Pesticides for Termite Control

Pyrethroids

The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellant to termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes and gardens. Some examples include: bifenthrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

They may be applied alone or in combination with other insecticides. Pyrethroids are formulated as ECs, WPs, Gs and aerosols.

Although certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route, systemic toxicity by inhalation and dermal absorption is low. There have been very few systemic poisonings of humans by pyrethroids. Although limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible. Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney.

In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to “sunburn” sensation of the face and especially the eyelids. Sweating, exposure to sun or heat and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours. For first aid, wash with soap and water to remove as much residue as possible, and then apply a Vitamin E oil preparation or cream to the affected area.

Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano groups: fenvalerate, cypermethrin and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or microencapsulated formulation.

Borates

Borate is a generic term for compounds containing the elements boron and oxygen. Boron never occurs alone naturally, but as calcium and sodium borate ores in several places in the world.

Borax and other sodium borates are used in numerous products such as laundry additives, eye drops, fertilizers and insecticides. While its toxic mechanisms are not fully understood, boron is very toxic to insects and decay fungi that commonly damage wood in structures. However, at low levels boron is only minimally toxic, and perhaps beneficial, to humans, other mammals and growing plants. Use of borate-treated wood for construction of homes and their wood-based contents appears to offer many advantages to today’s environmentally sensitive world.

Unlike most other wood preservatives and organic insecticides that penetrate best in dry wood, borates are diffusible chemicals (they penetrate unseasoned wood by diffusion, a natural process). Wood moisture content and method and length of storage are the primary factors affecting penetration by diffusion.

Properly done, diffusion treatments permit deep penetration of large timbers and refractory (difficult-to-treat) wood species that cannot be treated well by pressure. The diffusible property of borates can be manipulated in many ways; suitable application methods range from complex automated industrial processes to simple brush or injection treatments. Application methods include momentary immersion by bulk dipping; pressure or combination pressure/diffusion treatment; treatment of composite boards and laminated products by treatment of the “wood finish,” hot and cold dip treatments and long soaking periods; spray or brush-on treatments with borate slurries or pastes; and placement of fused borate rods in holes drilled in wood already in use.

Organophosphates and Carbamates

These are two very large families of insecticides. Indeed, they have been the primary insecticides for the past 25 to 30 years. They range in toxicity from slightly to highly toxic. They are formulated in all kinds of ways from highly concentrated ECs to very dilute G formulations.

These insecticide families are similar in their modes of action. They are all nervous system poisons. Insects and all other animals, including humans, have nervous systems that are susceptible. Both insecticide

families are efficiently absorbed by inhalation, ingestion and skin penetration. To a degree, the extent of poisoning depends on the rate at which the pesticide is absorbed. Organophosphates break down chiefly by hydrolysis in the liver; rates of hydrolysis vary widely from one compound to another. With certain organophosphates whose breakdown is relatively slow, significant amounts may be temporarily stored in body fat.

The organophosphates and carbamates replaced the chlorinated hydrocarbons (e.g., chlordane, aldrin and heptachlor) for all uses, including termite control. Examples of organophosphates are chlorpyrifos for termite control and diazinon for other household pests. An example of a carbamate is Carbaryl (Sevin®), also used for household and lawn pests. The pyrethroids are gaining significantly in some aspects of termite control.

Nicotinoids

Nicotinoids are similar to and modeled after the natural nicotine. Imidacloprid is an example of this type of chemistry that is used as a termiticide. Imidacloprid was introduced in Europe and Japan in 1990 and first registered in the U.S. in 1992. Imidacloprid acts on the central nervous system of termites, causing irreversible blockage of postsynaptic nicotinergic acetylcholine receptors. Imidacloprid is registered for use as a termiticide under the name Premise®. It is non-repellent to termites and has contact activity as well as activity as a stomach poison.

Pyrroles

Chlorfenapyr is the only termiticide from the pyrrole family of chemistry and is active primarily as a stomach poison with some contact activity. It is also non-repellent to termites. Chlorfenapyr is registered as a termiticide under the tradename Phantom®. Chlorfenapyr acts on the mitochondria of cells and uncouples or inhibits oxidative phosphorylation, preventing the formation of the crucial energy molecule adenosine triphosphate (ATP). As a result, energy production in the cells shuts down resulting in cellular and ultimately, termite death.

Fiproles (or Phenylpyrazoles)

Fipronil is the only insecticide in this new class, introduced in 1990 and registered in the U.S. in 1996. It is marketed as a termiticide under the tradename Termidor®. This termiticide is a non-repellent material with contact and stomach activity. Fipronil works by blocking the gamma-aminobutyric acid- (GABA) regulated chloride channel in neurons, thus disrupting the activity of the insect's central nervous system.

Insect Growth Regulators

An insect growth regulator (IGR) is a synthetic chemical that mimics insect hormones. Hormones regulate a wide array of body and growth (physiological) functions. Some examples include interfering with molting, interfering with pupal emergence and interfering with body wall formation.

IGRs are often specific for an insect species or group of very closely related species. They often have delayed effects because they are taken into the insect and "stored" until the insect reaches the right growth stage. This may range from days to weeks or even months. For example, if the IGR stops the insect from molting, and a given insect is exposed just after a molt, it would continue to function normally until the next molt before dying.

In the case of termite control, the slow action of the IGR allows the chemical to be widely spread throughout the colony as the termite workers feed and groom each other.

The IGRs are, in general, environmentally safe and have very low mammalian toxicity. Some examples include noviflumuron, hexaflumuron, pyriproxyfen and methoprene.

Biological Agents

Biological control agents such as disease causing fungi and bacteria and parasitic nematodes are being studied as possible termite control or termite reduction options. In some cases these agents are released into the soil and in other cases they are injected into the aboveground termite galleries. As with all new methods of control, more research is needed to determine the advantages and limitations of such organisms. *Bacillus thuringiensis* or Bt is an example of a commonly used biological control agent.