

# A REVIEW OF THE HYMENOPTERAN EGG PARASITOIDS OF LEPIDOPTERA IN INDIA

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## ABSTRACT

Hymenopteran parasitoids attacking the eggs of Lepidoptera fall under the superfamilies Platygastroidea and Chalcidoidea. Nearly 75 species under 9 genera namely *Telenomus* Haliday, *Paratrichogramma* Girault, *Trichogrammoatoidea* Girault, *Trichogramma* Westwood, *Anastatus* Motschulsky, *Ooencyrtus* Ashmead, *Agiommatus* Crawford, *Tetrastichus* Haliday and *Pediobus* Walker are known to parasitise the eggs of Lepidoptera in India. A brief synoptic review of the genera of hymenopteran egg parasitoids of Lepidoptera in India is presented here along with their species diversity and host accounts.

**Keywords:** Parasitic Hymenoptera, Lepidoptera, Egg parasitoids, India.

## INTRODUCTION

Parasitic Hymenoptera are well known for their valuable role in maintaining the diversity of natural communities of other insects and arthropods. They are undoubtedly one of the most important components of agrobiodiversity (Clausen, 1940; Quicke, 1997) and have been successfully utilized as biocontrol agents with notable success in the recent past (Narendran, 2001). Their ability to parasitize herbivorous insects and to use them as hosts can prevent the outbreak of pests, thereby decreasing the need to use chemical means in pest control (Clausen, 1940; Noyes and Hayat, 1984). They cause mortality of herbivorous insects more efficiently than predators and pathogens (Hawkins *et al.*, 1997).

Based on the host stage, the parasitoids are categorized as egg, larval and pupal parasitoids or a combination of these like egg-larval and larval-pupal (University of California, 2004). Among them, the egg parasitoids are considered the most economically significant and effective biocontrol agent, since the pests are killed before the crops are

damaged (Mills, 2010). The egg parasitoids, either solitary or gregarious, attack and complete their development within the host eggs (Mills, 1994), thus preventing the latter from hatching.

At least 14 families under Hymenoptera use arthropod eggs as hosts. Of these, members of Mymaridae and Trichogrammatidae (Chalcidoidea) and Telenominae, Teleasinae, Scelioninae and Sceliotrachelinae (Platygastridae: Platygastroidea) are categorized as exclusive egg parasitoids (Austin *et al.*, 2005) and true egg parasitoids. They use only a single host egg to complete their development and are associated with hosts belonging to 15 orders (Romani *et al.*, 2010). The mymarids generally parasitise the eggs of Hemiptera and Coleoptera and hardly attack the lepidopteran eggs (Romani *et al.*, 2010). Though not true egg parasitoids, a few species among the chalcid families of Aphelinidae, Eulophidae, Encyrtidae, Pteromalidae, Tetracampidae and Eupelmidae are also known to attack the eggs of other insects and arthropods (Noyes, 2011).

## THE HYMENOPTERAN EGG PARASITIDS OF LEPIDOPTERA IN INDIA

Hymenopteran egg parasitoids of Lepidoptera fall under the superfamilies Platygastroidea and Chalcidoidea. Among the platygastroids, only one genus, *Telenomus* Haliday, is known to attack the eggs of Lepidoptera (Masner, 1976). Among the chalcids, *Trichogramma* Westwood, *Paratrichogramma* Girault and *Trichogrammatoidea* Girault (Trichogrammatidae) are exclusively egg parasitoids. However, a few species of *Tetrastichus* Haliday and *Pediobius* Walker (Eulophidae), *Ooencyrtus* Ashmead (Encyrtidae), *Anastatus* Motschulsky (Eupelmidae) and *Agiommatus* Crawford (Pteromalidae) are also reported from lepidopteran eggs.

The parasitoids attacking the eggs of Lepidoptera under Platygastroidea and Chalcidoidea differ in aspects like host ranges, host specificity, searching ability and also hyperparasitism (Orr, 1988). Most of the individual species of egg parasitoids in the chalcid genera have very broad host ranges, stretching even across several insect orders and at times even lack specificity with regard to the host stage they attack. Compared to Chalcidoidea, platygastroids, in general exhibit a narrower host range and a relatively higher degree of specificity of the host stage attacked.

In this account, we present a brief synoptic review of the hymenopteran egg parasitoids of Lepidoptera from India, along with their species diversity and host accounts. The species diversity and host account of chalcid genera are adapted from Universal Chalcidoidea database (Noyes, 2011), while that of the platygastroid genus is after Nixon (1937, 1940), Mani (1939) and Dey *et al.* (1999). The host accounts of both chalcids and platygastroids are treated on a global scale.

Host: Pyralidae: *Tryporyza incertulas*, *Tryporyza innotata*, *Scirpophaga incertulas*, *Chilo suppressalis*, *Chilo auricilius*, *Schoenobius bipunctifer*, *Cnaphalocrocis medinalis*; Noctuidae: *Sesamia inferens*.

***Telenomus talaus* Nixon**

Host: Papilionidae: *Papilio* sp.

***Telenomus transversiceps* Nixon**

Host: Lycaenidae: *Tarucus theophrastus* on lac.

## 2. Genus *Trichogrammatoidea* Girault (Family: Trichogrammatidae)

Of the 12 species known from India, 11 use lepidopteran eggs as their hosts. (Since species with unavailable names are not included, here, only 10 species are listed below). The host ranges of some of the individual species in this genus extend across two or more insect orders. To quote a few instances, *T. bactrae* is known from both lepidopteran and dipteran eggs, where as *T. brasiliensis* are parasitoids of both hemipteran and lepidopteran eggs and *T. nana* is known from the eggs of Coleoptera, Diptera, Hemiptera and Lepidoptera.

***Trichogrammatoidea armigera* Manjunath**

Host: Gelechiidae: *Gnorimoschema operculella*, *Phthorimaea operculella*; Lycaenidae: *Lampides boeticus*; Noctuidae: *Achaea janata*, *Helicoverpa armigera*, *Helicoverpa zea*, *Heliiothis armigera*, *Heliiothis peltigera*; Oecophoridae: *Opisina arenosella*; Pyralidae: *Chilo partellus*, *Corcyra cephalonica*, *Eldana saccharina*, *Etiella zinckenella*, *Ostrinia furnacalis*; Blastobasidae: *Pseudohypatopa pulverea*; Gelechiidae: *Pectinophora gossypiella*, *Pectinophora scutigera*, *Sitotroga cerealella*, *Tuta absoluta*; Hesperidae: *Pelopidas mathias*; Noctuidae: *Achaea janata*, *Agrotis ipsilon*, *Chrysodeixis chalcites*, *Earias insulana*, *Earias vittella*, *Helicoverpa armigera*, *Heliiothis armigera*, *Plusia orichalcea*, *Trichoplusia ni*; Oecophoridae: *Opisina arenosella*, *Artogeia rapae*, *Pieris brassicae*; Pyralidae: *Chilo indicus*, *Chilo infuscatellus*, *Chilo partellus*, *Chilo sacchariphagus*, *Chilo suppressalis*, *Chilotraea infuscatella*, *Coccyra cephalonica*, *Emmalocera depressella*, *Ephestia kuehniella*, *Nymphula depunctalis*, *Scirpophaga intacta*; Sphingidae: *Agrius convolvuli*; Tortricidae: *Arotrophora arcuatalis*, *Bactra venosana*, *Ctenopseustis obliquana*, *Eucosma* sp. *Tetramoera schistaceana*; Yponomeutidae: *Plutella xylostella*.

***Trichogrammatoidea bactrae* Nagaraja**

Host: Blastobasidae: *Pseudohypatopa pulverea*; Gelechiidae: *Pectinophora gossypiella*, *Pectinophora scutigera*, *Sitotroga cerealella*, *Tuta absoluta*; Hesperidae: *Pelopidas mathias*; Noctuidae: *Achaea janata*, *Agrotis ipsilon*, *Chrysodeixis chalcites*, *Earias insulana*, *Earias vittella*, *Helicoverpa armigera*, *Heliiothis armigera*, *Plusia orichalcea*, *Trichoplusia ni*; Oecophoridae: *Opisina arenosella*; Pieridae: *Artogeia rapae*, *Pieris brassicae*; Pyralidae: *Chilo indicus*, *Chilo infuscatellus*, *Chilo partellus*, *Chilo*

*sacchariphagus*, *Chilo suppressalis*, *Chilotraea infuscatella*, *Coccyra cephalonica*, *Emmalocera depressella*, *Ephestia kuehniella*, *Etiella* sp., *Nymphula depunctalis*, *Scirpophaga intacta*; Sphingidae: *Agrius convolvuli*; Tortricidae: *Arotrophora arcuatalis*, *Bactra venosana*, *Ctenopseustis obliquana*, *Eucosma* sp., *Tetramoera schistaceana*; Yponomeutidae: *Plutella xylostella*.

#### ***Trichogrammatoidea brasiliensis* (Ashmead)**

Host: Arctiidae: *Amsacta moorei*; Blastobasidae: *Pseudohypatopa pulverea*; Gelechiidae: *Pectinophora gossypiella*, *Phthorimaea operculella*, *Platyedra gossypiella*, *Scrobipalpula absoluta*, *Sitotroga cerealella*; Noctuidae: *Anomis texana*, *Autographa* sp., *Copitarsia* sp., *Earias insulana*, *Earias vittella*, *Eublemma amabilis*, *Helicoverpa armigera*, *Heliothis armigera*, *Heliothis stombleri*, *Heliothis virescens*, *Heliothis zea*, *Mamestra brassicae*, *Rachiplusia nu*, *Spodoptera exigua*, *Spodoptera litura*; Oecophoridae: *Opisina arenosella*; Pyralidae: *Anagasta kuehniella*, *Chilo partellus*, *Corcyra cephalonica*, *Diatraea saccharalis*, *Ephestia kuehniella*, *Loxostege sticticalis*, *Pyrausta machaeralis*; Tortricidae: *Epinotia aporema*, *Lobesia botrana*; Yponomeutidae: *Plutella xylostella*.

#### ***Trichogrammatoidea eldanae* Viggiani**

Host: Noctuidae: *Helicoverpa armigera*, *Spodoptera frugiperda*; Pyralidae: *Chilo infuscatellus*, *Corcyra cephalonica*, *Diatraea saccharalis*, *Eldana saccharina*.

#### ***Trichogrammatoidea fulva* Nagaraja**

Host: Pyralidae: *Corcyra cephalonica*; Tortricidae: *Cryptophlebia ombrodelta*.

#### ***Trichogrammatoidea fumata* Nagaraja**

Host: Gracillariidae: *Conopomorpha cramerella*; Noctuidae: *Achaea janata*, *Chrysodeixis chalcites*, *Corcyra cephalonica*; Tortricidae: *Ctenopseustis obliquana*, *Epiphyas postvittana*, *Planotortrix octo*.

#### ***Trichogrammatoidea lutea* Girault**

Host: Gelechiidae: *Sitotroga cerealella*; Noctuidae: *Agrotis segetum*, *Anomis leona*, *Busseola fusca*, *Chrysodeixis chalcites*, *Diparopsis castanea*, *Earias biplaga*, *Helicoverpa armigera*, *Heliothis armigera*, *Spodoptera littoralis*, *Trichoplusia ni*; Pyralidae: *Anagasta kuehniella*, *Cactoblastis cactorum*, *Chilo partellus*, *Corcyra cephalonica*, *Dichocrocis crocodora*, *Ephestia kuehniella*; Tortricidae: *Argyroploce leucotreta*, *Carpocapsa pomonella*, *Cryptophlebia leucotreta*, *Cydia pomonella*, *Olethreutes batrachopa*, *Olethreutes leucotreta*, *Tortrix capensana*.

#### ***Trichogrammatoidea nana* (Zehntner)**

Host: Blastobasidae: *Holcocera pulverea*; Cossidae: *Phragmataecia gummata*; Gelechiidae: *Sitotroga cerealella*; Hyblaeidae: *Hyblaea puera*; Limacodidae: *Thosea asigna*; Lycaenidae: *Lampides boeticus*, *Tarucus theophrastus*; Noctuidae: *Cosmophila*

sp., *Eublemma amabilis*, *Heliothis armigera*, *Sesamia inferens*, *Spodoptera* sp.; Pieridae: *Catopsilia crocale*; Pyralidae: *Chilo infuscatellus*, *Chilo sacchariphagus*, *Chiloptera infuscatella*, *Corcyra cephalonica*, *Diatraea obliqua*, *Diatraea striatalis*, *Ephestia cautella*, *Hapalia machaeralis*, *Hypsipyla grandella*, *Hypsipyla robusta*, *Proceras polychrysa*, *Proceras sacchariphagus*, *Proceras venosatus*, *Pyrausta machaeralis*, *Schoenobius incertulas*, *Scirpophaga intacta*, *Sylepta derogata*, *Tirathaba trichogramma*; Tortricidae: *Archips occidentalis*, *Argyroplote schistaceana*, *Bactra venosana*, *Eucosma isogramma*, *Homona coffearia*, *Laspeyresia schistaceana*, *Olethreutes schistaceana*, *Tetramoera schistaceana*, *Tortrix dinota*; Zygaenidae: *Artona trisignata*, *Levuana iridescens*.

### ***Trichogrammatoidea prabhakeri* Nagaraja**

Host: Noctuidae: *Achaea janata*; Pyralidae: *Corcyra cephalonica*.

### ***Trichogrammatoidea robusta* Nagaraja**

Host: Noctuidae: *Heliothis* sp.; Pyralidae: *Corcyra cephalonica*, *Hypsipyla grandella*, *Hypsipyla robusta*.

## **3. Genus *Trichogramma* Westwood (Family: Trichogrammatidae)**

*Trichogramma* with 210 species is distributed worldwide and forms the largest genus under Trichogrammatidae (Pinto, 2006). Lepidopterous insects are the most preferred hosts (Sorokina, 1999) and of the 35 species reported India, 34 are known to attack lepidopteran eggs. (Since species with unavailable names are not included, here, only 33 species are listed below). Other than Lepidoptera, they are also known to parasitise Coleoptera, Diptera, Hymenoptera, Hemiptera and Neuroptera. Though they parasitise nearly all families of Lepidoptera, members of Noctuidae are attacked the most. Plant characters are found to influence the parasitism by *Trichogramma*. Romeis *et al.* (1999) through a study of *T. chilonis* on chickpea (*Cicer arietinum*) in India, concluded that some plant characters like the trichome and its exudates repel the parasitoids, inspite of the presence of their hosts in good numbers.

Other than the conventional morphological characters, the male genitalia are one of the most reliable characters in species delimitation in *Trichogramma* taxonomy. Studies based on characterization of the of ITS-2 region are also giving promising results in species studies.

A total of 33 species are listed here (species with unavailable taxonomic names have been excluded).

### ***Trichogramma achaeae* Nagaraja & Nagarkatti**

Host: Gelechiidae: *Pectinophora gossypiella*, *Sitotroga cerealella*; Geometridae: *Boarmia variegata*; Noctuidae: *Achaea janata*, *Anticarsia gemmatalis*, *Chrysodeixis chalcites*, *Earias insulana*, *Earias vittella*, *Helicoverpa armigera*, *Heliothis armigera*, *Heliothis zea*, *Mamestra brassicae*, *Spodoptera litura*, *Tiracola plagiata*, *Trichoplusia ni*;

Notodontidae: *Clostera cupreata*; Nymphalidae: *Ergolis merione*, Oecophoridae: *Opisina arenosella*; Pieridae: *Catopsilia pyranthe*; Pyralidae: *Chilo partellus*, *Corcyra cephalonica*, *Loxostege sticticalis*; Sphingidae: *Acherontia styx*, *Agrius convolvuli*; Tortricidae: *Laspeyresia koenigana*; Yponomeutidae: *Plutella xylostella*.

***Trichogramma agriae* Nagaraja**

Host: Pyralidae: *Corcyra cephalonica*; Sphingidae: *Agrius convolvuli*.

***Trichogramma australicum* Girault**

Host: Arctiidae: *Diacrisia obliqua*; Cossidae: *Phragmataecia gummata*; Gelechiidae: *Brachmia modicella*, *Sitotroga cerealella*; Lymantriidae: *Euproctis fraterna*; Noctuidae: *Achaea janata*, *Achaea trapezoides*, *Alabama argillacea*, *Helicoverpa armigera*, *Helicoverpa punctigera*, *Heliothis armigera*, *Heliothis punctigera*, *Naranga aenescens*, *Plusia chalcites*, *Rivula atimeta*, *Sesamia calamistis*, *Sesamia inferens*, *Sesamia vuteria*, *Spodoptera litura*; Nymphalidae: *Melanitis leda*; Papilionidae: *Papilio xuthus*; Pterophoridae: *Exelastis atomosa*; Pyralidae: *Chilo indicus*, *Chilo infuscatellus*, *Chilo partellus*, *Chilo sacchariphagus*, *Chilo simplex*, *Chilo suppressalis*, *Chilo venosatus*, *Chilotraea infuscatella*, *Cnaphalocrocis medinalis*, *Corcyra cephalonica*, *Diatraea saccharalis*, *Ephestia cautella*, *Nymphula depunctalis*, *Ostrinia salentialis*, *Proceras indicus*, *Proceras sacchariphagus*, *Proceras venosatus*, *Schoenobius incertulas*, *Scirpophaga incertulas*, *Scirpophaga innotata*, *Scirpophaga nivella*, *Susumia exigua*; Saturniidae: *Philosamia cynthia*; Sphingidae: *Acherontia styx*, *Agrius convolvuli*, *Eryinnis ello*; Tortricidae: *Argyroploce schistaceana*, *Carpocapsa pomonella*, *Eucosma schistaceana*, *Homona coffearia*, *Olethreutes schistaceana*, *Tetramoera schistaceana*.

***Trichogramma breviciliata* Yousuf & Hassan**

Host: Pyralidae: *Corcyra cephalonica*.

***Trichogramma brevifringiata* Yousuf & Shafee**

Host: Pyralidae: *Chilo infuscatellus*.

***Trichogramma californicum* Nagaraja & Nagarkatti**

Host: Lycaenidae: *Chlorostrymon simaethis*, *Habrodais grunus*, *Loranthomitoura spinetorum*, *Philotes sonorensis*; Lymantriidae: *Hemerocampa pseudotsugata*, *Orgyia pseudotsugata*; Tortricidae: *Cydia pomonella*, *Epinotia kasloana*.

***Trichogramma chilonis* Ishii**

Host: Arctiidae: *Amsacta moorei*, *Spilarctia obliqua*, *Spilosoma obliqua*, Blastobasidae: *Pseudohypatopa pulverea*; Cossidae: *Phragmataecia gummata*; Danaidae: *Anosia chrysippus*; Eupterotidae: *Apha aequalis*; Gelechiidae: *Pectinophora gossypiella*, *Phthorimaea operculella*, *Sitotroga cerealella*; Geometridae: *Boarmia variegata*; Hesperidae: *Parnara guttata*, *Pelopidas mathias*; Hyblaeidae: *Hyblaea puera*; Lasiocampidae: *Dendrolimus punctatus*, Lycaenidae: *Deudorix epijarbas*, *Deudorix isocrates*, *Virachola livia*; Lymantriidae: *Euproctis similis*, *Ivela*

*auripes*; Noctuidae: *Achaea janata*, *Anomis flava*, *Asota ficus*, *Autographa nigrisigna*, *Busseola fusca*, *Chrysodeixis chalcites*, *Earias insulana*, *Earias vittella*, *Eublemma amabilis*, *Helicoverpa armigera*, *Helicoverpa assulta*, *Heliothis armigera*, *Heliothis assulta*, *Heliothis virescens*, *Heliothis zea*, *Mamestra brassicae*, *Naranga aenescens*, *Plusia nigrisigna*, *Plusia orichalcea*, *Rivula atimeta*, *Sesamia inferens*, *Spodoptera exigua*, *Spodoptera litura*, *Tiracola plagiata*, *Trichoplusia ni*; Notodontidae: *Clostera cupreata*; Nymphalidae: *Ergolis merione*, *Hypolimnas anomala*, *Hypolimnas anomala*, *Hypolimnas bolina*, *Melanitis leda*; Oecophoridae: *Opisina arenosella*; Papilionidae: *Papilio demoleus*, *Papilio machaon*, *Papilio polytes*, *Papilio protenor*, *Papilio xuthus*; Pieridae: *Catopsilia pyranthe*, *Pieris brassicae*, *Pieris rapae*; Pyralidae: *Acigona steniellus*, *Bissetia steniella*, *Chilo auricilius*, *Chilo indicus*, *Chilo infuscatellus*, *Chilo partellus*, *Chilo sacchariphagus*, *Chilo simplex*, *Chilo suppressalis*, *Chilo venosatus*, *Chilotraea infuscatella*, *Cnaphalocrocis medinalis*, *Corcyra cephalonica*, *Crocidolomia binotalis*, *Diaphania indica*, *Diatraea saccharalis*, *Emmalocera depressella*, *Eoreuma loftini*, *Ephestia cautella*, *Ephestia kuehniella*, *Hedylepta indicata*, *Hymenia recurvalis*, *Lamprosema indicata*, *Leucinodes orbonalis*, *Marasmia exigua*, *Marasmia patnalis*, *Noorda albizonalis*, *Nymphula depunctalis*, *Ostrinia furnacalis*, *Ostrinia nubilalis*, *Proceras venosatus*, *Raphimetopus ablutellus*, *Schoenobius incertulas*, *Scirpophaga excerptalis*, *Scirpophaga incertulas*, *Scirpophaga intacta*, *Scirpophaga nivella*, *Susuma exigua*, *Tryporyza incertulas*, *Tryporyza nivella*; Saturniidae: *Antheraea pernyi*, *Antheraea yamamai*, *Dictyoploca japonica*, *Philosamia cynthia*, *Philosamia ricini*, *Samia cynthia*; Sphingidae: *Acherontia styx*, *Agrius convolvuli*, *Cephonodes hylas*, *Clanis bilineata*, *Theretra silhetensis*; Tortricidae: *Adoxophyes orana*, *Argyroploce schistaceana*, *Bactra truculenta*, *Cydia pomonella*, *Eucosma schistaceana*, *Homona coffearia*, *Laspeyresia koenigana*, *Leguminivora glycinivorella*, *Pandemis heparana*, *Peronea crocepepla*, *Tetramoera schistaceana*; Yponomeutidae: *Plutella xylostella*.

### ***Trichogramma chilotraeae* Nagaraja & Nagarkatti**

Host: Cossidae: *Phragmataecia gummata*, Hesperidae: *Pelopidas mathias*, Lycaenidae: *Deudorix isocrates*, Noctuidae: *Helicoverpa armigera*, *Heliothis armigera*, *Heliothis peltigera*, *Mamestra brassicae*, *Naranga aenescens*, *Rivula atimeta*, *Sesamia inferens*, *Trichoplusia ni*; Pyralidae: *Chilo infuscatellus*, *Chilo partellus*, *Chilo sacchariphagus*, *Chilo suppressalis*, *Chilo tumidicostalis*, *Chilotraea infuscatella*, *Cnaphalocrocis medinalis*, *Corcyra cephalonica*, *Loxostege sticticalis*, *Marasmia patnalis*, *Noorda albizonalis*, *Ostrinia furnacalis*, *Scirpophaga incertulas*, *Susuma exigua*, *Susumia exigua*, *Tryporyza incertulas*; Sphingidae: *Agrius convolvuli*; Tortricidae: *Tetramoera schistaceana*.

### ***Trichogramma convolvuli* Nagaraja**

Host: Pyralidae: *Corcyra cephalonica*; Sphingidae: *Agrius convolvuli*.

### ***Trichogramma cuttackensis* Nagaraja**

Host: Lymantriidae: *Psalis* sp.

***Trichogramma danausicida* Nagaraja**

Host: Danaidae: *Danaus chrysippus*; Pyralidae: *Corcyra cephalonica*.

***Trichogramma dendrolimi* Matsumura**

Host: Arctiidae: *Hyphantria cunea*, Gelechiidae: *Sitotroga cerealella*; Geometridae: *Buzura suppressaria*; Hesperiiidae: *Parnara guttata*; Hyblaeidae: *Hyblaea puera*; Lasiocampidae: *Dendrolimus albolineatus*, *Dendrolimus latipennis*, *Dendrolimus pini*, *Dendrolimus punctatus*, *Dendrolimus sibiricus*, *Dendrolimus spectabilis*, *Dendrolimus superans*, *Lebeda nobilis*, *Malacosoma neustria*; Limacodidae: *Cnidocampa flavescens*, *Monema flavescens*, *Scopelodes contractus*; Lymantriidae: *Dasychira abietis*, *Euproctis chrysorrhoea*, *Euproctis pseudoconspersa*, *Lymantria dispar*, *Orgyia antiqua*; Noctuidae: *Agrotis exclamationis*, *Agrotis ipsilon*, *Agrotis segetum*, *Agrotis ypsilon*, *Anomis flava*, *Asota ficus*, *Autographa gamma*, *Barathra brassicae*, *Cocytodes coerulea*, *Discestra trifolii*, *Helicoverpa armigera*, *Helicoverpa assulta*, *Heliothis armigera*, *Heliothis virescens*, *Leucania unipuncta*, *Mamestra brassicae*, *Mamestra trifolii*, *Mythimna separata*, *Phytometra aganata*, *Plusiodonta coelonota*, *Spodoptera litura*; Notodontidae: *Clostera anastomosis*, *Fentonia ocypete*, *Lampronadata cristata*, *Micromelalopha troglodyta*, *Phalera assimilis*; Nymphalidae: *Inachis io*; Oecophoridae: *Opisina arenosella*; Papilionidae: *Papilio protenor*, *Papilio xuthus*; Pieridae: *Pieris brassicae*, *Pieris rapae*; Pyralidae: *Algedonia coclesalis*, *Anagasta kuehniella*, *Chilo partellus*, *Chilo sacchariphagus*, *Chilo suppressalis*, *Cnaphalocrocis medinalis* *Corcyra cephalonica*, *Ephestia cautella*, *Ephestia kuehniella*, *Galleria mellonella*, *Loxostege sticticalis*, *Notarcha derogata*, *Ostrinia furnacalis*, *Ostrinia nubilalis*; Saturniidae: *Actias artemis*, *Actias selene* *Antheraea pernyi*, *Caligula japonica*, *Dictyoploca japonica*, *Eriogyna pyretorum*, *Philosamia cynthia*, *Philosamia ricini*; Sphingidae: *Clanis bilineata*; Tortricidae: *Adoxophyes orana*, *Adoxophyes privatana*, *Archips rosanus*, *Cacoecia crataeganus*, *Cacoecimorpha pronubana*, *Capua reticulana*, *Carpocapsa pomonella*, *Cydia funebrana*, *Cydia pomonella*, *Epichoristodes acerbella*, *Eupoecilia ambiguella*, *Grapholitha funebrana*, *Grapholitha molesta*, *Homona coffearia*, *Homona magnanima*, *Laspeyresia pomonella*, *Laspeyresia strobilella*, *Leguminivora glycinivorella*, *Lobesia botrana*, *Pandemis heparana*, *Rhyacionia buoliana*, *Spilonota lechriaspis*, *Tetramoera schistaceana*; Yponomeutidae: *Acrolepiopsis assectella*, *Plutella xylostella*, *Prays oleae*.

***Trichogramma embryophagum* (Hartig)**

Host: Gelechiidae: *Pectinophora gossypiella*, *Sitotroga cerealella*; Geometridae: *Bupalus piniarius*, *Ellopija prospiaria*, *Gonodontis bidentata*, *Semiothisa liturata*, *Thera firmata*, *Thera obeliscata*; Hyblaeidae: *Hyblaea puera*; Lasiocampidae: *Dendrolimus pini*, *Gastropacha quercifolia*, *Malacosoma neustria*, *Selenephera lunigera*; Lymantriidae: *Dasychira pudibunda*, *Euproctis similis*, *Leucoma salicis*, *Orgyia antiqua*; Noctuidae: *Acronicta tridens*, *Agrotis segetum*, *Cirrhia togata*, *Heliothis zea*, *Lithophane ornitopus*, *Mamestra brassicae*, *Panolis flammea*, *Sarrothripus asiatica*, *Sesamia cretica*, *Sesamia*



*nonagrioides*; Notodontidae: *Clostera anachoreta*, *Clostera anastomosis*, *Thaumetopoea pityocampa*, *Thaumetopoea wilkinsoni*, *Traumatocampa pityocampa*; Oecophoridae: *Opisina arenosella*; Pieridae: *Pieris brassicae*, *Pieris rapae*; Pyralidae: *Anagasta kuehniella*, *Corcyra cephalonica*, *Ectomyelois ceratoniae*, *Ephestia elutella*, *Ephestia kuehniella*, *Ostrinia furnacalis*, *Ostrinia nubilalis*, *Pyrausta nubilalis*, *Spectrobates ceratoniae*; Saturniidae: *Antheraea pernyi*; Sphingidae: *Macroglossum stellatarum*; Tortricidae: *Adoxophyes orana*, *Adoxophyes reticulana*, *Ancylis achatana*, *Archips rosanus*, *Argyroplote nubiferana*, *Carpocapsa pomonella*, *Clysia ambiguella*, *Cydia pomonella*, *Eupoecilia ambiguella*, *Grapholitha funebrana*, *Grapholitha molesta*, *Grapholitha prunifoliae*, *Hedya nubiferana*, *Laspeyresia pomonella*, *Lobesia botrana*, *Pandemis heparana*, *Pandemis ribeana*, *Ptycholoma lecheana*, *Rhyacionia buoliana*, *Spilonota ocellana*, *Tmetocera ocellana*, *Tortrix viridana*, *Zeiraphera diniana*, *Zeiraphera griseana*.

### ***Trichogramma evanescens* Westwood**

Host: Arctiidae: *Arctia caja*, *Diacrisia obliqua*, *Hyphantria cunea*; Bombycidae: *Rondotia menciana*; Danaidae: *Danaus chrysippus*; Gelechiidae: *Pectinophora gossypiella*, *Phthorimaea operculella*, *Sitotroga cerealella*; Geometridae: *Boarmia grisescens*, *Bupalus piniarius*, *Cidaria bilineata*, *Cidaria didymata*, *Crocallis elinguaris*, *Erannis defoliaria*, *Lambdina fiscellaria*, *Operophtera brumata*; Glyphipterygidae: *Anthophila atrilineata*; Lasiocampidae: *Cosmotriche potatoaria*, *Dendrolimus pini*, *Dendrolimus punctatus*, *Dendrolimus segregatus*, *Dendrolimus spectabilis*, *Malacosoma disstria*, *Malacosoma neustria*; Leptidae: *Atherix* sp.; Lycaenidae: *Thecla betulae*, *Virachola livia*; Lymantriidae: *Arctornis chrysorrhoea*, *Euproctis lunata*, *Euproctis phaeorrhoea*, *Laelia salicis*, *Lymantria dispar*, *Lymantria monacha*, *Notolophus antiquus*, *Nygmia phaeorrhoea*, *Orgyia antiqua*, *Orgyia gonostigma*, *Porthetria dispar*, *Stilpnotia salicis*; Noctuidae: *Acontia luctuosa*, *Acronicta aceris*, *Acronicta major*, *Acronicta rumicis*, *Acronicta tridens*, *Agrotis exclamationis*, *Agrotis ipsilon*, *Agrotis segetum*, *Amathes c-nigrum*, *Antitype flavicincta*, *Apopestes spectrum*, *Autographa gamma*, *Barathra brassicae*, *Catocala elocata*, *Chrysodeixis chalcites*, *Cirrhia gilvago*, *Discestra trifolii*, *Earias cupreoviridis*, *Earias fabia*, *Earias insulana*, *Euxoa obelisca*, *Euxoa segetum*, *Gonospileia glyphica*, *Helicoverpa armigera*, *Heliothis armigera*, *Heliothis virescens*, *Heliothis zea*, *Mamestra brassicae*, *Mamestra oleracea*, *Mamestra trifolii*, *Naranga aenescens*, *Oria musculosa*, *Panolis flammea*, *Parallelia algira*, *Phalaena typica*, *Phlogophora meticulosa*, *Phytometra gamma*, *Plusia gamma*, *Polia oleracea*, *Polia pisi*, *Polia suasa*, *Prodenia litura*, *Pyrrhia umbra*, *Rivula atimeta*, *Sarrothripus musculana*, *Scotia ipsilon*, *Sesamia cretica*, *Sesamia nonagrioides*, *Spaelotis pronubana*, *Spodoptera littoralis*, *Spodoptera litura*, *Tholera popularis*, *Trachea triplicis*, *Trichoplusia ni*, *Triphaena pronuba*; Notodontidae: *Lampronadata cristata*, *Phalera bucephala*, *Phalera bucephaloides*, *Thaumetopoea pityocampa*; Nymphalidae: *Nymphalis polychloros*; Oecophoridae:

*Depressaria nervosa*, *Endrosis lactella*, *Opisina arenosella*; Papilionidae: *Iphiclides podalirius*, *Papilio polytes*; Pieridae: *Aporia crataegi*, *Artogeia rapae*, *Leptidea sinapis*, *Pieris brassicae*, *Pieris daplidice*, *Pieris napi*, *Pieris rapae*; Pyralidae: *Achroia grisella*, *Anagasta kuehniella*, *Cadra cautella*, *Chilo agamemnon*, *Chilo indicus*, *Chilo infuscatellus*, *Chilo partellus*, *Chilo sacchariphagus*, *Chilo simplex*, *Chilo suppressalis*, *Cnaphalocrocis medinalis*, *Corcyra cephalonica*, *Crambus geniculeus*, *Ectomyelois ceratoniae*, *Ephestia calidella*, *Ephestia cautella*, *Ephestia elutella*, *Ephestia kuehniella*, *Etiella zinckenella*, *Evergestis forficalis*, *Galleria mellonella*, *Glyphodes pyloalis*, *Hymenia recurvalis*, *Loxostege sticticalis*, *Marasmia patnalis*, *Maruca vitrata*, *Ostrinia furnacalis*, *Ostrinia nubilalis*, *Palpita unionalis*, *Phlyctaenia forficalis*, *Plodia interpunctella*, *Pyrausta machaeralis*, *Pyrausta nubilalis*, *Salebria semirubella*, *Spectrobates ceratoniae*, *Susumia exigua*; Saturniidae: *Attacus cynthia*, *Attacus ricini*, *Philosamia cynthia*; Sphingidae: *Celerio lineata*, *Manduca sexta*, *Smerinthus populi*, *Sphinx pinastri*; Tortricidae: *Adoxophyes orana*, *Adoxophyes reticulana*, *Archips crataeganus*, *Archips pronubana*, *Archips rosanus*, *Cacoecia rosanus*, *Cacoecimorpha pronubana*, *Carpocapsa pomonella*, *Choristoneura fumiferana*, *Clysia ambiguella*, *Cnephasia longana*, *Cnephasia pumicana*, *Cydia funebrana*, *Cydia pomonella*, *Epinotia pygmaeana*, *Epinotia tedella*, *Eupoecilia ambiguella*, *Grapholitha delineana*, *Grapholitha funebrana*, *Grapholitha molesta*, *Gypsonoma aceriana*, *Homona coffearia*, *Laspeyresia microgrammana*, *Laspeyresia molesta*, *Laspeyresia nigricana*, *Laspeyresia pomonella*, *Lobesia botrana*, *Pandemis chondrillana*, *Pandemis heparana*, *Petrova resinella*, *Polychrosis botrana*, *Rhopobota naevana*, *Rhyacionia buoliana*, *Sparganothis pilleriana*, *Tetramoera schistaceana*, *Zeiraphera diniana*; Yponomeutidae: *Acrolepiopsis assectella*, *Argyresthia conjugella*, *Plutella maculipennis*, *Plutella xylostella*, *Prays citri*, *Prays oleae*; Zygaenidae: *Theresimima ampelophaga*.

### ***Trichogramma exiguum* Pinto & Platner**

Host: Gelechiidae: *Scrobipalpula absoluta*, *Sitotroga cerealella*, *Tuta absoluta*, Lycaenidae: *Deudorix epijarbas*, *Strymon melinus*; Lymantriidae: *Euproctis lunata*; Noctuidae: *Celama sorghiella*, *Helicoverpa zea*, *Heliothis armigera*, *Heliothis virescens*, *Heliothis zea*, *Mamestra brassicae*, *Pseudoplusia includens*, *Sacadodes pyralis*, *Spodoptera frugiperda*, *Trichoplusia ni*; Notodontidae: *Clostera cupreata*; Nymphalidae: *Agraulis vanillae*, *Basilarchia archippus*, *Dione juno*, *Euptoieta claudia*; Pieridae: *Eurema daira*, *Eurema nicippe*, *Pieris rapae*; Pyralidae: *Chilo partellus*, *Corcyra cephalonica*, *Diaphania nitidalis*, *Diatraea grandiosella*, *Diatraea indigenella*, *Diatraea saccharalis*, *Eoreuma loftini*, *Ephestia cautella*, *Ephestia kuehniella*, *Neoleucinodes elegantalis*, *Ostrinia nubilalis*, *Palpita persimilis*, *Pococera atramentalis*; Sphingidae: *Erinnyis ello*, *Manduca sexta*; Tortricidae: *Argyrotaenia sphaleropa*, *Bonagota cranaodes*, *Grapholitha molesta*, *Rhyacionia frustrana*; Yponomeutidae: *Plutella xylostella*.

***Trichogramma fasciatum* (Perkins)**

Host: Gelechiidae: *Gnorimoschema absoluta*; Geometridae: *Oxydia trychiata*; Lymantriidae: *Lymantria monacha*, *Nygmia phaeorrhoea*; Noctuidae: *Alabama argillacea*, *Helicoverpa zea*, *Heliothis virescens*, *Heliothis zea*, *Mamestra brassicae*, *Sacadodes pyralis*, *Spodoptera frugiperda*; Pyralidae: *Chilo sacchariphagus*, *Corcyra cephalonica*, *Diatraea dyari*, *Diatraea saccharalis*, *Eodiatraea centrella*, *Eodiatraea rufescens*, *Hypsipyla grandella*, *Maruca testulalis*, *Mescinia peruella*, *Proceras sacchariphagus*, *Zeadiatraea lineolata*; Sphingidae: *Erinnyis ello*; Tortricidae: *Acleris gloverana*, *Carpocapsa pomonella*.

***Trichogramma flandersi* Nagaraja & Nagarkatti**

Host: Pyralidae: *Chilo infuscatellus*, *Corcyra cephalonica*; Sphingidae: *Agrius convolvuli*.

***Trichogramma hebbalensis* Nagaraja**

Host: Pyralidae: *Corcyra cephalonica*.

***Trichogramma hesperidis* Nagaraja**

Host: Hesperidae: *Pelopidas mathias*; Pyralidae: *Corcyra cephalonica*.

***Trichogramma japonicum* Ashmead**

Host: Arctiidae: *Cretonotos gangis*; Cossidae: *Phragmataecia gummata*; Gelechiidae: *Brachmia modicella*, *Sitotroga cerealella*; Geometridae: *Boarmia variegata*; Hesperidae: *Parnara guttata*, *Parnara mathias*, *Parnara pellucida*, *Pelopidas mathias*; Noctuidae: *Achaea janata*, *Anomis flava*, *Chrysodeixis eriosoma*, *Helicoverpa armigera*, *Heliothis armigera*, *Leucania unipuncta*, *Naranga aenescens*, *Sesamia inferens*, *Trichoplusia ni*; Notodontidae: *Clostera cupreata*; Oecophoridae: *Opisina arenosella*; Pieridae: *Eurema* sp.; Pyralidae: *Achroia grisella*, *Ancylolomia chrysographella*, *Chilo auricilius*, *Chilo infuscatellus*, *Chilo partellus*, *Chilo polychrysus*, *Chilo sacchariphagus*, *Chilo simplex*, *Chilo suppressalis*, *Cnaphalocrocis medinalis*, *Corcyra cephalonica*, *Diatraea saccharalis*, *Ephestia cautella*, *Galleria mellonella*, *Leucinodes orbonalis*, *Marasmia exigua*, *Marasmia patnalis*, *Ostrinia nubilalis*, *Proceras indicus*, *Pyralis farinalis*, *Raphimetopus ablutellus*, *Schoenobius bipunctifer*, *Schoenobius incertulas*, *Scirpophaga excerptalis*, *Scirpophaga incertulas*, *Scirpophaga innotata*, *Scirpophaga nivella*, *Susumia exigua*, *Tryporyza incertulas*, *Tryporyza innotata*, *Tryporyza nivella*; Saturniidae: *Philosamia cynthia*, *Samia cynthia*; Tortricidae: *Laspeyresia koenigana*, *Tetramoera schistaceana*; Yponomeutidae: *Plutella xylostella*.

***Trichogramma kankerensis* Yousuf & Hassan**

Host Pyralidae: *Corcyra cephalonica*.

***Trichogramma manii* Nagaraja & Gupta**

Host: Lycaenidae: *Deudorix isocrates*.

**Trichogramma minutum** Riley

Host: Arctiidae: *Cisthene nexa*, *Diacrisia obliqua*, *Estigmene acraea*, *Hyphantria cunea*, *Hyphantria textor*, *Utetheisa ornatrix*; Blastobasidae: *Holcocera pulverea*; Coleophoridae: *Coleophora fuscedinella*, *Coleophora malivorella*, *Coleophora pruniella*, *Coleophora serratella*; Danaidae: *Danaus limniace*, *Danaus menippe*, *Danaus plexippus*; Gelechiidae: *Gnorimoschema absoluta*, *Gnorimoschema operculella*, *Pectinophora gossypiella*, *Phthorimaea heliopa*, *Phthorimaea operculella*, *Platyedra gossypiella*, *Sitotroga cerealella*; Geometridae: *Alsophila pometaria*, *Ennomos subsignarius*, *Epirranthis hemipteraria*, *Lambdina fiscellaria*, *Operophtera bruceata*, *Operophtera brumata*, *Sabulodes caberata*; Gracillariidae: *Porphyrosela minuta*; Hesperiiidae: *Calpodes ethlius*, *Erynnis lucilius*, *Erynnis lucillius*, *Nyctelius nyctelius*, *Panoquina ethlius*, *Panoquina nero*, *Panoquina nyctelius*, *Panoquina sylvicola*, *Urbanus proteus*; Hyblaeidae: *Hyblaea puera*; Lasiocampidae: *Malacosoma americanum*, *Malacosoma disstria*, *Malacosoma pluviale*; Limacodidae: *Cnidocampa flavescens*; Lycaenidae: *Celastrina argiolus*, *Deudorix epijarbas*, *Hemiargus banno*, *Lampides boeticus*, *Lycaena icarioides*, *Plebejus icarioides*, *Tarucus theophrastus*; Lymantriidae: *Hemerocampa pseudotsugata*, *Leucoma salicis*, *Lymantria monacha*, *Nygmia phaeorrhoea*, *Olene pinicola*, *Orgyia detrita*, *Orgyia leucostigma*, *Orgyia pseudotsugata*, *Parorgyia plagiata*, *Porthetria dispar*, *Stilpnotia salicis*; Noctuidae: *Achaea janata*, *Actebia fennica*, *Agrotis ipsilon*, *Alabama argillacea*, *Anomis erosa*, *Anomis texana*, *Anticarsia gemmatalis*, *Autographa brassicae*, *Barathra brassicae*, *Brithys crini*, *Caenurgina erechtea*, *Celama sorghiella*, *Ceramica picta*, *Cirphis latiuscula*, *Copitarsia turbata*, *Cosmophila erosa*, *Earias chromateria*, *Earias cupreoviridis*, *Earias fabia*, *Earias insulana*, *Elydna nonagricola*, *Eublemma amabilis*, *Feltia annexa*, *Feltia experta*, *Gonodonta nutrix*, *Helicoverpa zea*, *Heliothis armigera*, *Heliothis virescens*, *Heliothis zea*, *Laphygma exigua*, *Laphygma frugiperda*, *Leucania latiuscula*, *Lithophane bethunei*, *Mamestra brassicae*, *Mocis undata*, *Panolis flammea*, *Peridroma margaritosa*, *Peridroma saucia*, *Plathypena scabra*, *Platyhypena scabra*, *Plecoptera reflexa*, *Plusia ni*, *Plusia nu*, *Prodenia litura*, *Pseudaletia unipuncta*, *Rachiplusia nu*, *Sesamia calamistis*, *Sesamia inferens*, *Spodoptera exigua*, *Spodoptera frugiperda*, *Spodoptera latifascia*, *Spodoptera mauritia*, *Syngrapha circumflexa*, *Tiracola plagiata*, *Trichoplusia ni*, *Xylomyges curialis*; Notodontidae: *Datana integerrima*, *Dicentria lignicolor*, *Heterocampa guttivitta*, *Oligocentria lignicolor*; Nymphalidae: *Agraulis vanillae*, *Basilarchia archippus*, *Dione vanillae*, *Limenitis archippus*, *Nymphalis milberti*, *Oeneis macounii*, *Polygonia interrogationis*, *Vanessa atalanta*, *Vanessa cardui*, *Vanessa tammeamea*; Oecophoridae: *Nephantis serinopa*; Papilionidae: *Papilio glaucus*, *Papilio polytes*; Pieridae: *Catopsilia crocale*, *Colias eurytheme*, *Colias philodice*, *Pieris brassicae*, *Pieris rapae*; Psychidae: *Thyridopteryx ephemeraeformis*; Pterophoridae: *Platyptilia carduidactyla*; Pyralidae: *Acrobasis caryae*, *Acrobasis juglandis*, *Acrobasis vaccinii*, *Argyria sticticraspis*, *Bissetia steniella*, *Cactoblastis cactorum*, *Cadra cautella*, *Chilo auricilius*, *Chilo comptulatalis*, *Chilo*

*forbesellus*, *Chilo indicus*, *Chilo infuscatellus*, *Chilo loftini*, *Chilo partellus*, *Chilo plejadellus*, *Chilo simplex*, *Chilo suppressalis*, *Chilo venosatus*, *Chilo zonellus*, *Chilotraea auricilia*, *Corcyra cephalonica*, *Diatraea busckella*, *Diatraea canella*, *Diatraea crambidoides*, *Diatraea dyari*, *Diatraea flavipenella*, *Diatraea grandiosella*, *Diatraea impersonatella*, *Diatraea lineolata*, *Diatraea pedibarbata*, *Diatraea rosa*, *Diatraea saccharalis*, *Diatraea sticticraspis*, *Dioryctria zimmermanni*, *Doratoperas atroparsellus*, *Emmalocera depressella*, *Eodiatraea centrella*, *Eodiatraea rufescens*, *Eoreuma loftini*, *Ephestia cautella*, *Ephestia kuehniella*, *Etiella zinckenella*, *Galleria mellonella*, *Hedylepta indicata*, *Hellula undalis*, *Herpetogramma perusialis*, *Hymenia perspectalis*, *Hymenia recurvalis*, *Hypsipyla robusta*, *Leucinodes elegantalis*, *Loxostege similalis*, *Loxostege sticticalis*, *Margaronia quadristigmalis*, *Megastes grandalis*, *Mescinia peruella*, *Mineola vaccinii*, *Neoleucinodes elegantalis*, *Occidentalia comptulatalis*, *Omiodes accepta*, *Omiodes blackburni*, *Omiodes swezeyi*, *Ostrinia nubilalis*, *Pachyzancla bipunctalis*, *Phlyctaenia coronata*, *Phlyctaenia rubigalis*, *Plodia interpunctella*, *Proceras sacchariphagus*, *Proceras venosatus*, *Psara bipunctalis*, *Pyrausta ainsliei*, *Pyrausta nubilalis*, *Pyrausta penitalis*, *Schoenobius bipunctifer*, *Schoenobius incertulas*, *Schoenobius melinellus*, *Tryporyza incertulas*, *Udea rubigalis*, *Zeadiatraea grandiosella*, *Zeadiatraea lineolata*; Saturniidae: *Anisota rubicunda*, *Anisota senatoria*, *Coloradia pandora*, *Dryocampa rubicunda*; Sesiidae: *Sanninoidea exitiosa*; Sphingidae: *Ceratomia catalpae*, *Ceratomia catalpe*, *Erinnyis ello*, *Herse convolvuli*, *Manduca sexta*, *Phlegethontius quinquemaculatus*, *Phlegethontius sextus*, *Protoparce sexta*; Syntomidae: *Ceramidia butleri*; Tortricidae: *Acleris gloverana*, *Acleris variana*, *Argyrotaenia velutinana*, *Amelia ivana*, *Amorbia emigratella*, *Amorbia essigana*, *Ancylis comptana*, *Archips argyrospilus*, *Archips excessana*, *Archips fumiferana*, *Archips piceana*, *Archips postvittana*, *Archips rosaceana*, *Argyrotaenia citrana*, *Argyrotaenia ivana*, *Argyrotaenia mariana*, *Argyrotaenia sphaleropa*, *Argyrotaenia velutinana*, *Bactra lancealana*, *Bactra truculenta*, *Barbara colfaxiana*, *Carpocapsa pomonella*, *Choristoneura fumiferana*, *Choristoneura occidentalis*, *Choristoneura parallela*, *Choristoneura pinus*, *Choristoneura rosaceana*, *Choristoneura fumiferana*, *Ctenopseustis obliquana*, *Cydia molesta*, *Cydia pomonella*, *Endopiza viteana*, *Epinotia aceriella*, *Eulia loxonephes*, *Grapholitha molesta*, *Gretchena bolliana*, *Homona coffearia*, *Homona phanaea*, *Laspeyresia caryana*, *Laspeyresia nigricana*, *Laspeyresia pomonella*, *Melissopus latiferreanus*, *Platynota rostrana*, *Polychrosis botrana*, *Polychrosis viteana*, *Rhopobota naevana*, *Rhyacionia adana*, *Rhyacionia buoliana*, *Rhyacionia frustrana*, *Sparganothis sulfureana*, *Sphaeroeca ocellana*, *Spilonota ocellana*, *Zeiraphera canadensis*, *Zeiraphera fortunana*, *Zeiraphera ratzeburgiana*; Yponomeutidae: *Plutella maculipennis*, *Plutella xylostella*, *Prays oleae*.

### ***Trichogramma pallidiventris* Nagaraja**

Host: Pyralidae: *Corcyra cephalonica*, *Scirpophaga incertulas*, *Tryporyza incertulas*.

***Trichogramma perkinsi* Girault**

Host: Arctiidae: *Diacrisia obliqua*, Gelechiidae: *Sitotroga cerealella*; Lycaenidae: *Deudorix epijarbas*; Lymantriidae: *Euproctis fraterna*; Noctuidae: *Achaea janata*, *Helicoverpa zea*, *Heliothis armigera*, *Heliothis virescens*, *Spodoptera litura*; Notodontidae: *Clostera cupreata*; Nymphalidae: *Vanessa tammeamea*; Pterophoridae: *Exelastis atomosa*; Pyralidae: *Chilo partellus*, *Corcyra cephalonica*, *Diatraea saccharalis*, *Omiodes accepta*, *Omiodes blackburni*, *Omiodes swezeyi*; Tortricidae: *Amorbia emigratella*, *Archips postvittana*, *Argyrotaenia sphaleropa*, *Bactra straminea*.

***Trichogramma pintoii* Voegelé**

Host: Gelechiidae: *Sitotroga cerealella*; Lycaenidae: *Icaricia acmon*, *Lycaeides melissa*; Lymantriidae: *Leucoma salicis*; Noctuidae: *Actebia fennica*, *Agrotis segetum*, *Barathra brassicae*, *Helicoverpa armigera*, *Helicoverpa zea*, *Heliothis armigera*; Nymphalidae: *Vanessa* sp.; Pterophoridae: *Platyptilia carduidactyla*; Pyralidae: *Corcyra cephalonica*, *Ephestia kuehniella*, *Ostrinia nubilalis*; Saturniidae: *Antheraea pernyi*, *Philosamia cynthia*; Tortricidae: *Carpocapsa pomonella*, *Cydia nigricana*, *Cydia pomonella*; Yponomeutidae: *Plutella xylostella*.

***Trichogramma plasseyense* Nagaraja**

Host: Noctuidae: *Helicoverpa armigera*; Pyralidae: *Chilo auricilius*, *Chilo infuscatellus*, *Chilo tumidicostalis*, *Corcyra cephalonica*, *Ostrinia furnacalis*.

***Trichogramma poliae* Nagaraja**

Host: Lepidoptera indet. *Lepidoptera* unspecified sp.; Notodontidae: *Clostera cupreata*; Pyralidae: *Chilo auricilius*, *Chilo infuscatellus*, *Chilo tumidicostalis*, *Corcyra cephalonica*; Yponomeutidae: *Plutella xylostella*.

***Trichogramma pretiosum* Riley**

Host: Arctiidae: *Estigmene acraea*, Blastobasidae: *Pseudohypatopa pulverea*; Danaidae: *Danaus plexippus*; Gelechiidae: *Dichomeris famulata*, *Keiferia lycopersicella*, *Pectinophora gossypiella*, *Phthorimaea operculella*, *Scrobipalpula absoluta*, *Scrobipalpuloides absoluta*, *Sitotroga cerealella*, *Tuta absoluta*; Geometridae: *Alsophila pometaria*, *Oxydia vesulia*, *Pleuroprucha asthenaria*; Hesperidae: *Calpodes ethlius*, *Lerodea eufala*, *Pholisora catullus*; Lycaenidae: *Brephidium exilis*, *Incisalia irus*, *Philotes sonorensis*, *Strymon melinus*; Lymantriidae: *Laelia salicis*; Noctuidae: *Agrotis ipsilon*, *Alabama argillacea*, *Anicla butleri*, *Anticarsia gemmatalis*, *Celama sorghiella*, *Earias insulana*, *Earias vittella*, *Eublemma amabilis*, *Helicoverpa armigera*, *Helicoverpa zea*, *Heliothis armigera*, *Heliothis pretiosum*, *Heliothis virescens*, *Heliothis zea*, *Hypocala andremona*, *Mamestra brassicae*, *Mocis latipes*, *Mythimna sequax*, *Plathypena scabra*, *Pseudaletia sequax*, *Pseudoplusia includens*, *Spodoptera exigua*, *Spodoptera frugiperda*, *Spodoptera litura*, *Trichoplusia ni*; Notodontidae: *Clostera cupreata*, *Datana integerrima*; Nymphalidae: *Agraulis vanillae*, *Dione juno*, *Euptoieta*

*claudia*, *Hamadryas feronia*; Oecophoridae: *Opisina arenosella*, *Stenoma catenifer*; Papilionidae: *Heraclides thoas*, *Papilio cresphontes*, *Papilio palamedes*; Pieridae: *Eurema दौरा*, *Pieris rapae*; Pyralidae: *Acrobasis vaccinii*, *Amyelois transitella*, *Anagasta kuehniella*, *Cactoblastis cactorum*, *Cadra cautella*, *Chilo sacchariphagus*, *Corcyra cephalonica*, *Diaphania hyalinata*, *Diaphania nitidalis*, *Diatraea busckella*, *Diatraea canella*, *Diatraea grandiosella*, *Diatraea impersonatella*, *Diatraea indigenella*, *Diatraea lineolata*, *Diatraea muellerella*, *Diatraea rosa*, *Diatraea rufescens*, *Diatraea saccharalis*, *Eldana saccharina*, *Eoreuma loftini*, *Ephestia cautella*, *Ephestia kuehniella*, *Galleria mellonella*, *Hypsipyla grandella*, *Neoleucinodes elegantalis*, *Ostrini nubilalis*, *Plodia interpunctella*; Sphingidae: *Erinnyis ello*, *Hyles lineata*, *Manduca sexta*; Syntomidae: *Ceramidia butleri*; Tortricidae: *Argyrotaenia sphaleropa*, *Argyrotaenia velutinana*, *Bactra verutana*, *Bonagota cranaodes*, *Carpocapsa pomonella*, *Choristoneura rosaceana*, *Cydia caryana*, *Cydia pomonella*, *Ecdytolopha aurantianum*, *Endopisa viteana*, *Epinotia aporema*, *Grapholitha molesta*, *Rhopobota naevana*, *Rhyacionia frustrana*, *Tetramoera schistaceana*, *Tortrix capensana*; Yponomeutidae: *Plutella xylostella*, *Prays oleae*.

### ***Trichogramma raoi* Nagaraja**

Host: Geometridae: *Boarmia variegata*; Noctuidae: *Achaea janata*; Pieridae: *Eurema* sp., Pyralidae: *Corcyra cephalonica*; Tortricidae: *Laspeyresia koenigana*.

### ***Trichogramma sankarani* Nagaraja**

Host: Pyralidae: *Corcyra cephalonica*; Sphingidae: *Agrius convolvuli*.

### ***Trichogramma semblidis* (Aurivillius)**

Host: Gelechiidae: *Phthorimaea operculella*, *Sitotroga cerealella*; Glyphipterygidae: *Anthophila fabriciana*; Noctuidae: *Achaea janata*, *Earias insulana*, *Heliothis armigera*, *Hypena proboscidalis*, *Mamestra brassicae*, *Mamestra oleracea*, *Trichoplusia ni*; Notodontidae: *Thaumetopoea pityocampa*; Nymphalidae: *Aglais urticae*; Pieridae: *Pieris rapae*; Pyralidae: *Chilo infuscatellus*, *Corcyra cephalonica*, *Ephestia kuehniella*, *Haritala ruralis*, *Loxostege sticticalis*, *Ostrinia nubilalis*, *Pyrausta nubilalis*; Tortricidae: *Argyroploce lacunana*, *Cacoecimorpha pronubana*, *Clysiana ambiguella*, *Cydia pomonella*, *Epichoristodes acerbella*, *Eupoecilia ambiguella*, *Lobesia botrana*, *Notocelia uddmanniana*; Yponomeutidae: *Plutella xylostella*.

### ***Trichogramma semifumatum* (Perkins)**

Host: Arctiidae: *Estigmene acraea*; Gelechiidae: *Gnorimoschema operculella*, *Sitotroga cerealella*; Geometridae: *Scotorythra* sp.; Noctuidae: *Anomis texana*, *Autographa californica*, *Helicoverpa zea*, *Heliothis virescens*, *Heliothis zea*, *Prodenia ornithogalli*, *Pseudoplusia includens*, *Rachiplusia ou*, *Spodoptera exigua*, *Trichoplusia ni*; Nymphalidae: *Vanessa cardui*, *Vanessa carye*; Pieridae: *Colias eurytheme*, *Colias vauthieri*; Pyralidae: *Cactoblastis cactorum*, *Diatraea saccharalis*, *Ephestia kuehniella*, *Herpetogramma licarsisalis*, *Hypsipyla grandella*; Sphingidae:

*Celerio calida*, *Celerio lineata*, *Erinnyis ello*, *Protoparce cingulata*, *Protoparce sexta*; Tortricidae: *Bactra straminea*, *Bactra verutana*, *Carpocapsa pomonella*, *Platynota stultana*, *Spheterista asaphopis*.

#### 4. Genus *Paratrichogramma* Girault (Family: Trichogrammatidae)

Of the 3 species reported from India, only one species is known to be an egg parasitoid of Lepidoptera.

*Paratrichogramma giraulti* Hayat & Shuja-Uddin

Host: Gracillariidae: *Acrocercops orthostacta*.

#### 5. Genus *Ooencyrtus* Ashmead (Family: Encyrtidae)

37 species are known from India, of which only 8 species are recorded as primary egg parasitoids of lepidopteran eggs. The rest are either hyperparasitoids (larval or nymphal) or egg parasitoids of other insect orders. The same species are known to parasitise the eggs of different insect orders. *O. papilionis* and *O. telenomicida* are reported from both hemipteran and lepidopteran eggs.

*Ooencyrtus* plays an important role in controlling the populations of many insect pests of agriculture and forestry. More than ten species of *Ooencyrtus* have been used in biocontrol programs (Noyes and Hayat, 1984).

*Ooencyrtus lucens* Huang & Noyes

Host: Noctuidae: *Achaea janata*.

*Ooencyrtus lucina* Huang & Noyes

Host: Notodontidae: *Clostera cupreata*.

*Ooencyrtus macula* Huang & Noyes

Host: Notodontidae: *Turnaca acuta*.

*Ooencyrtus pallidipes* (Ashmead)

Host: Hesperiiidae: *Erionota thrax*.

*Ooencyrtus papilionis* Ashmead

Host: Danaidae: *Danaus chrysippus*, *Tirumala limniace*; Hesperiiidae: *Erionota thrax*; Lycaenidae: *Deudorix isocrates*; Lymantriidae: *Aroa cometaris*; Noctuidae: *Othreis fullonia*; Nymphalidae: *Ariadne ariadne*, *Euploea core*, *Heliconius charitonius*, *Hypolimnas bolina*, *Junonia lemonias*, *Phalanta phalantha*, *Tanaecia julii*; Papilionidae: *Papilio agamemnon*, *Papilio aegaeus*, *Papilio demoleus*, *Papilio helenus*, *Papilio memnon*, *Papilio polytes*, *Papilio rumanzovia*, *Troides helena*, Pyralidae: *Chilo terenellus*; Sphingidae: *Cephonodes hylas*; Agonoxenidae: *Agonoxena argaula*; Danaidae: *Danaus chrysippus*, *Tirumala limniace*.



***Ooencyrtus plautus* Huang & Noyes**Host: Papilionidae: *Papilio demoleus*.***Ooencyrtus telenomicida* (Vassiliev)**Host: Lasiocampidae: *Taragama repanda*; Lymantriidae: *Euproctis phaeorrhoea*; Notodontidae: *Thaumatopoea pityocampa*; Papilionidae: *Iphiclides podalirius*.***Ooencyrtus utetheisae* (Risbec)**Host: Arctiidae: *Utetheisa pulchella*.**6. Genus *Anastatus* Motschulsky (Family: Eupelmidae)**

Of a total of 26 species reported from India, 6 species are known to attack the lepidopteran eggs. Some of the individual species have wide host ranges, like *A. bifasciatus* attacking the eggs of Orthoptera, Lepidoptera and Hemiptera.

***Anastatus acherontiae* Narayanan**Host: Sphingidae: *Acherontia styx*.***Anastatus bifasciatus* (Geoffrey)**

Host: Lasiocampidae: *Dendrolimus pini*, *Dendrolimus punctatus*, *Dendrolimus spectabilis*, *Dendrolimus spectabilis*, *Gastropacha quercifolia*, *Macrothylacia rubi*; Lymantriidae: *Lymantria dispar*, *Nygmia phaeorrhoea*, *Porthetria dispar*, *Stilpnotia salicis*; Notodontidae: *Thaumatopoea pityocampa*, *Thaumatopoea processionea*, *Thaumatopoea wilkinsoni*, *Traumatocampa pityocampa*; Nymphalidae: *Charaxes jasius*; Papilionidae: *Iphiclides podalirius*; Saturniidae: *Philosamia cynthia*, *Saturnia pyri*; Sphingidae: *Polyptychus dentatus*.

***Anastatus colemani* Crawford**Host: Saturniidae: *Attacus atlas*.***Anastatus japonicus* Ashmead**

Host: Lasiocampidae: *Dendrolimus sibiricus*, *Dendrolimus spectabilis*, *Malacosoma neustria*; Lymantriidae: *Lymantria dispar*, *Lymantria obfuscata*, *Nygmia phaeorrhoea*, *Porthetria dispar*; Notodontidae: *Cerura vinula*, *Dicranura vinula*; Papilionidae: *Iphiclides podalirius*; Saturniidae: *Antheraea pernyi*, *Philosamia cynthia*.

***Anastatus kashmirensis* Mathur**Host: Lymantriidae: *Lymantria dispar*, *Lymantria obfuscata*, *Porthetria dispar*.***Anastatus ramakrishnai* (Mani)**Host: Arctiidae: *Halis dentate*.

## 7. Genus *Agiommatus* Crawford (Family: Pteromalidae)

Of a total of 9 species from the world, only two species under this genus are reported from India till date and both are egg parasitoids of Lepidoptera.

### *Agiommatus paria* (Motschulsky)

Host: Sphingidae: *Acherontia styx*.

### *Agiommatus geethae* Sureshan & Narendran

Host: Noctuidae: *Spodoptera litura*.

## 8. Genus *Tetrastichus* Haliday (Family: Eulophidae)

Eighty one species are known from India, out of which only 2 species are reported from the eggs of Lepidoptera. Majority are larval or pupal parasitoids of a diverse group of insects.

*T. schoenobii* which attack the pyralid stem borer eggs behaves differently from other egg parasitoids. The developing larvae of *T. schoenobii* consume 3 eggs within an egg pod for its development (Shepherd *et al.*, 1987), thus behaving like an egg predator. A true parasitoid usually confines to a single egg for its development.

### *Tetrastichus hindicus* Özdikmen

Host: Pyralidae: *Tryporyza incertulas*.

### *Tetrastichus schoenobii* Ferriere

Host: Noctuidae: *Sesamia inferens*, *Spodoptera mauritia*; Pyralidae: *Chilo suppressalis*, *Chilo traea infuscatella*, *Schoenobius bipunctifer*, *Scirpophaga incertulas*, *Scirpophaga innotata*, *Scirpophaga intacta*, *Scirpophaga nivella*, *Scirpophaga praelata*, *Tryporyza incertulas*, *Tryporyza innotata*, *Tryporyza nivella*.

## 9. Genus *Pediobius* Walker (Family Eulophidae)

The host stage of two species under *Pediobius*, namely *P. viggiani* Khan and *P. cydiae* Khan is not clear. Khan (1996) has made only a sweeping statement that the species of the genus are egg or larval parasites of *Nymphula depunctalis* and *Cydia (Eucosma)* respectively.

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