

5. The adults lay eggs on the brown sheets. The adults are collected daily and allowed into fresh rearing troughs with fresh foods.
6. From the old troughs, the brown paper sheets along with *Crysopa* eggs are removed.
7. The sheets containing *Crysopa* eggs are stored at 10°C in BOD incubator or refrigerator for about 21 days.
8. When the eggs are required for culturing or for field release the egg sheets are kept in room temperature for a day and eggs during these period turn brown and hatch on 3 days later.
9. The first larvae are either taken for culture or for recycling or for field release.



#### Dose of Trichocard application

**Sugarcane borers Early shoot borer :** 4-6 releases of *Trichogramma chilonis* @ 50,000/ha at 10 days interval starting from 45th day after planting or with appearance of the pest.

**Top shoot borer :** 4-6 releases of *Trichogramma japonicum* @ 50,000/ha at 10 days interval starting from 60th day after planting and onwards.

**Sugarcane plassy borer :** 9-11 releases of *Trichogramma chilonis* @ 50,000/ha at 10 days interval starting from 70th day onwards or with the appearance of the pests.

**Maize stem borer :** 6 releases of *Trichogramma chilonis* @ 75,000/ha from 45th day onwards at an interval of 10 days or with the appearance of the pests.

**Tomato fruit borer :** 6 releases of *Trichogramma brasiliensis* @ 1,00,000/ha from 45th day after transplanting at weekly interval or with the appearance of the pests.

**Rice stem borer :** *Trichogramma japonicum* @ 50,000/ha with the appearance of the pest or 30 days after transplantation, 6 releases to be made in one session.

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## Mass Production Techniques of Biological Control Agents



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### **Biological Control in Assam:**

The north-east Indian state Assam covers a total geographical area of 78.44 lakh hectares. Rice is the staple food for Assamese at the same time as other crops also cultivated viz. wheat, pulse, mustard, coconut, tea etc. with a total cropped area of 39.89 lakh hectares. There were 30 numbers of parasitoid species and 26 numbers of predator species were recorded from rice ecosystem of Assam. Moreover, two larval parasitoids (*Cotesia* sp. and *Bracon* sp.) and 3 predatory spiders (*Oxyopes sweta*, *Plexippus paykulli* and *Plexippus* sp.) were recorded as natural enemies of potato tuber moth, *Phthorimaea operculella* (Zeller) in Assam.

### **Production of Trichogrammatids**

Trichogrammatids are an important group of bio agents which have been used successfully for biological suppression of various lepidopteran pests damaging crops like rice, sugarcane, cotton, vegetables, maize etc. In India, *Trichogramma* spp., are in great demand today and their mass production has already been taken up by various cooperatives, sugar factories and other agencies in public and private sector.

Trichogrammatids can be reared very easily using glass tubes (8" x 1.3"). Egg cards made of about 10,000 frozen eggs of *Corcyra* are exposed to the adult female parasitoids (*Trichogramma* spp.) in the ratio of 20:1. After exposing for 24 hrs, the egg card is removed and 1/3 of it can be cut and transferred to another tube to be used for maintain pure culture. The remaining parasitized egg cards can be utilized as nucleus culture for shipment or field release. The adult *Trichogramma* emerge from the parasitized card 6-8 days later. This method can be used for rearing all *Trichogramma* species.

### **Production of Predacious Coccinellids**

Coccinellids prefer to feed on aphids, mealybugs, white flies but when these preys are not available they switch to other prey such as mites, thrips, lepidopteran eggs etc. both adult and larvae are voracious feeders. During its development through four instars, the larvae eat between 200-300 aphids and adult may eat up to 50 aphids per day.

### **Coccinellids for laboratory rearing:**

- 1) A plastic container with a capacity of 1-2 ltr. has to be taken .
- 2) A piece of cotton dipped in water and another one dipped in 10-15% honey solution in a petri plate has to be kept inside the container.
- 3) A container (small cup) with mustard seedling/cowpea infested with aphids are placed in the container.
- 4) 5-10 adults of coccinellids (mixed sex) are released in each container.
- 5) A corrugated white paper is placed inside the container for egg laying by the coccinellids.
- 6) Eggs laid by the females will be collected daily by cutting of the paper with eggs and transferred to a petri plate.
- 7) Eggs will be incubated in the growth chamber at 28°+6C with 65% RH.
- 8) On hatching the grubs may be transferred into new container with similar setup as described earlier.

### **Production of Predacious Reduviids**

The reduviids, also known as assassin bugs, are of considerable economic importance because they reduce the pest population by killing the host quickly with

their proteolytic saliva. The effectiveness of the reduviids as biocontrol agents has been demonstrated and the field release usually resulted in quick and effective control of the target pests. Reduviids can be reared on natural or alternative hosts. In the laboratory, reduviids are mass reared using *Corcyra cephalonica* larvae as host.

### **Reduviids for laboratory rearing**

1. A plastic tub is taken with sterilized sand to a depth of 2 cm.
2. A cotton swab dipped in 10-50 % honey solution is placed on the side wall of the tub.
3. A corrugated white paper for oviposition is attached inside the plastic tub.
4. 2-3 grown up larvae (4<sup>th</sup>-5<sup>th</sup> instars) of *Corcyra* or natural hosts ( *Helicoverpa*/ *Spodoptera* or any other lepidopteran host caterpillars are added inside the plastic tub.
5. 2-3 pairs of young adults ( male and female in 1:1 ratio) of reduviids are released inside the plastic tub.
6. The open mouth of the plastic tub is covered with a muslin cloth immediately after releasing the reduviids.
7. Cotton with honey solution is to be changed every two days .
8. Larvae of lepidopteran host are to be added every two days
9. The female reduviids lay eggs on corrugated white paper in clusters of 40-50 eggs.
10. The egg masses from the white paper are collected by cutting out the paper with eggs on it.
11. The paper with egg masses should be placed in a petri dishes and cover it with a lid.
12. Egg hatch into nymphs in 7-10 days. The nymphs are maintain in petri dishes for a week by adding 3-4, 1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup> instar host larvae or as needed.
13. The nymphs are transferred after a week to a plastic container or tub( 10 -20 / container) with sand ( 2cm thickness) at the bottom with a piece of corrugated white paper. A cotton swab dipped in 10-50 % honey solution on the side of the wall is to be placed.
14. The eggs laid by the reduviids may be transferred to new container again with similar steps as described.

### **Production of *Chrysoperla carnea***

The green lacewings, *Chrysoperla carnea* is a cosmopolitan predator found in a wide range of agricultural habitat. Lacewings are effective against aphids and other sucking pests. Lacewings can be reared on natural or alternative hosts. In mass production; the adults are fed on various types of diets. The larvae are reared either in plastic tubes or empty injection vials.

1. The adults are collected daily and transferred to plastic vial or glass troughs (30 cm × 12cm)
2. Before allowing the adults, the rearing troughs are wrapped inside with brown sheet which act as egg receiving card.
3. About 250 adults (60% females) are allowed into each trough and covered with white nylon or georgette cloth secured by rubber band.
4. On the cloth outside three bits of foam sponge (2 sq.in) dripped in water is kept. Besides an artificial protein rich diet is provided in semisolid paste in three spots on the cloth outside.