those in human medicine, will not replace diagnostic procedures in current use, but will provide additional information to achieve more accurate detection and diagnosis.

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BASIC INFORMATION ON INSECTICIDES AND THEIR USE[1]

by Roscoe Randell

Insect control includes much more than the application of various chemicals in an attempt to eliminate an insect population. Insect control involves everything that suppresses an insect population or prevents it from increasing to damaging numbers.

Insecticides are just one group of tools available for insect control. They are chemical or microbial substances which kill insects by their actions. Often the word insecticide is used interchangeably with pesticides. Pesticides include fungicides, herbicides, rodenticides, nematicides, growth regulators as well as insecticides and some other minor chemicals.

Some authors group insecticides into various classifications. During the early days of DDT and related compounds, insecticides were simply grouped according to their method of killing the insect, often referred to as mode of action. This grouping was into stomach poisons and contact poisons. A stomach poison was one which was consumed, usually by a chewing insect and caused death. A contact poison was one which would kill a susceptible species by contact, usually having an effect on the nervous system.

Today, a more complete classification would be as follows: inorganic, organic with the group broken down into organic-plant origin, and organic-synthetic origin. Inorganic insecticides would include compounds that are, or were used as stomach poisons to control certain chewing insects. Example of inorganic stomach poisons are the arsenicals (with lead arsenate being the most common example), fluoricides, and sulfur compounds.

Organic plant-derived chemicals, often called botanical or natural occurring insecticides, are contact poisons which enter the pest insect through the body wall or nervous system. Simple contact by the insect leg with an insecticide on a leaf surface is adequate to kill the insect. Nicotine, rotenone, and pyrethrums, all derived from plants are examples of organic, nonsynthetic, contact insecticides.

The largest group of insecticides used or are available today are classified as synthetic-organic insecticides. Prior to the mid-1940's, there were only a few attempts to formulate organic insecticides chemically. But since the development of DDT and its related compounds such as dieldrin, aldrin, and lindane; a whole group of chlorinated hydrocarbon insecticides were developed. Then very soon after came many organic phosphate compounds including parathion, malathion, Cygon, Dibrom, Ethion, Dursban, and diazinon as examples.

Another group began in the 1950's which were called carbamates. The best known example today of this group are Sevin, Temik, Bidrin, Furadan, and Mesurol.

From the mid-1940's to the mid-1960's, a great many organic phosphate and carbamate insecticides were formulated, screened for their performance against certain pest insects, and either labeled or discarded. This procedure was extremely active until recently when the testing and labeling of an insecticide has been made more difficult. Fewer and fewer chemicals are being formulated as candidate insecticides. This fact is of serious concern to economic entomologists and users of insecticides, especially arborists.

Even though there are new groups of insecticides slowly being developed today, we will have to get by in the near future with the insecticides we now have.

There are new groups including growth regulator (insect growth regulators) biological insecticides including bacterial agents and viruses, and a renewed interest in pyrethrums, the synthetic ones.

Our existing situation today is one of having an arsenal of synthetic-organic insecticides, most of them in the organic phosphate and carbamate groups.

During the rest of this discussion certain characteristics of insecticides that cause them to be effective against certain insect pests will be explained. Toxicity is a term associated with each insecticide as well as other pesticides. The toxicity of an insecticide is its capacity to produce death among a group of test animals. These animals could belong to an insect pest species, or laboratory animals such as rats or mice. Toxicity can vary greatly with a specific insecticide as to its effectiveness against different insects. For example, DDT was highly toxic to houseflies but of very low toxicity to grasshoppers. Pyrethrum was 50 times more toxic to certain mosquitoes than to houseflies.

Persistence of an insecticide is another important characteristic. Persistence is determined by how quickly or slowly an insecticide breaks down. Highly persistent

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insecticides were at one time thought to be the most desirable. Today, we use moderately persistent insecticides for borer control where the hatch occurs for over a period of weeks. Low persistence insecticides are often used where there is an outbreak of pest insects. Many of the clorinated hydrocarbon insecticides were highly persistent. Some of the phosphates lack persistence and this fact limits their usage.

Some users of insecticides wish that an insecticide was "broad-spectrum" or would be effective on almost all pest insects. Some insecticides will give a fair to very good range of control on many insects but the variability in toxicity to certain insects prohibits such an insecticide from being formulated.

An insecticide that is systemic is one that is translocated through the plant to the new terminal growth. Being a systemic does not improve an insecticide unless the target pest is infesting only the new foliage.

Phytotoxicity can be a detriment to an insecticide but it is often the result of plant damage by the solvent in which the chemical is mixed.

Insecticide formulations commonly used for insect control on trees and shrubs are generally emulsifiable concentrates (EC or E), wettable powders (WP), soluble powders (S), flowables (F), and occasionally dusts (D) and granules (G).

An emulsifiable concentrate is a liquid formulation of a pesticide that can be mixed with water to form an emulsion. An emulsion is one liquid dispersed (usually as small globules) throughout another liquid. Many pesticide active ingredients are not soluble in water but are soluble in oils. In emulsifiable concentrates, the active ingredient is often dissolved in an oil, and an emulsifying agent is added so that the EC can be conveniently mixed with water to form a "milky" emulsion.

Wettable powders are dry, powdered pesticide formulations that resemble dusts. Unlike dusts, however, they contain wetting and dispersing agents. They are made to mix with water; and when mixed, they form a suspension. Strong agitation is needed in the spray tank to keep the formulation in suspension, since it does not form a true solution.

Soluble powders, like wettable powders, are dry formulations. When soluble powders are added to water, however, they dissolve and form true solutions. Agitation in the spray tank is sometimes required to get soluble powders into solution. Once the powders are in solution, no further agitation is necessary.

A flowable is a finely ground wettable powder formulation. It is sold as a thick suspension in a liquid to facilitate its addition to water in the spray tank. Flowables require only moderate agitation and seldom clog spray nozzles.

A dust formulation usually consists of the active ingredient mixed with an inert material, such as a talc, clay, powdered nut hulls, volcanic ash, or similar materials. All of the ingredients are finely ground to a fairly uniform particle size. Other inert materials are often added so that the formulation will store well and handle properly.

Granular formulations are made by applying a liquid formulation of the active ingredient to particles of clay or other porous materials such as corncobs or walnut shells. The granule carrier is prepared in advance to a standard size, and then the liquid formulation is added. The liquid active ingredient is absorbed into the granule or coats the outside of the granule.

This has been a brief review of basic information concerning some of the insecticides which you will use for insect control.

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