Trichogramma (*Trichogramma* spp.)
Moth Egg Parasite

Target pests
Several species of moths

Description
'Trichogramma' is a minute parasitic wasp, that attacks the eggs over 150 species of moths, including cabbage looper, codling moth, oriental fruit moth, twig borers and fruitworms.

- Adults are less than 1 mm (1/25 inch) long.
- Larvae develop entirely inside the eggs of moths, which darken when they are parasitized.

Use in Biological Control

- Several different species of Trichogramma are used in North American crops. For greenhouse crops use *T. pretiosum;* in orchards and field crops use *T. minutum* in the east and *T. platneri* in the west. New species such as *T. sibericum* are being used in greenhouse trials.
- Optimum conditions are moderate temperatures of 20-27 ºC (68-81 ºF) and relative humidity 60%.
- Moth species that lay eggs in clusters are more easily controlled using Trichogramma than those that lay eggs singly.

Life Cycle
A complete life cycle takes 14 days at 21^{o}C (70^{o}F).

- Sex ratio in the population is about equal (50% females).
- Mated females lay 60-70 eggs in moth eggs over a period of 1-2 weeks. Most Trichogramma eggs are laid within 1-2 days of mating.
- Larvae take 10 days to develop within the moth egg, which turns brown or black as the larvae pupate.
- Adults begin to emerge within 2-3 days at 20-27 ºC (68-81 ºF) and over 60% relative humidity. They chew a small hole in the moth egg to emerge. Males emerge slightly earlier and await female emergence for mating. Adults can feed on nectar, honeydew, and pollen.

Total life span may be 7-75 days depending upon temperature, relative humidity and species of moth parasitized. There may be 30 or more generations per season.

Product Information
Trichogramma is shipped as parasitized moth eggs fixed to cardboard sheets. Each sheet holds about 125,000 Trichogramma. The sheets are perforated into 30 small squares, each with 4,000-5,000 Trichogramma. Carefully tear the sheets along the perforations and either distribute them immediately throughout the crop or hold them in containers with food until the adults begin to emerge (described below).

Incubation Method
This method significantly improves the rates of emergence, and provides an area for the Trichogramma to mate before release.

- Enclose each square of cardboard in a small vial or paper cup along with a small piece of cotton moistened with dilute honey or fruit juice.
- Hold for 2-10 days at 24-25ºC (76-78ºF) and when the Trichogramma begin to emerge, place the vials throughout the crop.

Parasitized eggs may be held for short periods at 10-15ºC (50-60ºF) if necessary to delay their emergence.

Introduction Rates
General Introduction Rates

- 22 Trichogramma/m² (2 /ft²), weekly, until caterpillars populations are controlled; or 22,000 wasps per 1000 m^2 (10,000 ft^2) per week.

Use in Greenhouses
Introduction rates for greenhouses should be considered experimental.
In greenhouse tomatoes, monthly releases of 875,000-950,000 Trichogramma/hectare (350,000-380,000 Trichogramma/acre) gave 80% control of cabbage loopers after three months.

All release should be made weekly at the first sign of moths, ensuring the Trichogramma are distributed evenly throughout the greenhouses. Continue regular weekly releases for at least 4 weeks or until control is achieved.

- Greenhouse tomatoes – 22 Trichogramma/m² (10 ft²), weekly
- Greenhouse sweet peppers — 1-10 Trichogramma/m² (10 ft²), weekly

Use in Outdoor Crops
Regularly releasing Trichogramma ensures that mated females are always present to attack moth eggs. Releases should start as soon as moths are first detected (either seen flying or trapped in pheromone lure traps).

- Field crops – 250,000-750,000/hectare (100,000-300,000/acre) over three weeks or evenly spread out over the egg laying period of the target pest;
- Codling moth in orchards – 125,000-250,000/hectare (50,000-100,000/acre) spread over three weeks, as soon as moths are detected in traps;
- Home gardens – 12,000/wk for each of 3 weeks.

In orchards, place some Trichogramma at the base of each infested tree. Releasing a percentage of the Trichogramma upwind may encourage their natural spread through the orchard.

Trichogramma can be released in large numbers using an aircraft fitted with special Venturi tubes. Release in early morning or late afternoon, particularly where the plant canopy does not cover the ground.

For Best Results

- Because Trichogramma are weak flyers, they must be well distributed throughout the crop.
- Use *Bacillus thuringiensis (*i.e., Dipel® or Foray®*)* to control caterpillars until Trichogramma is well established.

Using Pesticides

Pesticide compatibility has not been evaluated for Trichogramma, but it is likely that the same recommendations would apply as for *Encarsia formosa* (see Sheet 180).

- Kinoprene (Enstar®) and fenbutatin oxide (Vendex ®) should be safe to use.
- Most fungicides and plant growth regulators should not be harmful.
- Spreader stickers may be harmful and high volume sprays of any pesticide may drown adult Trichogramma.