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Chlorfenapyr Insecticide

The active ingredient, chlorfenapyr, belongs to the pyrrole class of chemistry. Chlorfenapyr is a broad spectrum insecticide with activity on a number of both crop and non-crop pests. Chlorfenapyr has a novel mode of action which makes it very effective on insects and mites that are resistant to other classes of chemistry. No cross-resistance with other insecticides has been observed. Chlorfenapyr is non-repellent which is especially important in the control of some non-crop pests where the insects travel through the treated zone and acquire a lethal dose.

Mode of Action

The mode of action of chlorfenapyr is an uncoupler of oxidative phosphorylation via disruption of the proton gradient (IRAC Group 13). It is highly effective on target pests primarily by ingestion with some contact activity.

Chlorfenapyr is a pro-insecticide which is converted to its active form by the oxidative removal of the N-ethoxymethyl group by mixed-function oxidases (MFO) in insects. The active form targets the mitochondria within cells throughout the insect. An important process which occurs in the mitochondria is the conversion of adenosine diphosphate (ADP) to adenosine triphosphate (ATP) via a process known as oxidative phosphorylation. ATP is chemical energy which allows cells to sustain their vital functions.

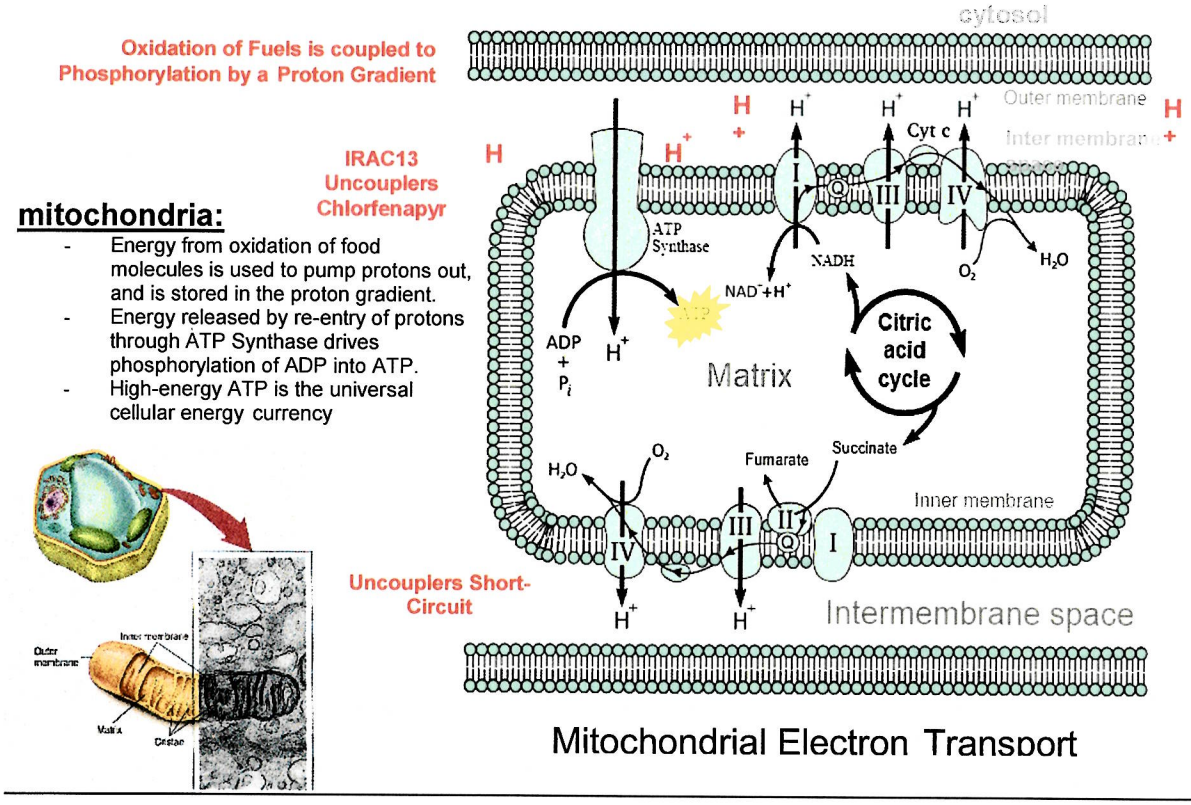
In the insect, the mitochondria accumulates high-energy H^+ protons which serve as the energy sources to drive reactions such as oxidative phosphorylation (Fig. 1). Chlorfenapyr accumulates between the inner and outer membranes of the mitochondria, where it then facilitates H^+ proton loss by drawing H^+ protons from inside the mitochondria and releases them outside. Mitochondria can no longer accumulate H^+ protons internally; subsequently they become uncoupled from the H^+ proton energy source, and can no longer generate ATP. Without production of ATP, cells cease functioning and the insect eventually dies.

Insecticide Resistance Management (IRM)

Many of the insect pests in urban environments such as bed bugs, mosquitoes, house flies, cockroaches, and others have developed resistance to the major insecticide classes due to frequent and prolonged use of the same active ingredient. Chlorfenapyr effectively controls both susceptible insects and insects resistant to other insecticide classes. No cross-resistance of chlorfenapyr to other insecticides has ever been reported. Studies show that chlorfenapyr provides excellent control of susceptible cockroaches and house flies (Husen et al. 2011), susceptible and pyrethroid-resistant

bed bugs (Romero et al. 2010), and susceptible and pyrethroid-resistant mosquitoes (Yuan et al. 2014). In addition, without a specific target site, uncouplers such as chlorfenapyr are not subject to the development of target site resistance. The unique mode of action and lack of cross-resistance to other insecticides makes chlorfenapyr an important tool for use in Integrated Pest Management (IPM) programs to help manage insecticide-resistant populations.

Figure 1. Schematic of the mode of action of chlorfenapyr.



Non-Repellency

Many of the current insecticides for use in pest management of urban insects are repellent products which will:

1) flush the insect from its harborage which results in insects such as cockroaches entering into the open where they might be seen by customers or move to a new untreated area

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2) prevent the use of baits and other products that require ingestion because of contamination of the bait or avoidance of the insect from the bait because of the repellent nature of the insecticide
3) prevent insects from coming in contact with the insecticide because they avoid the treated area which could result in the insects being trapped inside when an outside barrier treatment was applied

Chlorfenapyr is a non-repellent insecticide which means the insect is not aware that the product is present. This characteristic is important in pest control for a number of reasons. Pests will come into contact with the product, acquire a lethal dose, and die. No flushing or movement to a new area occurs because the insect is not agitated by the product. IPM can be followed because a combination of baits and dilutable sprays can be applied at the same time. Finally, the insects are not trapped within a structure which allows for them to come into contact with the treatment and does not cause trapping within a structure thus reducing stress and concern of the occupant.

Literature Cited

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