# Enfold Insecticide Technical Bulletin

Enfold™ is an insecticide that is highly effective against larval stages of lepidoptera species (worms/caterpillars) and suppresses Liriomyza leafminer, Tetranychid (spider) mite and pear psylla.

The active ingredient in Enfold, *emamectin benzoate*, is in the avermectin chemical class, chemical Mode of Action Group 6. It will be formulated as a 5% soluble granule, and when registered is expected to be classified as a Restricted Use Pesticide.

Enfold penetrates the plant cuticle to form a reservoir of active ingredient within the plant leaf through translaminar movement. This reservoir provides long residual insect control.

Research shows Enfold is effective at low use rates and will be an excellent tool in integrated pest management programs.

## Biological Activity

*Mode of Action*

Emamectin benzoate, the active ingredient in Enfold, causes loss of cell function and disruption of nerve impulses in targeted pests. As a result, pests stop feeding and become irreversibly paralyzed shortly after ingestion. Mortality is achieved within two to four days, and subsequent plant damage is minimal since feeding stops within hours of ingesting treated plant material.

## Pests Controlled

Enfold insecticide has contact activity, but it is most efficacious when ingested by pests such as:

| | |
|---|---|
| Fall armyworm | Tent caterpillar (western) |
| Southern armyworm | Diamondback moth |
| Beet armyworm | Codling moth |
| Cabbage looper | Spruce budworm |
| Soybean looper | Leafminer blister moth |
| Tobacco budworm | Leafminer tentiform |
| Corn earworm | Leafminer dipterous[1] |
| Fall webworm | Pear psylla[2] |
| Tent caterpillar (eastern) | Spider mites[2,3] |

[1] Suppression of *Liriomyza trifolii*, *L. sativae*, *L. hudriobresis*
[2] Suppression
[3] Phytophagous (plant-damaging) mites in subfamily Tetraychinae

## Use Information

*Use Sites*

Enfold has been submitted as an insecticide for use on outdoor container and in-ground grown herbaceous and woody ornamental plants in commercial nursery production. Woody ornamentals include, but are not limited to, shrubs, non-bearing fruit and nut trees, Christmas trees, forest seedlings and shade trees.

*Use Rate and Application Timing Anticipated Upon Registration*

- The proposed use rate for Enfold insecticide will be 2.4–3.2 oz/A for low to moderate infestations and 4.8 oz/A for high infestations and suppresion of Liriomyza species leafminers and mites.

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**Enfold insecticide is not currently registered for sale or use in the United States.**

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- Apply Enfold insecticide to plant foliage when eggs are present or immediately after egg hatch, when larvae first appear, but before populations reach damaging levels. Target applications at small (1/4 inch or smaller in length) larvae.
- Treatments must be made before larvae penetrate plant parts or before larvae begin webbing and sheltering.
- Applications may be repeated at a 7- to 14-day interval to maintain control.
- Two sequential applications should be made, then rotate to a product with a different mode of action following labeled recommendations for resistance management.
- Thorough spray coverage is essential for optimum performance. Apply Enfold insecticide in sufficient water to ensure good coverage of all plant surfaces. The use of greater water volumes will generally result in better coverage, especially under adverse conditions (e.g., hot, dry) or when the plant canopy is dense.

*Adjuvants and Mixing*

Emamectin benzoate is soluble in water at typical use dilutions. Thorough spray coverage of plant foliage is essential for optimum control. To provide optimum coverage and insect control, the use of a penetrating type spray adjuvant such as horticultural spray oil (not a dormant oil) or a nonionic surfactant at the manufacturer's suggested rate is recommended. Do not use a sticker/binder type adjuvant or tank mix with products that contain a sticker/binder component in the formulation because this may interfere with the effectiveness of the product. Enfold is rainfast immediately upon drying.

## Plant Tolerance

**NOTICE TO FUTURE USERS:** Plant tolerance to Enfold insecticide has been found to be acceptable for many genera and species. Due to the large number of species and varieties of ornamentals and nursery plants, it is impossible to test every one for tolerance. The professional user should determine if Enfold insecticide can be used effectively prior to commercial use. In a small area, test the recommended rates on a small number of plants for phytotoxicity prior to widespread use.

## Beneficial Selectivity

Emamectin benzoate photodegrades rapidly from foliage surfaces. Due to the short surface residual, Enfold has little impact on beneficial arthropods. Enfold insecticide is not disruptive to biological control practices and is suitable for use in integrated pest management (IPM) programs.

Based on field and laboratory data, the selectivity of emamectin benzoate was established for beneficial arthropods. The arthropods listed below were exposed to foliage 24 hours after it had been treated with emamectin benzoate (0.0075-0.015 lb ai/acre). The survival rate for each species was 80 percent or better.

| Beneficials | Common Name | Family | Other |
|---|---|---|---|
| *Aphidoletes aphidimyza* | Aphid midge | Cecidomyiidae | Diptera |
| *Chrysopa carnea* | Green lacewing | Chrysopidae | |
| *Cotesia orobenae* | | Braconidae | Hymenoptera |
| *Diadegma insulare* | | Ichneumonidae | Hymenoptera |
| *Diglyphus begini* | | Eulophidae | Hymenoptera |
| *Galandromus occidentalis* | Western predatory mite | Phytoseiidae | Acari |
| *Geocoris spp., Sinea spp.,* and *spiders* | Big-eyed and assassin bugs and spiders | Lygaeidae<br>Reduviidae<br>Araneida | Hymenoptera<br><br>Arachnidae |
| *Hippodamia convergens* | Convergent lady beetle | Coccinellidae | Coleoptera |
| *Nabis roseipennis* | Damsel bug | Nabidae | Heteroptera |
| *Podisus maculiventris* | Spined soldier bug | Pentatomidae | Heteroptera |
| *Pteromalus puparum* | | Pteromalidae | Hymenoptera |
| *Trichogramma pretiosum* | | Trichogrammatidae | Hymenoptera |

## Chemical and Physical Properties

| | |
|---|---|
| Common name: | Emamectin benzoate |
| CAS No.: | 137512-74-4 |
| Chemical structure: | |
| Empirical formula: | Emamectin benzoate $B_{1a}$: $C_{49}H_{75}NO_{13}.C_7H_6O_2$ |
| | Emamectin benzoate $B_{1b}$: $C_{48}H_{73}NO_{13}.C_7H_6O_2$ |
| Molecular weight: | Emamectin benzoate $B_{1a}$: 1008.26 |
| | Emamectin benzoate $B_{1b}$: 994.23 |
| Physical appearance: | White crystalline powder |
| Melting point: | 141-146° C (DSC 2° C/min, N2) |
| Solubility: | Soluble in acetone and methanol, poorly soluble (approximately 300 ppm at pH 5) in water, and insoluble in hexane. |
| Stability: | The active ingredient and formulated product are stable under normal storage conditions. |
| Formulation: | 5% soluble granule |

## Toxicology Technical

| | | |
|---|---|---|
| Acute oral $LD_{50}$ (rat): | 70 mg/kg bw | |
| Acute dermal $LD_{50}$ (rabbit): | >2,000 mg/kg bw | |
| Ames bacterial mutagen test: | Negative | |
| Teratogenicity (rat, rabbit): | Negative | |
| Eye irritation (rabbit): | Severe | |
| Primary skin irritation (rabbit): | Slight | |
| Acute oral $LD_{50}$ (rat): | 1,516 mg/kg bw | |
| Acute dermal $LD_{50}$ (rabbit): | >2,000 mg/kg bw | |
| Eye irritation (rabbit): | Mild, irritation reversible within 96 hrs. | |
| Primary skin irritation (rabbit): | Slight | |
| Aquatic organism toxicity: | $LC_{50}$ (mg/L) | |
| Daphnia Magna | 0.0029 | 48 hr |
| Bluegill sunfish | 0.24 | 96 hr |
| Rainbow trout | 0.67 | 96 hr |

## Environmental Fate

Emamectin benzoate binds tightly to soil and does not leach or accumulate in the environment.

## ANTICIPATED PRECAUTIONARY STATEMENTS WHEN REGISTERED

**Hazards to Humans and Domestic Animals**

Signal Word: **CAUTION**

**Personal protective equipment (PPE)**

<u>Ground application (except airblast sprayers), airblast application and application using OPEN CAB airblast sprayers:</u>

**Applicators, mixers, loaders and other handlers must wear:**

- Long-sleeved shirt and long pants (applicators using OPEN CAB airblast sprayers must wear coveralls over long-sleeved shirt and long pants).
- Chemical-resistant gloves made of any waterproof material such as polyvinyl chloride, nitrile rubber or butyl rubber.
- Shoes plus socks.

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Application using ENCLOSED CAB airblast sprayers:

**While inside the cab, applicators must wear:**

- Long-sleeved shirt and long pants.
- Shoes plus socks.

**When entering or leaving the cab, must also wear:**

- Chemical-resistant gloves made of any waterproof material such as polyvinyl chloride, nitrile rubber or butyl rubber.

**NOTE:** Once inside the cab, applicator must remove gloves and store them in a chemical-resistant container such as a plastic bag.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions exist for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

## Environmental Hazards

This pesticide is toxic to fish, birds, mammals and aquatic invertebrates. Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash water or rinsate.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow drift to blooming crops or weeds if bees are foraging in and around the treatment area.

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