FARMERS GUIDE ON INSECT FRIENDS

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सत्यमेव जयते

NATIONAL INSTITUTE OF PLANT HEALTH MANAGEMENT
Department of Agriculture, Cooperation & Farmers Welfare
Ministry of Agriculture & Farmers Welfare, Govt. of India
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NIPHM

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PREFACE

Agro-Ecosystem is a very complex situation where various biotic factors plays crucial role for ecological and economic sustainability. The micro and macro environment of the crop ecosystem is the key for the development / suppression of the economically important insects. NIPHM promote the ecologically sustainable methods through Agro Eco-System Analysis (AESA) and Ecological Engineering (EE) methods for crop pest management, most importantly insect pests, through creation of environment suitable for survival of beneficial insects naturally.

In view of the importance of beneficial insects in agricultural ecosystem, a compilation on "*Farmers Guide on Insect Friends*" is prepared for the benefit of extension personnel and farmers, through easy to identify pictures and brief information about each insect belong to various groups such as parasitoids, predators, pollinators, weed killers *etc*. The goal of this publication is to make farmers and farm level extension personnel to identify at field level and understand insect friends as these insects are naturally integrated into crop ecosystem providing uncountable help to ecosystem and farmers.

I sincerely compliment the efforts of scientists of Plant Health Management Division under the guidance Dr. Cherukuri Sreenivasa Rao, Director, Plant Health Management.

Ms. G. Jayalakshmi, IAS
Director General, NIPHM

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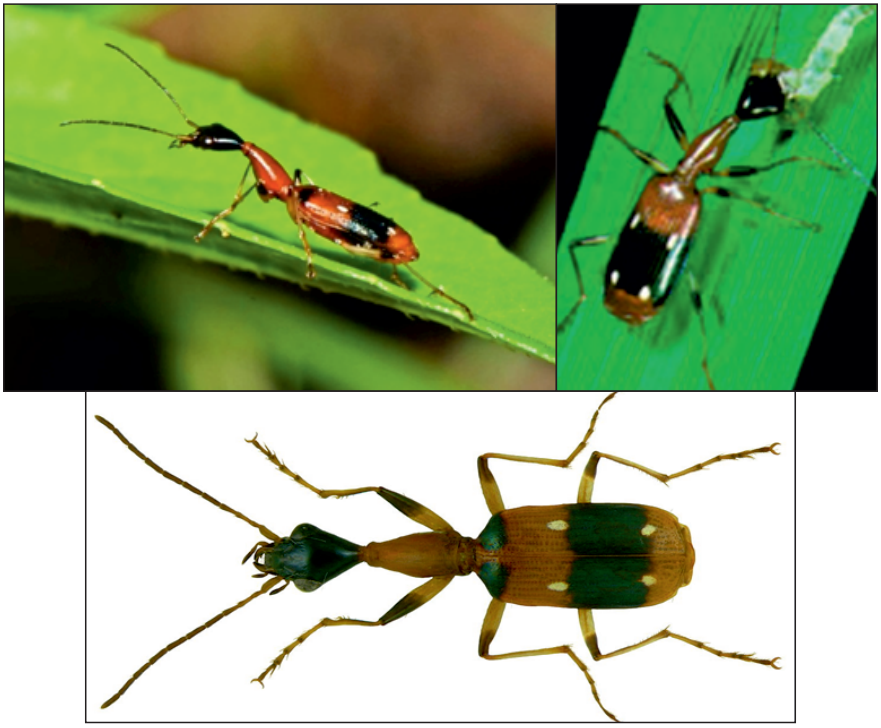
PREDATORS

Ground beetle

Order: Coleoptera
Family: Carabidae

Genus: *Ophionea*
Species: *nigrofasciata*



- Carabidae is an effective predator of rice leaf folder larvae.
- Carabid beetles play a major role in agroecosystems by contributing to the mortality of insects and slugs.
- Adults are most active at night, dark in colour, with long legs.
- They can consume up to their body weight daily.
- They eat a wide variety of pest organisms including aphids, moth larvae (such as armyworm, cutworm and gypsy moth larvae), beetle larvae (such as the corn rootworm, Colorado potato beetle and the cucumber beetle), mites and springtails.

Rove beetle

Order: Coleoptera

Family: Staphylinidae

Genus: *Paederus*

Species: *fuscipes*

- Staphylinidae is the largest family of beetles, with over 63,000 species known worldwide and probably over 75% of tropical species still undescribed.
- Staphylinidae occupy almost all moist environments throughout the world.
- Prey on small soft-bodied insects and insect eggs, larvae, and pupae.
- Adults brown or black with soft, short wing covers.
- Larvae are long and thin with a large head.
- Both adults and larvae are predatory on several crop pests throughout the world.
- Commonly found in rice, maize, and sorghum fields.

Hister beetle

Order: Coleoptera

Family: Histeridae

Genus: *Carcinops*

Species: *pumilio*

- Most active at night
- Predatory in nature
- Commonly feed on the egg, larval, and adult stages of other insects
- When disturbed, these beetles lay motionless, resembling tiny black seeds

Soldier beetle

Order: Coleoptera

Family: Cantharidae

Genus: *Chauliognathus*

Species*: marginatus*

- Cosmopolitan in distribution
- Most larvae are carnivorous, feeding on insects in the soil
- Adult insects predators feed on insect eggs, caterpillars, aphids, and other soft-bodied insects

Firefly

Order: Coleoptera

Family: Lampyridae

Genus: *Lampyris*

Species*: noctiluca*

- Female insects are larviform
- Both adults and larvae predatory in nature
- The larvae of most species feed on other larvae, terrestrial snails and slugs.

Checkered beetle

Order: Coleoptera

Family: Cleridae

Genus: *Enoclerus*

Species*: rosmarus*

- Checkered beetles are one of the most important insect predators
- Adults and larvae are predacious in nature
- Adults of some species feed on wood and bark beetles
- Many other species of Clerids predates on small beetles, wasps, aphids, true bugs and flies

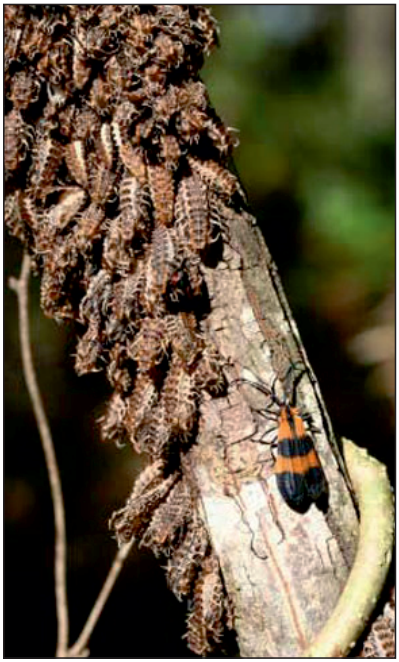
Netwinged beetle

Order: Coleoptera

Family: Lycidae

Genus: *Calopteron*

Species*: reticulatum*



- The larvae are the predators, feeding on soft-bodied insects.
- Feed on aphids, mealybugs, scales, thrips and other soft-bodied insects etc .

Click beetle

Order: Coleoptera

Family: Elateridae

Genus: *Alaus*

Species*: oculatus*

- The adults are typically nocturnal and phytophagous
- The larvae are effective predators on many wood-boring beetle larvae

Blister beetle

Order: Coleoptera

Family: Meloidae

Genus: *Epicauta*

Species*: pennsylvanica*

- Larvae are predatory in nature
- Mainly the larvae attack grasshoppers
- The newly hatched beetle larvae use their legs to seek out clusters of grasshopper eggs to feed on.

Tiger beetle

Order: Coleoptera

Genus: *Cicindela* spp.

Family: Cicindelidae

- Tiger beetles are usually diurnal
- They are well known for their aggressive predatory habits and running speed
- Both adults and larvae are predatory
- Larvae capture prey insects that wander over the ground

Gyrinid beetle

Order: Coleoptera

Family: Gyrinidae

Genus: *Dineutus*

Species*: indicus*

- Gyrinid beetles are also known as Whirligig beetles
- Theses insects are likely to be found in ponds, lakes and wetlands on water surfaces
- The adults rapidly revolve around a fixed point on the surface of the water
- Gyrinid beetles are predators, feeding on other freshwater invertebrates

Dytiscid beetle

Order: Coleoptera

Family: Dytiscidae

Genus: *Eretes*

Species*: griseus*

- Dytiscid beetles are also known as predacious diving beetles
- Voracious predator
- Found in fresh water, either still or slow-running, and seem to prefer water with vegetation
- This beetle hunts a wide variety of prey including small fish
- They are able fliers and fly usually at night

Anegleis cardoni

Order: Coleoptera

Family: Coccinellidae

Genus: *Anegleis*

Species*: cardoni*

- An attractively patterned, medium-sized ladybird beetle
- Both grub and adult stages are predator
- Widespread almost throughout India
- Feed on whiteflies and scale insects, aphids and mealybugs
- Commonly associated with infesting cabbage, cauliflower and other crucifers, brinjal, wheat, peas, tomato, sunflower, sunnhemp, sugarcane, tobacco, chaff flower, ivy gourd, *Duranta,* common jujube, chrysanthemum, neem etc.,

Axinoscymnus puttarudriahi

Order: Coleoptera

Genus: *Axinoscymnus*

Family: Coccinellidae

Species*: puttarudriahi*

- Common in southern states of India
- Small sized beetle brownish, hairy elytra with black patches
- Both grub and adult stages are predator
- Specific whitefly feeders
- Commonly associated with spiralling whitefly and other whiteflies infesting guava, cotton, curry leaf, *Bauhinia purpurea, Cassia siamea*, pomegranate and star gooseberry.

Brumoides suturalis

Order: Coleoptera

Genus: *Brumoides*

Family: Coccinellidae

Species*: suturalis*

- Elytra satiny white to creamy yellow, with three black stripes, medium-sized beetle
- Widespread almost throughout India
- Both grub and adult stages are predators
- More polyphagous and largely predatory on aphids, whiteflies, psyllids, scales, mealybugs and mites.
- Commonly associated with infesting sugarcane, maize, brinjal, rice, wheat, cotton, bhendi, cowpea, groundnut, sunflower, safflower, sesamum, coconut, pigeonpea, castor, sorghum, cabbage, indigo, peach, cumin, mustard, lucerne, tobacco, sandal, pongamia, crotalaria, rice bean, coriander, soyabean, bittergourd, Japanese mint, Citrus limon, etc.,

Cheilomenes sexmaculata

Order: Coleoptera

Family: Coccinellidae

Genus: *Cheilomenes*

Species*: sexmaculata*

- Six-spotted zigzag ladybird beetle
- Shiny and often have bright spots on the elytra
- Widespread almost throughout India
- Aphidophagous, also feeds on psyllids, whiteflies, mealybugs, tingids, leaf- and planthoppers, mites, and early instar lepidopteran larvae.
- Commonly associated with infesting maize, sorghum, rice, finger millet, cowpea, gliricidia, cotton, bhendi, brinjal, cabbage, cauliflower, groundnut, lucerne, and several other plants.
- Field release: 5000 larvae or 500 adults per ha (Two releases; first release to coincide with the appearance of aphids)

Coccinella septempunctata

Order: Coleoptera

Genus: *Coccinella*

Family: Coccinellidae

Species*: septempunctata*

- Seven-spotted ladybird beetle
- A palaearctic species, widely distributed almost throughout India
- Commonly associated with aphids infesting crops such as mustard, wheat, maize, cowpea, cotton, sorghum, sugarcane, etc. in very large numbers, especially during winter months in the northern region
- Field release: 5000 larvae or 500 adults per ha (Two releases; first release to coincide with the appearance of aphids)

Coccinella transversalis

Order: Coleoptera

Family: Coccinellidae

Genus: *Coccinella*

Species*: transversalis*

- Transverse ladybird beetle
- Widely distributed almost throughout India
- Associated with aphids infesting grasses and also several crops like groundnut, rice, cotton, sunflower, safflower, mustard, cowpea, cabbage, maize, sorghum, water melon, wheat, brinjal, bhendi, lucerne, etc.
- Smart weed (*Polygonum hydropiper*) harbours this species in large numbers.

Cryptolaemus montrouzieri

Order: Coleoptera

Family: Coccinellidae

Genus: *Cryptolaemus*

Species*: montrouzieri*

- Australian ladybird / mealybug destroyer
- Larva covered with long tufts of white waxy filaments protruding from all directions, those along lateral margins usually longer than the rest.
- Native of Australia and introduced into several countries including India.
- Predacious on mealybugs and soft scales infesting many horticultural and plantation crops, guava, mango, grapevine, sapota, citrus, coffee, ornamental plants, mulberry, brinjal, *Boehmeria* sp., etc.
- Found congregating in large numbers on *Araucaria* pines.
- Active almost throughout the year, less abundant during summer.
- This species is commonly multiplied on mealybug-infested pumpkins in most of the Indian insectaries. Mealybugs such as *P. citri, F. virgata*and *M. hirsutus*, which produce ovisacs, have been used for mass production.
- Adults are usually used for augmentative field releases as the larvae are cannibalistic. The release rate varies from 5-10 adults / mealybug-infested plant and depends on the crop and the mealybug species. For example, 1500 beetles / ha are released against *Maconellicoccus hirsutus* on grapevine.

Illeis cincta

Order: Coleoptera

Genus: *Illeis*

Family: Coccinellidae

Species*: cincta*

- Commonly found feeding on various powdery mildews caused by *Phyllactinia corylea*, *Podosphaera*, *Sphaerotheca*, and *Oidium* spp., infesting sunflower, mulberry, *Xanthium strumarium*, cowpea, chillies, *Pedulanthus* sp., etc.
- Common on sorghum, brinjal, pumpkin, cotton, sunflower, melon etc.,
- Reported to feed on aphids, coccids and mites have been reported in the literature, but apparently these are erroneous.

Scymnus coccivora

Order: Coleoptera

Genus: *Scymnus*

Family: Coccinellidae

Species*: coccivora*

- Widely distributed throughout India
- Introduced into the Caribbeans to control hibiscus mealybug (*Maconellicoccus hirsutus*)
- Both larvae and adults are predators, preying mostly on mealybug and also on spider mites, scales, aphids, whiteflies and on insect eggs.
- Common on brinjal, cotton, guava, mango, mulberry, teak, citrus, grapevine, *Pongamia* sp. etc.,
- Field release: 600-2500 adults/ha (One or more releases based on pest intensity)

Gall midge

Order: Diptera

Family: Cecidomyiidae

Genus: *Aphidoletes*

Species*: aphidimyza*

- Cecidomyiids are small, fragile flies that lay eggs among aphid colonies at night.
- Act as natural enemies of other crop pests.
- Commonly prey on aphids and spider mites, and also scale insects, whiteflies and thrips.
- As the larvae are incapable of moving considerable distances, a substantial population of prey must be present before the adults lay eggs, and the Cecidiomyiids are most frequently seen during pest outbreaks.

Hover fly

Order: Diptera

Family: Syrphidae

Genus: *Eupeodes*

Species*: luniger*

- Syrphid flies are also known as flower or hover flies as they visit flowers to feed on nectar and pollen.
- Adults are not predaceous, but the larvae prey on aphids, scale insects and thrips.
- Larvae may quickly suppress aphid infestations, as each is capable of destroying hundreds of aphids during its development.
- Where ladybird beetles are not abundant, syrphid fly larvae usually become the dominant predator.
- The egg resembles a small grain of rice. Eggs are laid singly on leaves, usually in or near an aphid colony.
- The larva is yellowish, legless and blind. It has a typical maggot shape, tapering to a point at the head end and broadly rounded at the rear.
- Adults often hover around flowers where they feed on nectar and honeydew from aphids and scale insects. Females lay eggs on leaves near or in aphid colonies, where the young maggots will locate prey easily.
- The life cycle takes 2 to 4 weeks to complete.

Robber fly

Order: Diptera

Genus: *Philodicus*

Family: Asilidae

- Adults are aggressive generalist predators that capture large prey while in flight
- An adult female lays whitish eggs in a mass that she then covers with a chalky protective covering.
- Eggs can be found on grasses or in crevices within soil, bark or wood.
- Larvae are also predatory, feeding on eggs, larvae, or other soft-bodied insects.
- Complete development ranges from one to three years, depending on species and environmental conditions.
- Both adults and immature stages are predators.

Long legged fly

Order: Diptera

Family: Dolichopodidae

Genus: *Chrysosoma*

Species*: leucopogon*

- Adults are medium to small slender flies normally with green, blue or copper metallic colored bodies and long legs. Mouthparts are for piercing (with a short proboscis).
- Commonly found on lightly shaded areas near swamps and streams, in meadows and woodlands habitats.
- Larvae develop in wet to dry soil, also in standing or slow moving water in streams, ponds, and marshes.
- They pupate in cocoons made up of soil particles cemented together.
- Adults are active predators of small insects including aphids

Aphid fly

Order: Diptera

Genus: *Leucopis*

Family: Chamaemyiidae

- Commonly known as aphid flies, silver flies.
- Presently about 12 genera and 300 species are known worldwide.
- Although widely distributed, they are best known from the Holarctic region.
- Larvae of Chamaemyiidae are predators of various stages of scale insects, mealybugs and aphids.
- Several species, particularly of the genus *Leucopis*, have been successfully used for the control of adelgids.
- Adults of living forms are known to feed on sap.
- Species of *Leucopis* are very commonly found among aphid colonies.

Drosophilid fly

Order: Diptera

Family: Drosophilidae

Genus: *Cacoxenus*

Species: *perspicax*

- Predatory on mealybugs and occasionally, aphids.
- Commonly collected in association with several mealybugs like *Maconellicoccus hirsutus*, *Planococcus lilacinus*, *Nipaecoccus viridis*, *Rastrococcus iceryoides*, *Saccharicoccus sacchari*, etc. on sugarcane, pomegranate, citrus, guava, mango, jack, etc. Occasionally also collected in association with aphids.

Minute pirate bug

Order: Hemiptera

Family: Anthocoridae

Genus: *Orius*

Species: *insidiosus*

- The predator about ⅛ inch long feeds on aphids, thrips, mites, psyllids, and insect eggs.
- Adults are oval, black with white markings and a triangular head.
- Nymphs are slightly pear-shaped and reddish brown or yellow.
- The eggs are 0.4 mm long and adult females deposit eggs within plant tissue.
- It is found in a wide range of agricultural crops and natural habitats.
- It is attracted to flowers and plants that have soft-bodied insects feeding on them.
- Pollen and plant juices are known to be used as food when prey is scarce.
- Nymphs and adults feed on a variety of small prey, including thrips, mites, aphids, whiteflies, scale insects, small caterpillars, and eggs of various insects.

Plant bug

Order: Hemiptera

Family: Miridae

Genus: *Macrolophus*

Species: *caligenosus*

- Miridae are small, terrestrial insects, usually oval-shaped or elongate and measuring less than 12 mm in length.
- It is a highly polyphagous predatory bug, which has proven to be effective in controlling many insect pests of greenhouse vegetables (eggplant, tomato, and cucumber) especially whiteflies, aphids, and thrips
- It is used in the biological control of whitefly in tomato crops in greenhouses.
- It can survive for some time on its host plants in the absence of insect prey, can feed on pests other than whitefly, and has the additional advantage of being able to move freely from plant to plant.
- Adults fed on whitefly larvae of all stages from the first larval stage to the pupal stage.
- The predator consumed the preys at almost similar daily rates (average of 5.94 per day).

Stink bug

Order: Hemiptera

Family: Pentatomidae

Genus: *Eocanthecona*

Species: *furcellata*

- It has been identified as an effective biological control agent against various lepidopteran pests and is commonly collected on several major field crops such as cotton, groundnut, etc.
- In addition to Lepidoptera they were reported to fed on coleopterns and heteropterans.
- It is most active at temperatures 25-30°C.
- A female adult can consume about 4.5 caterpillars per day.
- The predatory rates increases with prey density.

Assassin bug

Order: Hemiptera

Family: Reduviidae

Genus: *Rhynocoris*

Species: *fuscipes*

- The Reduviidae or Assassin bugs are a family of predaceous bugs which have a cosmopolitan distribution.
- Assassin bugs consume not only more number of preys but also a wider range of prey.
- Assassin bugs are polyphagous in nature.
- The analysis of pest prey record of predatory reduviids indicates that lepidopterans dominate the prey fauna followed by hemipteran, coleopteran, hymenopteran, isopteran, dipteran, orthopteran and dictyopteran pests
- Distributed in many agroecosystems such as soybean, tomato, groundnut, pigeonpea, cotton, castor, rice, cabbage, tobacco, pumpkin, okra, citrus, sugarcane, sunflower etc.,

Big-eyed bug

Order: Hemiptera

Genus: *Geocoris*

Family: Geocoridae

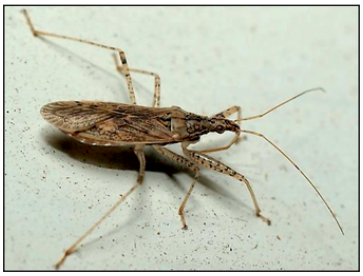
- The subfamily Geocorinae, commonly known as big-eyed bugs, are at least partially predatory in habit and hence beneficial.
- Geocorids are mainly predatory on aphids, thrips, mites, scales, mealybugs, whiteflies, tingids and early instar lepidopterous larvae.
- Members of the genera *Germalus* and *Geocoris*, particularly the latter, are commonly collected in agroecosystems.
- Adults are commonly seen running about on the ground or on foliage.
- Adult big-eyed bugs are small (about 3 mm) black, gray, or tan with proportionately large eyes.
- Eggs are deposited singly or in clusters on leaves near potential prey.

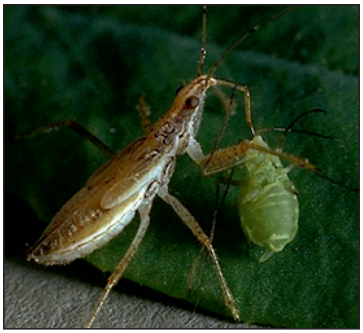
Damsel bug

Order: Hemiptera

Genus: *Nabis*

Family: Nabidae





- It is a generalist predator that can be found in open areas, including coastal habitats.
- It is particularly common in fields and agroecosystems.
- All nympal and adult life stages of *Nabis* sp. are excellent predators and can typically eat one lepidopteran egg or aphid per day when small and as many as two dozen eggs or other prey as later instars and adults.
- They can survive for up to two weeks without food, and become cannibalistic if other prey are unavailable.
- The raptorial fore legs are used to catch and hold prey. The body contents are with sucked their piercing mouthparts.
- Feed on aphids, leafhoppers, mites, caterpillars, and other insects.

Ambush bug

Order: Hemiptera

Genus: *Phymata*

Family: Phymatidae

- Ambush bugs are considered as one of the more beneficial insects since it feeds often on wasp and flies.
- Once the bug has trapped its victim with its large blade like pincers it will immediately inject a poisonous saliva-like substance into the body
- This substance will paralyze the victim and cause the breakdown of its internal tissues eventually causing its death.

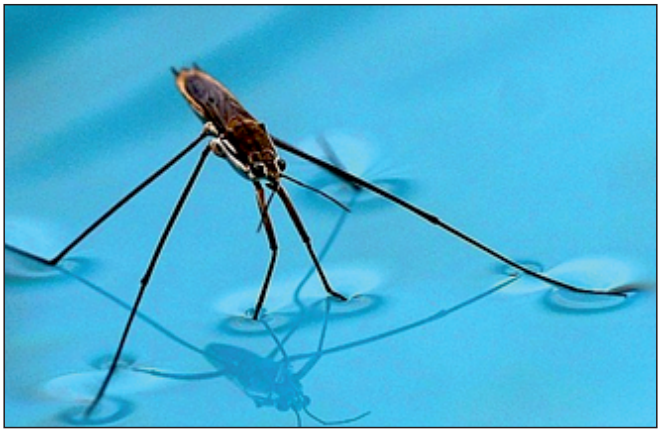
Smaller water strider

Order: Hemiptera

Family: Veliidae

Genus: *Velia*

Species*: caprai*



- Aquatic predator also called Ripple Bug, or Broad-shouldered Water Strider,
- Very sensitive to motion and vibrations on the water's surface. It uses this ability in order to locate prey.
- Water striders feed on small insects belonging to Diptera, Homoptera and Hymenoptera in larger proportions

Large water strider

Order: Hemiptera

Family: Gerridae

Genus: *Limnogonus*

Species*: fossarum*

- Water striders are long-legged and slender although some species have more robust bodies.
- They sit and skate on the surface of ponds, lakes and slow moving areas of streams. Water striders capture live or dead insects from the water surface.
- They use sucking mouthparts to drain body fluids from the insects they capture.

Water boatmen bug

Order: Hemiptera

Genus: *Callicorixa*

Family: Corixidae

- Water boatmen and their multitudes of young are preyed upon by many kinds of aquatic animals, ranging from other insects to fish to amphibians and more
- Corixids are commonly confused with backswimmers (Family Notonectidae), which are predaceous and can deliver a painful bite.
- Water boatmen are strong fliers and are attracted at night to artificial lights.

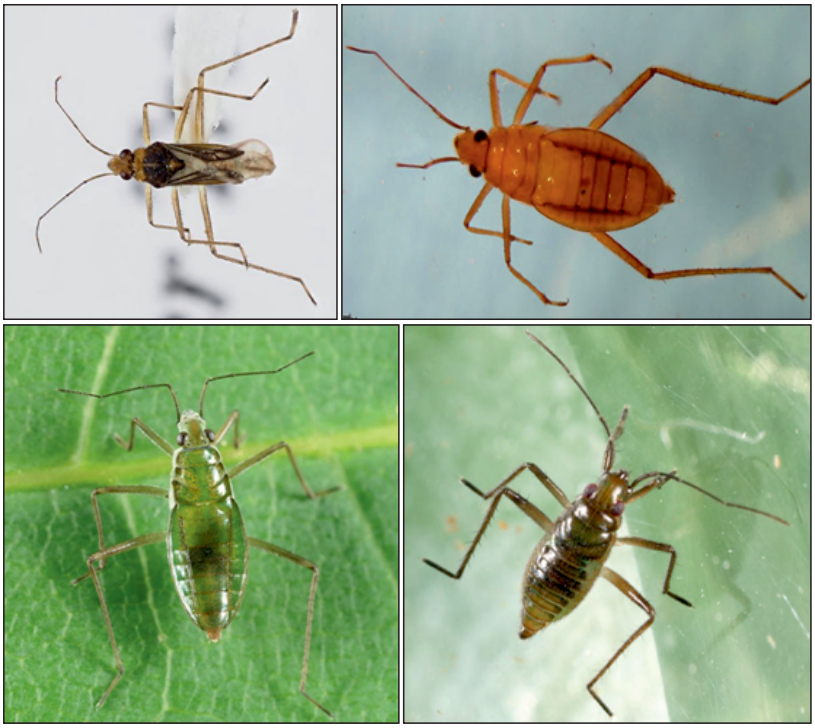
Water treader

Order: Hemiptera

Family: Mesoveliidae

Genus: *Mesovelia*

Species*: furcate*



- Mesoveliidae species are dimorphic, they may be apterous (wingless) or macropterous (winged)
- Commonly known as 'water treaders'
- Usually seen on floating vegetation or on the water surface
- Mesovelia species are predators or scavengers on small invertebrates, feeding on microcrustaceans (Crustacea: Ostracoda, Cladocera), dead or dying mosquitoes (Diptera: Culicidae) and midges (Diptera: Chironomidae)

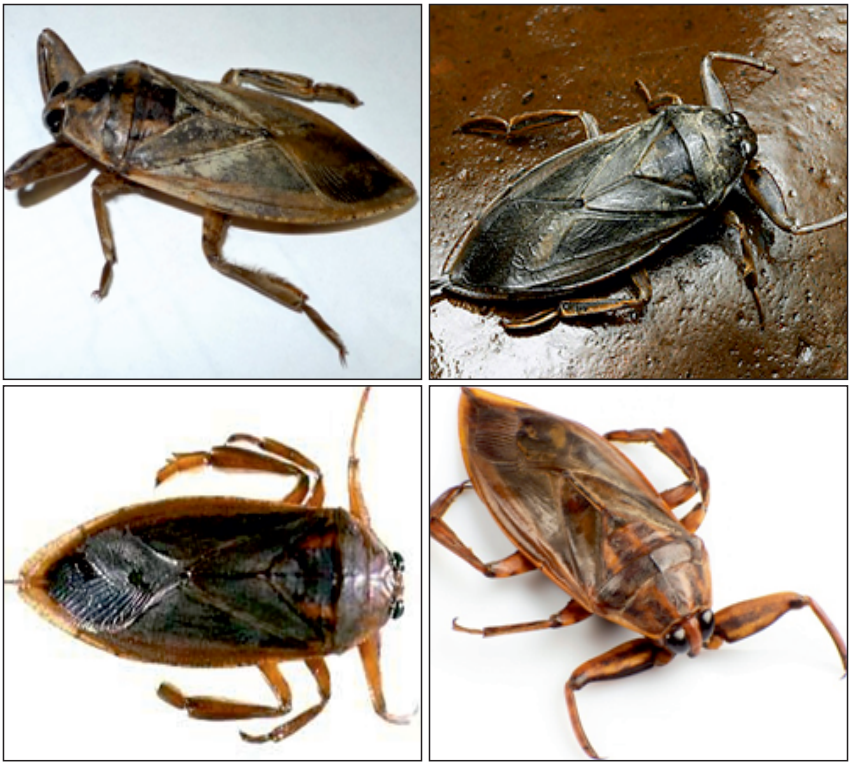
Giant water bug

Order: Hemiptera

Family: Belostomatidae

Genus: *Lethocerus*

Species*: indicus*



- Aquatic predator have got largest body size among the Heteroptera.
- Individuals are capable of inflicting a painful bite with their strong beak, and may also pinch with their front legs.
- Prey on aquatic insects, small fish, frogs, tadpoles, small birds, and other organisms they are able to capture.
- Powerful enzymes are injected into prey to kill them.

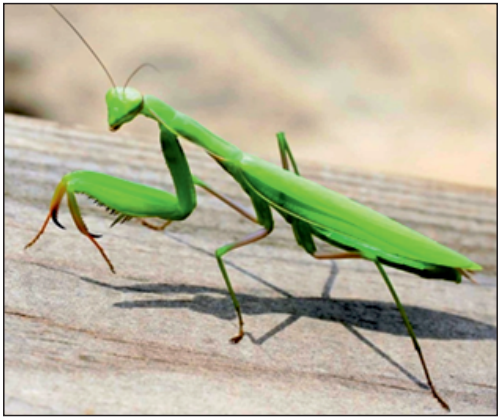
Praying mantis

Order: Mantodea

Genus: *Mantis*

Family: Mantidae

Species*: religiosa*



- The praying mantis is a large insect from the order of Mantodea.
- Use camouflage to hide from predators and sneak up on prey.
- Each egg case contains approximately 200 eggs.
- Egg cases are attached to leaves etc.
- It is the only known insect that can turn its head and look over its shoulder.
- Praying mantis are highly predacious and feed on a variety of insects, including moths, crickets, grasshoppers and flies.

Green lacewing

Order: Neuroptera

Family: Chrysopidae

Genus: *Chrysoperla*

Species*: zastrowi sillemi*

- Cosmopolitan predator found in a wide range of agricultural habitats.
- Important for the management of bollworms and aphids in cotton and tobacco and several sucking pests in fruit crops.
- The eggs are stalked and green in colour.
- The larva is white in colour on hatching. The larva has 3 instars which are completed in 8-10 days. The larva spins a cocoon from which the adult emerges in 5-7 days.
- They are capable of bringing down the population of the pest drastically.
- Field release: 10,000 first instar larvae/ha (Twice during the season with an interval of 15 days; On fruit crops, 10 – 20 larvae per infested tree)

Brown lacewing

Order: Neuroptera

Family: Hemerobiidae

Genus: *Micromus*

Species*: igorotus*

- Hemerobiids, commonly known as brown lacewings, are important predators of aphids and other insects.
- They can be recognised by the following combination of characters:
  - Colour mostly brown or greyish brown, rarely pale green
  - Nearly all costal crossveins branched or forked at the tip
  - Anterior radial trace with at least two or more (up to 12) radial sector branches
- This species has been reported to be quite abundant and appears to be a potential candidate for augmentative biological control of the aphid.
- The predator completes its life cycle in about 25 days.
- The larvae have three instars spanning about 5-7 days.
- Larvae and adults have a feeding potential of 20-25 aphids / day. Fecundity ranged from 110 to 170 over a period of 16-18 days.
- Field release: 10,000 first instar larvae/ha (Twice during the season with an interval of 15 days; On fruit crops, 10 – 20 larvae per infested tree)

Antlion

Order: Neuroptera

Genus: *Myrmeleon*

Family: Myrmeleontidae

Species*: formicarius*

- Commonly known as the Antlion
- Larvae are voracious predators that lie in wait for their insect prey under sand or loose soil.
- Within a few minutes of seizing its prey with its jaws and injecting it with venom and enzymes, it begins to suck out the digestion products.
- The larva is extremely sensitive to ground vibrations, the low-frequency sounds made by an insect crawling across the ground;
- It digs a shallow pit in loose sand to trap prey and some other genera live in tree holes.
- Most commonly occurs in dry and sandy habitats where the larvae can easily excavate their pits, but some larvae hide under debris or ambush their prey among leaf litter.

Earwig

Order: Dermaptera

Family: Carcinophoridae

- Earwigs are mostly nocturnal and often hide in small, moist crevices during the day, and are active at night, feeding on a wide variety of insects and plants
- Observed prey include largely plant lice, but also large insects such as bluebottle flies and woolly aphids
- Mostly scavengers, but some are omnivorous or predatory.

Predatory thrips

Order: Thysanoptera

Family: Aeolothripidae

- Thrips are primarily phytophagous but a few species are predaceous
- Predatory thrips eat their plant-sucking counterparts as well as mites, lace bugs, whiteflies and scale insect
- Due to their minute size, they prefer other tiny pests as their chosen food, which makes them a natural predator for thrips that have destructive feeding behaviors.
- Predatory thrips in gardens may be found on ornamental or fruit-bearing trees, vegetables, and other varieties of infested plant life in the landscape

Dragonfly

Class: Insecta

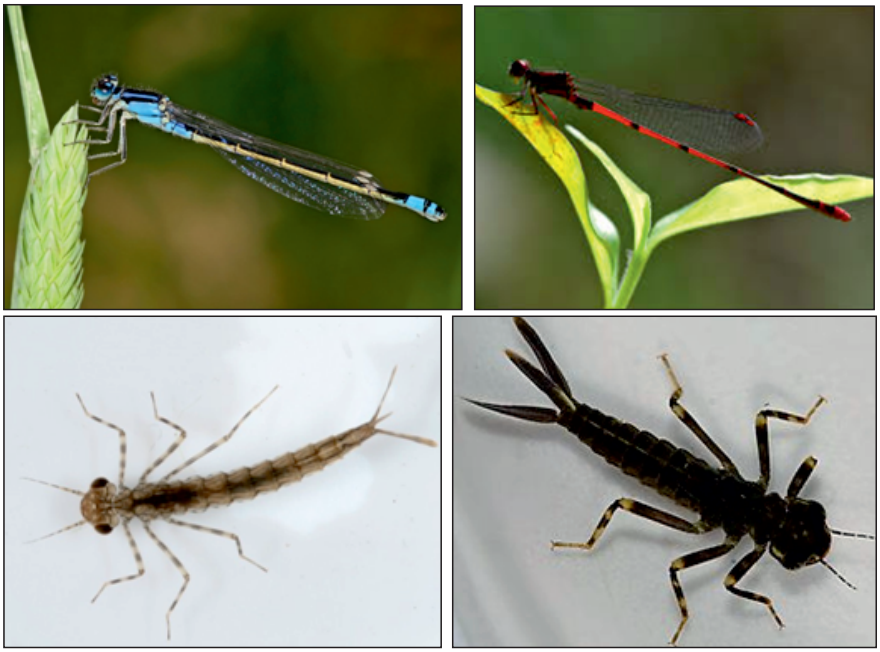
Order: Odonata

- Odonata occur in almost all types of freshwater habitats, and a few species are even terrestrial or occur in quite saline habitats.
- Many are restricted to certain habitats, such as forest streams, acidic waters, or even tree holes.
- They have good eyesight and great speed.
- Immature stages feed on aquatic insect larvae such as mosquitoes, tiny fish and tadpoles
- Adults prey on mosquitoes and midges as well as moths, butterflies, smaller dragonflies, and other flying insects.

Damselfly

Class: Insecta

Order: Odonata

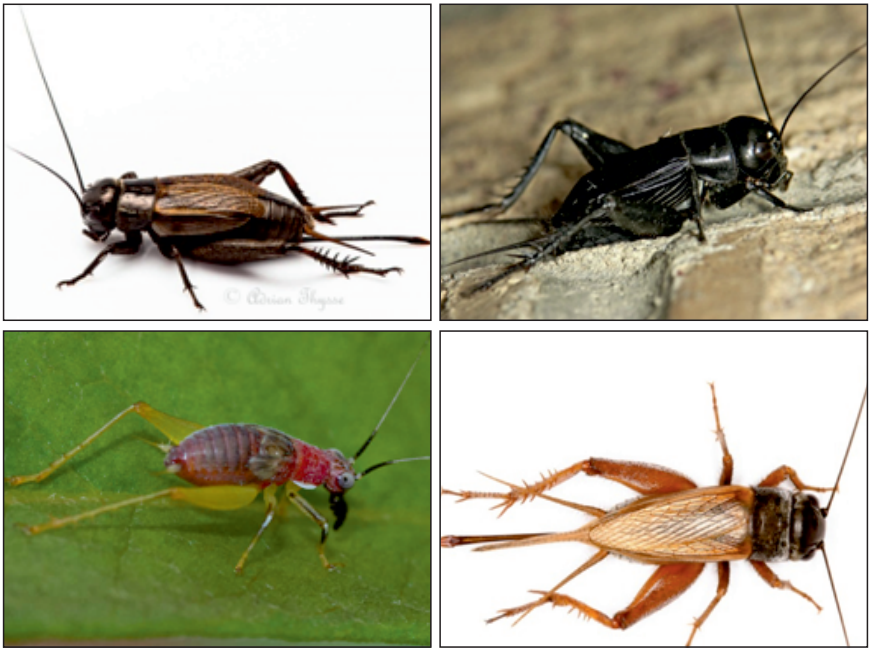


- Damselflies are flying insects associated with stream and wetland habitats.
- They are closely related to dragonflies, but can be told apart by their smaller, more delicate bodies and the way they fold their wings along their backs when at rest.
- Nymphs feed on tadpoles, mosquitoes and other fly larvae such as syrphid and chironomids.

Cricket

Order: Orthoptera

Family: Gryllidae



- Crickets are omnivores and scavengers.
- Some species are predatory in habit feeding on other insects, snails
- The cricket preys on the eggs of a range of insect pests of rice
- Field crickets eat live or dead insects, grasshopper eggs, and pupae of flies, moths and butterflies.
- Tree crickets feed on aphids and snowy tree crickets eat small insects.

Apefly

Order:Lepidoptera

Family: Lycaenidae

Genus: *Spalgis*

Species:*epeus*

- *Spalgisepeus* is the most common predator of mealybugs such as *Coccidohystrix insolita*, *Rastrococcus iceryoides*, *Planococcus lilacinus*, and *Planococcus citri* and also aphids.
- The caterpillars are covered with white mealy material, which is hard to detect amidst mealybugs and serves as an excellent camouflage.
- The fringe of long bristles about the sides and front of the body is used in shoveling the waxy covering of the host onto its back.
- The older larvae are considerably larger and markedly resemble syrphid larvae.
- Pupation takes place in the mealybug colony and the pupa has a rather characteristic monkey-like or phantom-like appearance, and is known as the monkey-face pupa

Dipha aphidivora

Order:Lepidoptera

Family: Pyralidae

Genus: *Dipha*

Species:*aphidivora*

- Widely distributed in India.
- Predatory on bamboo aphids (*Pseudoregma bambusicola* and *P. alexanderi*) and sugarcane woolly aphid (*Ceratovacuna lanigera*).
- Found effective in controlling *C. lanigera*in field conditions. Field level mass production is done by establishing larval nurseries on sugarcane raised in shade nets (10m x 10m) and after 3-4 months over 10,000 predators can be harvested, sufficient to control the pest in about 10 hectares of land, if released regularly during the peak infestation months of June-July in peninsular India.
- *D. aphidivora* has proved particularly voracious and, as a moth, has been able to spread easily to neighbouring areas.

PARASITOIDS

Telenomus spp.

Order: Hymenoptera

Genus: Telenomus

Family: Telenominae

- Hymenopteran egg parasitoids
- Mainly attacks lepidopteran and hemipteran insect pests.
- Field release: 1,00,000 /ha (Three to four releases)

Xanthopimpla stemmator

Order: Hymenoptera

Family: Braconidae

Genus: *Xanthopimpla*

Species: *stemmator*

- Solitary pupal endoparasitoid
- *Xanthopimpla* sp. are important parasitoids of lepidopterous stem borers of cereals, sugarcane and sometimes other crops.
- Besides *Xanthopimpla stemmator, X. punctata* and *X. pedator* are also commonly found in India.

Acerophagus papayae

Order: Hymenoptera

Family: Encyrtidae

Genus: *Acerophagus*

Species: *papayae*

- Native of Mexico
- A solitary endoparasitoid of papaya mealybug.
- It parasitizes the early stage (II instar) nymphs of the mealybug.
- Introduced in India in July 2010for the biological control of the papaya mealybug, *Paracoccus marginatus*
- Field release: 250 per ha (To reduce mealybug infestation)

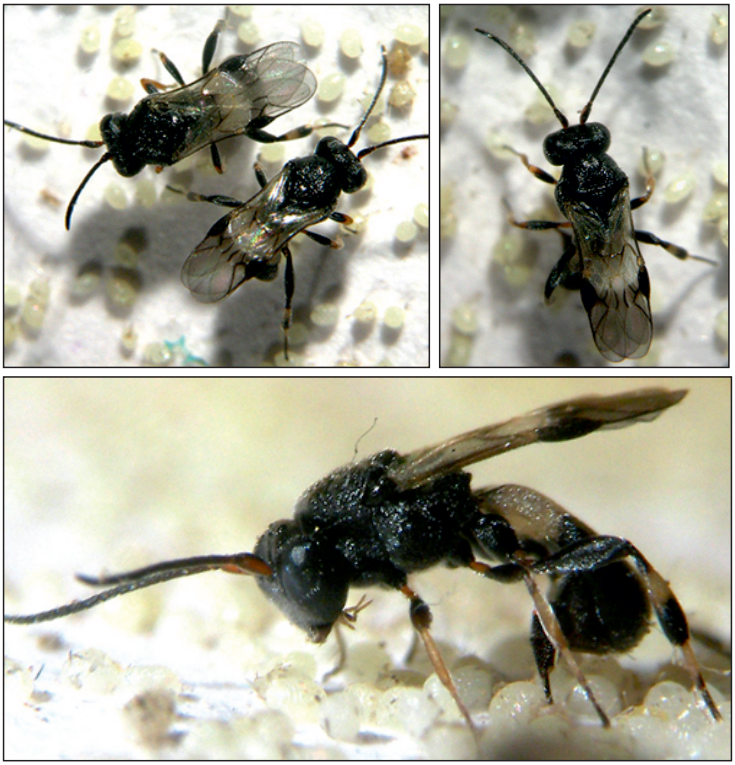
Chelonus blackburni

Order: Hymenoptera

Family: Braconidae

Genus: *Chelonus*

Species: *blackburni*



- *Chelonus blackburni* is an aparthenogenetic egg-larval parasitoid
- Introduced from Hawaii and widely established in different parts of India
- Released mainly for the biocontrol of lepidopteran insects like potato tuber moth, *Phthorimaea operculella,* cotton bollworms, *Hellula undalis, Plutella xylostella,* etc.
- Field release: 50000 adults /ha in the field (Two releases at weekly intervals; Three to four releases (or as per need) at fortnightly intervals)

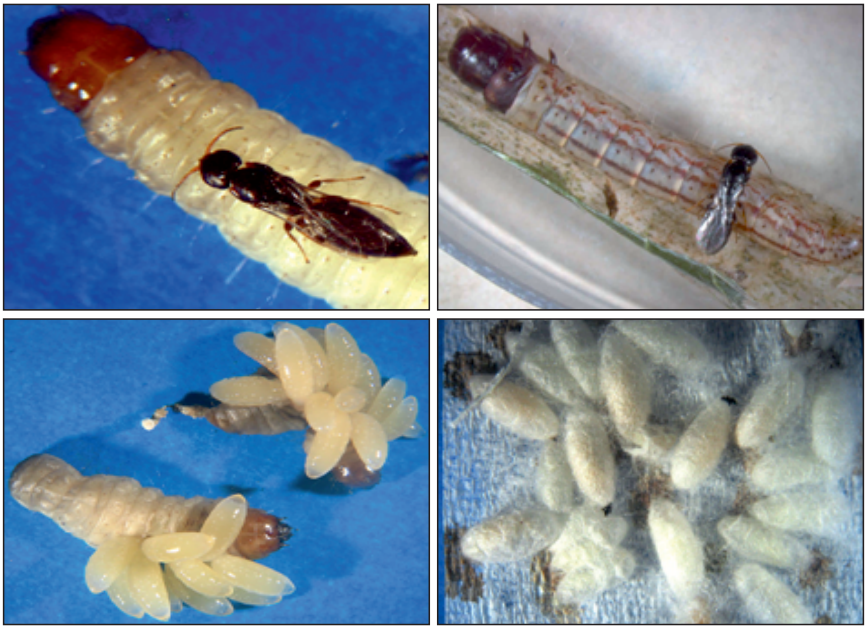
Goniozus nephantidis

Order: Hymenoptera

Family: Bethylidae

Genus: *Goniozus*

Species: *nephantidis*



- Widely distributed in Southern states of India
- Gregarious larval ectoparasitoid of the coconut black-headed caterpillar, *Opisina arenosella* (Lepidoptera: Xylorictidae).
- The wasp usually feeds on the fluid contents of the caterpillar before oviposition
- Occasionally just feeds on the caterpillar without laying eggs on it
- The larvae are gregarious
- Field release: 10 adults per palm (four releases)

Bracon bevicornis

Order: Hymenoptera

Family: Braconidae

Genus: *Bracon*

Species: brevicornis

- Cosmopolitan
- An extremely polyphagous ectoparasitoid
- Important hosts include *Opisina arenosella, Chilo partellus, Pectinophora gossypiella*
- *Corcyra cephalonica* is used as the factitious laboratory host for the mass production

Encarsia formosa

Order: Hymenoptera

Family: Aphelinidae

Genus: *Encarsia*

Species: *formosa*

- Aphelinidae is an economically important family of Chalcidoidea and includes some of the most successful and widely used parasitoids in applied biological control such as *Aphytis, Encarsia, Aphelinus*.
- The family includes mainly parasitoids of scales, whiteflies, aphids, etc some are egg parasitoids on other insects or hyperparasitoids.
- *Encarsia formosa* is a tiny parasitic wasp that parasitizes whiteflies and Aphids . It was the first biological control agent developed for use in greenhouses.
- Females lay their eggs inside the hosts. The larva hatches and feeds within the host

Metaphycus spp.

Order: Hymenoptera

Genus: *Metaphycus*

Family: Chalcidoidea

- Cosmopolitan.
- Mainly reported as solitary or gregarious parasitoids of scales, mainly soft scales (Hemiptera: Coccidae) and diaspidids (Diaspididae).
- A few species have been reported as parasitoids of Kermococcidae, Asterolecaniidae, Kerridae, Eriococcidae, Cerococcidae and Pseudococcidae.
- Three species have been reported as parasitoids of Triozidae and several have been obtained from whiteflies

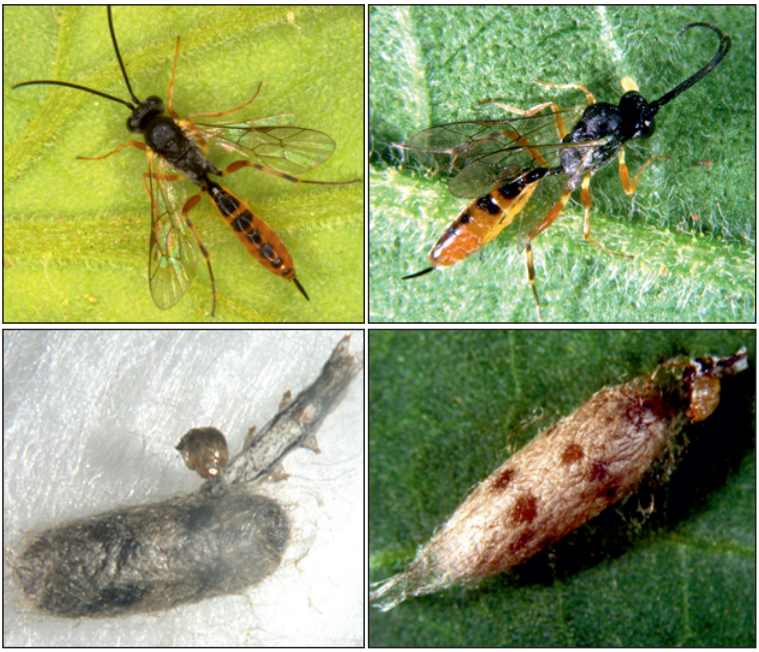
Campoletis chlorideae

Order: Hymenoptera

Family: Ichneumonidae

Genus: Campoletis

Species*: Chlorideae*



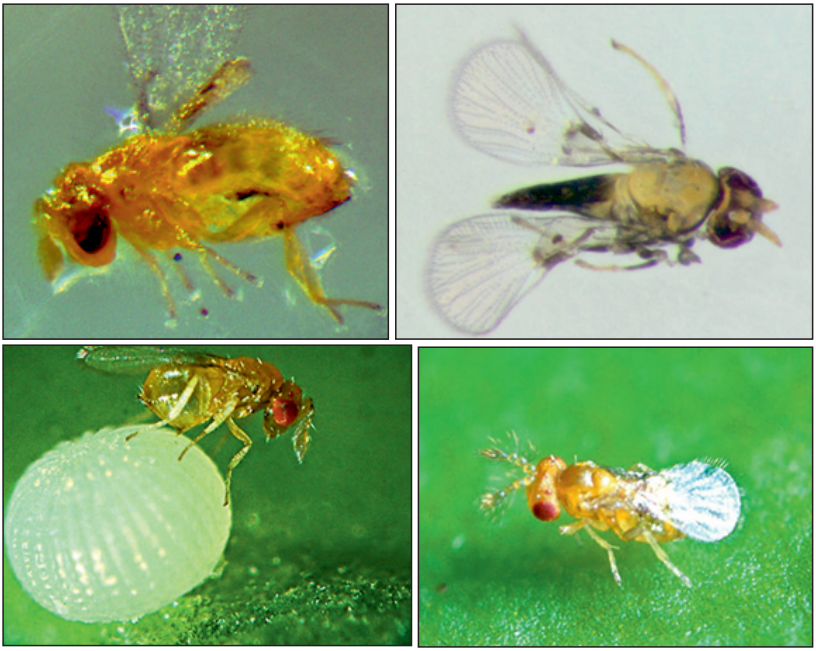
- Larval parasitoid of Noctuidae, particularly *Helicoverpa armigera* (Huebner) and *Spodoptera litura* (F.).
- Its numbers in nature appear to have come down drastically in recent years, possibly due to indiscriminate use of insecticides and other factors.
- The recommended dosage is 15000 adults / hectare.
- One to three releases are necessary depending on the population density of young larvae in the field.
- Field utilization of this parasitoid is severely limited due to the lack of effective mass production techniques and the highly male-biased sex ratio.

Trichogramma spp.

Order: Hymenoptera

Genus: *Trichogramma*

Family: Trichogrammatidae



- Widely distributed almost throughout India.
- Several hosts have been recorded worldwide, primarily in Lepidoptera and also Diptera and Coleoptera.
- Released mainly for the biocontrol ofsugarcane borers, rice stem borer, leaffolder, coconut blackheaded caterpillar, diamondback moth, cotton bollworms etc.,
- Field release: 50,000/ha on sugarcane, paddy and vegetables; 1,00,000/ha on maize and 1,50,000/ha on cotton; Sugarcane: 4 to 6 releases at 10 days intervals on observing pest or from 60th day Paddy: 6 releases on appearance of pest or from 30th day after transplantation.

Cotesia flavipes

Order: Hymenoptera

Family: Braconidae

Genus: *Cotesia*

Species: *flavipes*

- Body length approximately 2 mm.
- Gregarious cocoons, white, irregularly arranged near host.
- A major parasitoid of graminaceous stem borers such as *Chilo partellus* (Swinhoe) and *Chilo sacchariphagus* (Bojer).

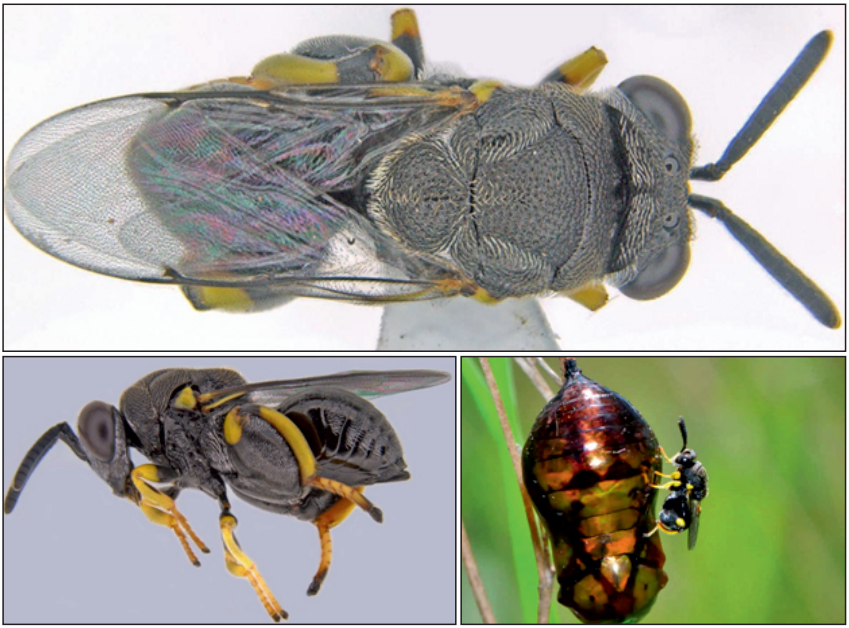
Brachymeria lasus

Order: Hymenoptera

Family: Chalcidoidea

Genus: *Brachymeria*

Species: *lasus*



- Adult large and robust
- Distribution: Worldwide (India: Andhra Pradesh; Karnataka; Kerala; Tamil Nadu).
- Hosts / Biology: Commonly collected on several species of Lepidoptera, occasionally hyperparasitic.
- Known hosts include *Conogethes punctiferalis, Diaphania indica, Earias* spp., *Anadevidia peponis, Opisina arenosella*, *Papilio polytes, Thysanoplusia orichalcea*, etc.

Eriborus argenteopilosus

Order: Hymenoptera

Family: Ichneumonoidea

Genus: *Eriborus*

Species: *argenteopilosus*

- Widely distributed throughout India.
- Larval endoparasitoid of several major noctuid pests such as *Spodoptera litura* (F.), *Helicoverpa armigera* (Huebner), *Leucinodes orbonalis* Guenee, and *Crocidolomia pavonana* (F.) on various crops.

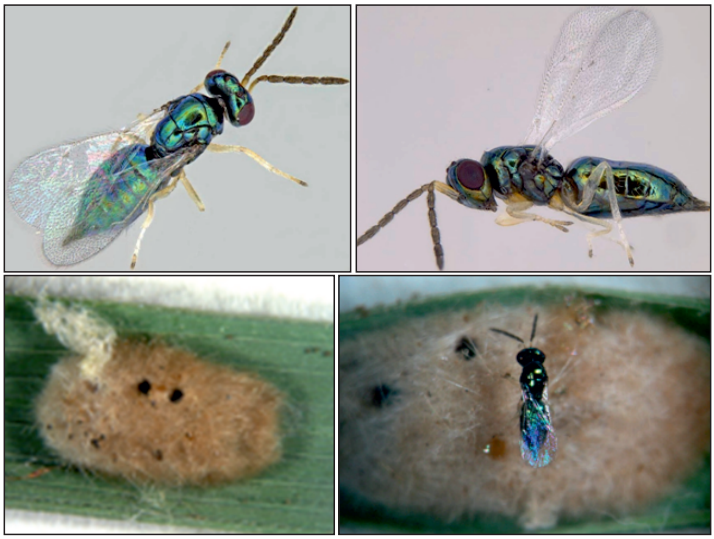
Tetrastichus schoenobii

Order: Hymenoptera

Family: Chalcidoidea

Genus: *Tetrastichus*

Species: *schoenobii*



- It has been recorded as a primary parasitoid of shoot borers of rice and sugarcane, particularly *Scirpophaga incertulas, S. excerptalis, S. innotata, Chilo suppressalis, C. infuscatellus* (all Pyralidae) and also *Sesamia inferens* and *Spodoptera mauritia* (Noctuidae).
- Itis a predator-cum-parasitoid of rice yellow stem borer eggs because it attacks several eggs during its development.
- Several wasps may parasitize an egg mass of stem borers. Each female parasitoid lays one egg in each stem borer egg.
- It can produce 10 to 60 offspring. Egg incubation takes 1 to 2 days. Larval development takes place inside the egg host.
- Once the egg is consumed, the larval parasite moves out from the egg and locates another egg host for its development.
- Several reports suggest that *T. schoenobii* is the most important egg parasitoid of rice yellow stem borer along with scelionids (*Telenomus* spp.) with parasitism levels going over 90% in some instances.

Ooencyrtus pallidipes

Order: Hymenoptera

Family: Chalcidoidea

Genus: *Ooencyrtus*

Species: *pallidipes*

- Distribution: India (Karnataka), Western India, Southern India, Northern India (Himalaya east), Southern Philippines, Taiwan, Japan, and Southern China to South East mainland Asia.
- Biology: The freshly laid eggs of *E. torus* are preferred for parasitism by *O. pallidipes*.
- It is reported to cause 80–82% parasitism and on an average 2–3 adults emerged per parasitized egg.
- Earlier it has been recorded from several Lepidoptera, including Eupterotidae, Gracillariidae, Nymphalidae, Papilionidae and Pieridae, but the eggs of Gracillariidae are too small to support this species.
- A record from egg of a buprestid represents a misidentification.
- Perhaps there is also an erroneous host record from unspecified aphid, possibly because a mummified aphid is almost similar in size, shape and colour to a parasitized egg of *E. thrax*.

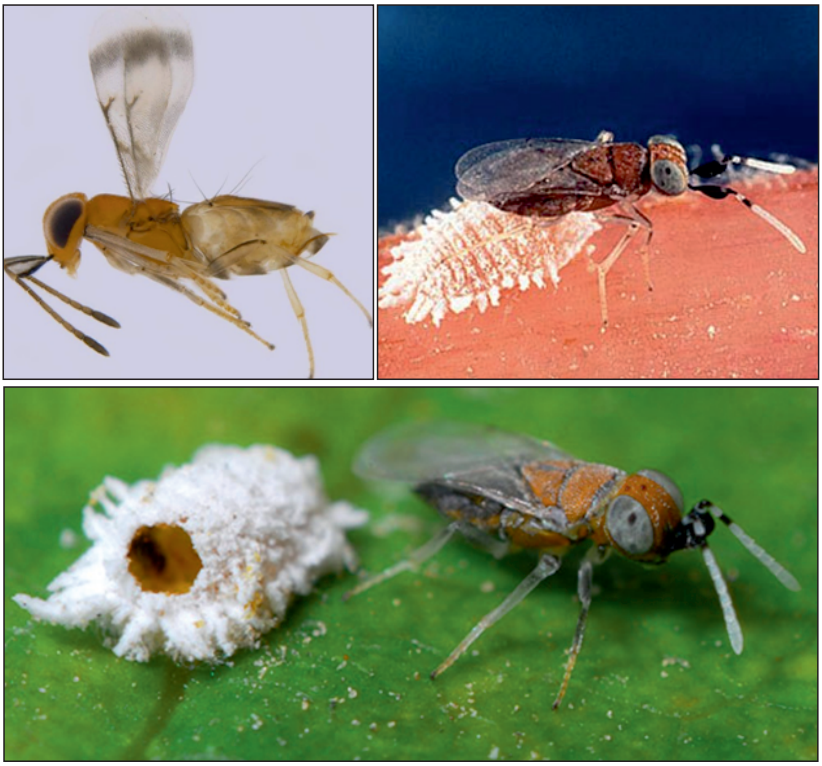
Anagyrus indicus

Order: Hymenoptera

Family: Chalcidoidea

Genus: *Anagyrus*

Species: *indicus*



- Distribution: India: Andhra Pradesh, Delhi, Karnataka, Kerala, Maharashtra, Punjab, Uttar Pradesh, West Bengal
- Hosts / Biology: *Ferrisia virgata* on guava, *Psidium guajava*, *Ficus*, and cotton; *Planococcus* sp. on *Giricidia sepium*; scales on *Acalypha* and *Jatropha*; *Nipaecoccus viridis.*
- Field release: 250 per ha (To reduce mealybug infestation)

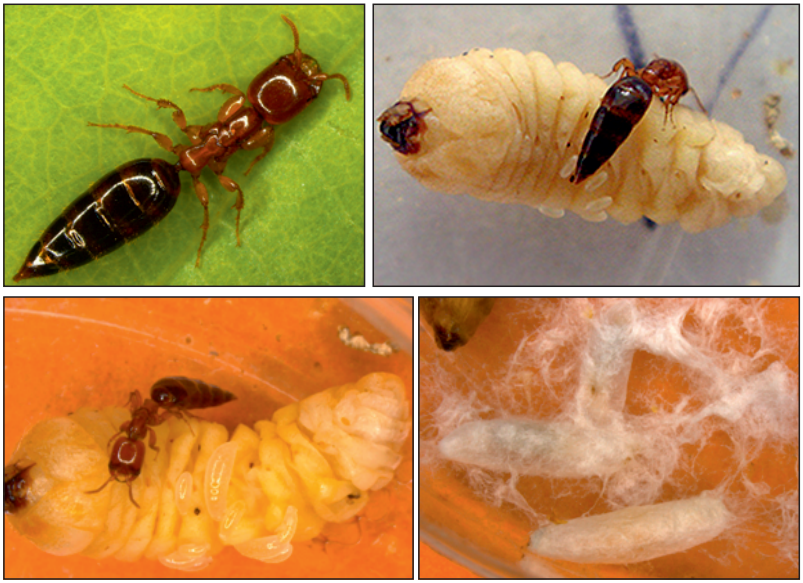
Apenesia sahyadrica

Order: Hymenoptera

Family: Chrysidoidea

Genus: *Apenesia*

Species: *sahyadrica*



- It is a gregarious external parasitoid of *Xylotrechus quadripes* Chevrolat (Coleoptera: Cerambycidae).
- The adult also feeds on smaller grubs, pupae and adults of the stem borer.
- The wasp lays its eggs on third to fourth instar larvae on the lateral and dorsal sides after paralysing them.
- There are four larval instars lasting 6-8 days.
- Pupation takes place inside silken cocoons and pupal stage lasts for about 18 days.
- The female exhibits parental care and remains near the brood till the emergence of adults.
- One female parasitises 3-5 stem borer larvae in its lifetime.

Elasmus flavescens

Order: Hymenoptera

Family: Chalcidoidea

Genus: *Elasmus*

Species: *flavescens*

- The genus Elasmus is the only genus in the family Elasmidae.
- Elasmids are either primary external parasitoids of the larvae of Lepidoptera or hyperparasitoids on them through various Hymenoptera, in particular the Ichneumonidae and Braconidae.
- Some species develop regularly both as primary and hyperparasitoids.
- They are usually gregarious.
- Hosts are usually attacked within a web, larval case or cocoon.
- Elasmids are rarely abundant enough to be of any importance in the control of their hosts.

Tachinid fly

Order: Diptera

Family: Tachinidae

- The Tachinidae is the largest family of all the parasitic flies in the order Diptera
- Tachinidae are parasitic on invertebrates, mainly insects at different life stages.
- Tachinidae are known to only parasitize insects in the insect orders of Hemiptera, Coleoptera and Lepidoptera.

Bee fly

Order: Diptera

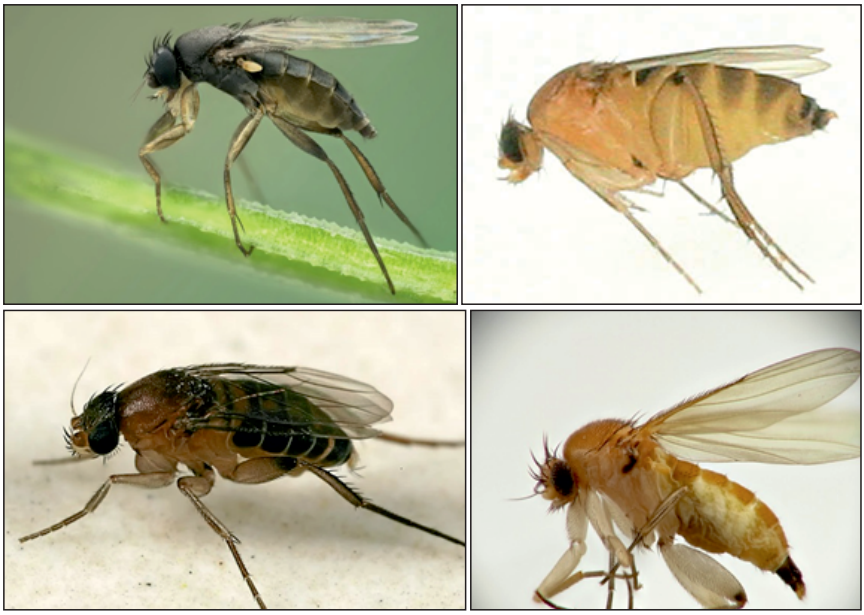
Family: Bombyliidae

- The larval stages are predators or parasitoids of the eggs and larvae of other insects
- The adult females usually deposit eggs in the vicinity of possible hosts, quite often in the burrows of beetles or wasps/solitary bees
- Hosts of bee flies belong to different orders of insects, but mostly are among the holometabolous orders. Among these are Hymenoptera, in particular the superfamilies of Vespoidea and Apoidea, beetles, other flies, and moths.

Hump-backed fly

Order: Diptera

Family: Phoridae

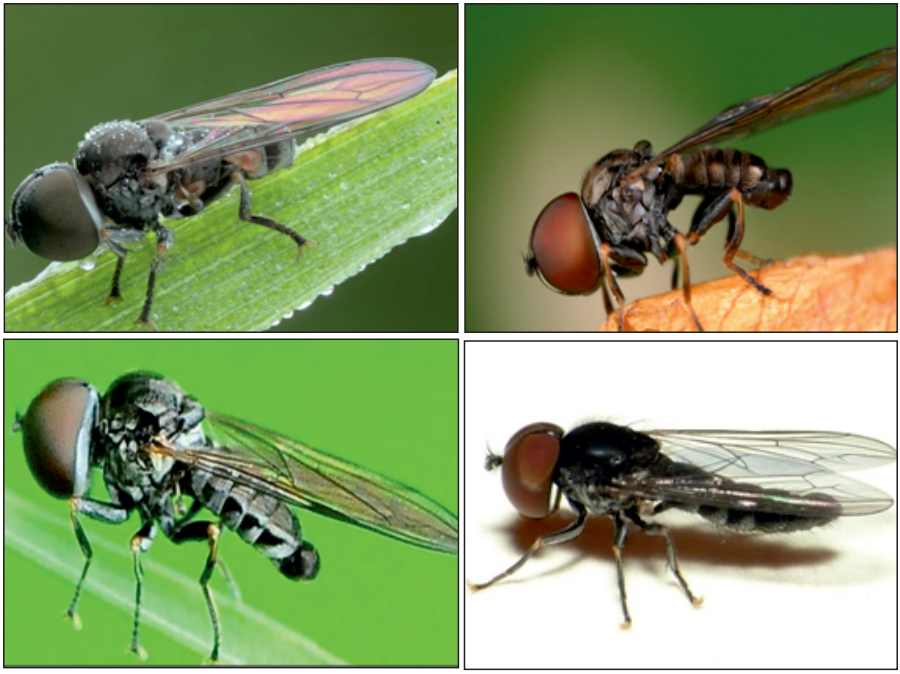


- This flies also known as humpbacked flies and scuttle flies
- Phorid flies have been considered viable options for biological control of leaf-cutter ants because they are highly specific to these hosts, producing direct mortality and also affecting the normal functioning of colonies

Big head fly

Order: Diptera

Family: Pipunculidae



- Big-headed flies form a moderately species-rich family of small to medium-sized parasitoid flies
- Some species are used as biological control agents in rice fields.
- Most known hosts are nymphs and adults of hoppers

Pyrgotis fly

Order: Diptera

Family: Pipunculidae

- The egg hatches and the fly larva enters the body cavity of the beetle,
- Larvae are internal parasites of adult scarab beetles
- Only a single larva develops in each beetle--killing the beetle within two weeks.
- The female fly is reported to insert eggs into the abdomen of the beetle while both are in flight, generally at night

Epiricania melanoleuca

Order: Lepidoptera

Family: Epipyropidae

Genus: *Epiricania*

Species: *melanoleuca*

- The parasitised nymphs of *Pyrilla* spp. can be immediately recognised by the presence of fleshy, ellipsoidal larvae with white waxy cover carried on the body of the nymphs.
- Presence of parasitic larvae on the body of the leafhopper is always indicated by the elevated position of the wing on one side.
- Boat-shaped white cocoons can be observed on leaves with hopper infestation.
- Adult moths of both sexes are small, dark brown, triangular in outline, with prominent bipectinate antennae.

POLLINATORS

Apis spp.

Order: Hymenoptera

Family: Apidae

- These honey bee was one of the first domesticated insects
- It is the primary species maintained by beekeepers to this day for both its honey production and pollination activities
- The honey bee's primary commercial value is as a pollinator of crops
- Commercial beekeepers plan their movements and wintering locations according to anticipated pollination services.

Megachile spp.

Order: Hymenoptera

Genus: *Megachile* spp.

Family: Apidae

- The genus Megachile is a cosmopolitan group of solitary bees, often called leafcutter bees or leafcutting bees.
- Leaf cutting bees are important pollinators of many wildflowers
- They also pollinate fruits and vegetables and are used by commercial growers to pollinate blueberries, onions, carrots and alfalfa.
- These bees will commonly cut circles from ornamental plants such as roses, bougainvillea and other plants with thin smooth leaves. This decreases the aesthetic value of these plants.

Xylocopa spp.

Order: Hymenoptera

Genus: *Xylocopa* spp.

Family: Apidae

- *Xylocopa* spp. are called as carpenter bees
- Carpenter bees have short mouthparts and are important pollinators on some open-faced or shallow flowers; for some they even are obligate pollinators
- Many carpenter bees "rob" nectar by slitting the sides of flowers with deep corollae.
- When foraging for pollen from some species with tubular flowers however, the same species of carpenter bees still achieve pollination, if the anthers and stigmata are exposed together.

Halictus spp.

Order: Hymenoptera

Genus: *Halictus* spp.

Family: Halictidae




- The genus *Halictus* is a large assemblage of bee species in the family Halictidae.
- Most species are polylectic, or gather floral resources from multiple plant species
- Adult halictids eat nectar and collect nectar and pollen for the larvae.
- These are very important pollinators for many wildflowers and crops, including stone fruits, pomme fruits, alfalfa and sunflower

WEED KILLERS

Salvinia weevil

Order: Coleoptera

Family: Curculionidae

Genus: *Cyrtobagous*

Species: *salviniae*

- Adult insect reside on or beneath the leaves or fronds of water fern.
- Eggs are laid individually in cavities formed by the female's feeding activity.
- The white coloured and c-shaped larvae feed on the leaves for two or three days and then bore into the stem or unopened leaves.
- Adults feed on the young terminal leaves and unopened leaves, leaving small, irregularly shaped holes, but prefer feeding on newly formed leaf buds.
- First instar larvae feed on the buds or roots, while second and third instar larvae tunnel within the apical rhizomes.
- The affected leaves turn brown and then finally drop off. The weed mat decays and sinks upon sustained feeding.

Mottled water hyacinth weevil

Order: Coleoptera

Family: Curculionidae

Genus: *Neochetina*

Species: *eichhorniae*

- The weevils are used for the biological suppression of water hyacinth (*Eichhornia crassipes*)
- The larvae feed within the bases of leaves and petioles, occasionally entering the apex of the stem, where they destroy the apical bud.
- Feeding damage caused by the weevil lead to the suppression of water hyacinth

Chromolaena stem gallfly

Order: Coleoptera

Family: Tephritidae

Genus: *Cecidochares*

Species: *connexa*

- Biocontrol agent of Siam weed, *Chromolaena odorata*
- Specific to the siam weed
- The insects forms galls on the stems of the plant

Parthenium beetle

Order: Coleoptera

Family: Chrysomelidae

Genus: *Zygogramma*

Species: *bicolorata*

- *Zygogramma bicolorata*, is called as Mexican beetle
- Eggs are generally laid on the ventral surface of both young and old leaves
- Adults and larvae are acting as biocontrol agents as it aid in the management of *Parthenium hysterophorus*
- Both adult and the larvae feed on the aerial part especially leaves of Parthenium

Lantana lace bug

Order: Hemiptera

Family: Tingidae

Genus: *Teleonemia*

Species: *scrupulosa*

- It was introduced in India from Australia in 1941
- It is the most common natural enemy of *Lantana camara* in India.
- The bug feeds on the undersurface of the leaves and attacks newly opened buds and flowers
- It causes defoliation and restricts the growth of lantana

Pareuchaetes pseudoinsulata

Order: Lepidoptera

Family: Arctiidae

Genus: *Pareuchaetes*

Species: *pseudoinsulata*

- *Pareuchaetes pseudoinsulata* has been widely released in tropical countries for the biological control of Siam weed, *Chromolaena odorata.*
- The larvae feed on the foliage of *odorata.*
- Defoliation causes most shoots of host plant to dry up
- Continuous defoliation of new sprouts from basal clumps will result in total death of the bushes

OTHER BENEFICIAL INSECTS

Rock bee

Order: Hymenoptera

Family: Apidae

Genus: *Apis*

Species: *dorsata*

- They are giant bees found all over India in sub-mountainous regions up to an altitude of 2700 m.
- They construct single comb in open about 6 feet long and 3 feet deep .
- They shift the place of the colony often. Rock bees are ferocious and difficult to rear.
- They produce about 36 Kg honey per comb per year.
- These bees are the largest among the bees described.

Little bee

Order: Hymenoptera

Family: Apidae

Genus: *Apis*

Species: *florea*

- They build single vertical combs.
- They also construct comb in open of the size of palm in branches of bushes, hedges, buildings, caves, empty cases etc.,
- They produce about half a kilo of honey per year per hive.
- They are not rearable as they frequently change their place.
- The size of the bees is smallest among four *Apis* species described and smaller than Indian bee.
- They distribute only in plains and not in hills above 450 MSL.

Indian hive bee

Order: Hymenoptera

Family: Apidae

Genus: *Apis*

Species: *cerana indica*

- They are the domesticated species, which construct multiple parallel combs with an average honey yield of 6-8 kg per colony per year.
- These bees are larger than *Apis florae* but smaller than *Apis mellifera*.
- They are more prone to swarming and absconding.
- They are native of India/Asia.

European bee / Italian bee

Order: Hymenoptera

Family: Apidae

Genus: *Apis*

Species: *mellifera*

- They are also similar in habits to Indian bees, which build parallel combs.
- They are bigger than all other honeybees except *Apis dorsata*.
- The average production per colony is 25-40 kg.
- They have been imported from European countries (Italy).
- They are less prone to swarming and absconding.

Bombyx mori

Order: Lepidoptera

Family: Bombycidae

Genus: *Bombyx*

Species: *mori*

- Sericulture is the rearing of silkworms for the production of raw silk.
- The major activities of sericulture comprises of food-plant cultivation to feed the silkworms which spin silk cocoons and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving.
- Although there are several commercial species of silkworms, *Bombyx mori* is the most widely used. Silk-fiber is a protein produced from the silk-glands of silkworms.
- Sericulture is ideally suited for improving the rural economy of the country, as it is practiced as a subsidiary industry to agriculture. Recent research has also shown that sericulture can be developed as a highly rewarding agro-industry

Laccifer lacca

Order: Hemiptera

Family: Lacciferidae

Genus: *Laccifer*

Species: *lacca*

- Lac (also called Laksha) is a slick serum and secretion from a scale insect species *Laccifer lacca*.
- These insects suck the sap of several plants and bushes and secrete lac as a protective covering.
- *Laccifer lacca* looks like tiny spots on plants having no limbs and covering with slick serum.
- Sometimes, these insects are difficult to recognize and we can only see resin excreted by them.
- Lac scales are main cash crops and are cultured in Burma, India and Thailand. Lac is collected from the plants.
- Before using it for several purposes, it has to undergo heating and filtering processes for purification.

Note:

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